JSS MAHAVIDYAPEETHA
JSS COLLEGE OF ARTS, COMMERCE & SCIENCE
(An Autonomous College of University of Mysore)
B.N. ROAD, MYSURU-570 025 KARNATAKA
Re-accredited by NAAC with 'A' grade
Recognised by UGC as "College with Potential for Excellence"
Ph: 0821-2548236 & 2548380. FAX: 0821-2548238 E-mail: jssautonomous@gmail.com Website: JSSCACS.edu.in

PG DEPARTMENT OF COMPUTER SCIENCE

Proceedings of the B.O.S Meeting -11th Jan -2022

Reviewed the Syllabus of Hardcore, Softcore and Open Elective Courses.

MEMBERS

Sl. No	Name	Signature
1	Dr. Guru D S Chairperson and Professor DOS in Computer Science University of Mysore, Mysuru	11/1/22
2	Dr. Pushpalatha.M.P Professor and H.O.D Department Of Computer Science and Engineering Sri Jayachamarajendra College of Engineering, Mysuru – 570 006. JSS Science and Technology University, Mysuru. mppvin@gmail.com	11/1/2022
3	Dr. M.T. SOMASHEKARA Assistant Professor Dept of Computer Science and Applications JB Campus,Bangalore University Bengaluru – 560 056 e-mail: somashekar_mt@hotmail.com 9880450894	
4	Smt. S Apoorva Assistant Professor PG Department of Computer Science JSS College of Arts, Commerce and Science, Ooty Road, Mysuru	11/1/22
5	Smt. Y S Sumanashree Assistant Professor and H.O.D PG Department of Computer Science JSS College of Arts, Commerce and Science, Ooty Road, Mysuru	Y.S. 11/1/2022

JSS MAHAVIDYAPEETHA
JSS COLLEGE OF ARTS, COMMERCE & SCIENCE
(An Autonomous College of University of Mysore)
B.N. ROAD, MYSURU-570 025 KARNATAKA
Re-accredited by NAAC with 'A' grade
Recognised by UGC as "College with Potential for Excellence"
Ph: 0821-2548236 & 2548380. FAX: 0821-2548238 E-mail: jssautonomous@gmail.com Website: JSSCACS.edu.in

PG DEPARTMENT OF COMPUTER SCIENCE

Proceedings of the B.O.S Meeting -11th Jan -2022

Reviewed the Syllabus of Hardcore, Softcore and Open Elective Courses.

Sl. No	Name	Signature
6	Mr. Sarmad Farhan khan Software Development Engineer-2 Maveric Systems,Bengaluru	
7	Dr.Mahamad Suhil Technical Manager AI Standard Charted , GBS,Bengaluru	Absent

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE

(AUTONOMOUS)

OOTY ROAD, MYSURU-570 025

(Autonomous under University of Mysore: Re-accredited by NAAC with 'A' Grade)

Choice Based Credit System and CGPA

MASTERS DEGREE

Syllabus

2021-23

Postgraduate Department of Computer Science

JSS College of Arts, Commerce and Science

Ooty Road, Mysore-25

2021-2023

PROGRAMME: MASTER OF SCIENCE IN COMPUTER SCIENCE

2 Years /4 Semesters (under CBCS-CAGP)

ADMISSIONS:

i) 50% seats of the total intake for M.Sc., Computer Science Programme of the College will be filled-up by University of Mysore through Centralized Admission Cell as per University regulations.

ii) Remaining 50% seats will be filled-up by the College under College Quota.

ADMISSION REQUIREMENT

Eligibility - All students who have 45% (40% for SC/ST) in their B.Sc degree (from Recognised University/ Open University) with Mathematics as one subject and any one-two among Electronics, Instrumentation, Computer Science or Computer Maintenance and Physics as other subject. OR Student with B.Sc (IT) are permitted provided they have not studied Mathematics in their 2 years PUC. OR Diploma (in Electronics, Computer Science and Information Technology) holders with B.Sc (IT) are permitted if they have SSLC level Mathematics. OR BCA degree from recognized University OR equivalent to this from any other recognized University in India or abroad is also permitted.

PROGRAMME OUTCOMES:

After Completing the M.Sc Program Students will be able to:

PO1. Identify, formulate, and solve computer science problems

PO2. Design, implement, test, and evaluate a computer system, component, or algorithm to meet desired needs

PO3. Receive the broad education necessary to understand the impact of computer science solutions in a global and societal context

PO4. Communicate effectively

PO5. Success in research or industry related to computer science

PO6. Have solid knowledge in computer science and engineering, including programming and languages, algorithms, theory, databases, etc.

PO7. Integrate well into and contribute to the local society and the global community related to computer science

PO8. Practice high standard of professional ethics

PO9. Draw on and integrate knowledge from many related areas

PROGRAMME SPECIFIC OUTCOMES:

PSO1. Programmers or the Software Engineers with the sound knowledge of practical and theoretical concepts for developing software.
PSO2. Serve as the Computer Engineers with enhanced knowledge of computers And its building blocks. Work as the Hardware Designers/Engineers with the knowledge of Networking Concepts.
PSO3. Work as the System Engineers and System integrators Serve as the System Administrators with thorough knowledge of DBMS.
PSO4. Work as the Support Engineers and the Technical Writers
PSO5. Work as IT Sales and Marketing person.
PSO6. Serve as the IT Officers in Banks and cooperative societies.
PSO7. Computer Scientist in research and R & D laboratories.
PSO8. Faculty for Graduate and Under graduate Colleges.

MSc. in Computer Science 2021-23

I Semester

Course	L:T:P	Credit Value
HC1 (Data Structures and Algorithms)	3:0:1	4
HC2 (System Software)	2:1:1	4
HC3 (Computer Networks)	2:1:1	4
SC1		4
SC2		4
TOTAL		**20**

II Semester

Course	L:T:P	Credit Value
HC4 (Analysis and Design of Algorithms)	2:1:1	4
HC5 (Operating System and Unix)	2:0:2	4
HC6 (Computer Graphics)	3:0:1	4
SC3		4
SC4		4
TOTAL		**20**

III Semester

Course	L:T:P	Credit Value
HC7 (Software Engineering)	3:1:0	4
HC8 (Theory of Languages)	3:1:0	4
HC9 (Database Management System)	2:1:1	4
SC5 / Term Work		4
SC6 (Open Elective ****)		4
TOTAL		**20**

IV Semester

Course	L:T:P	Credit Value
HC10 (Major Project)	0:1:7	8
SC7		4
SC8		4
TOTAL		**16**

****** Open Elective Course: III Semester**

Course	L:T:P	Credit Value
OE- Computer Fundamentals / Programming with C	2:0:2	4

HARD CORE:

Sl. No.	Course	L:T:P	Credit Value
1	Data Structures and Algorithms	3:0:1	4
2	System Software	2:1:1	4
3	Computer Networks	2:1:1	4
4	Analysis and Design of Algorithms	2:1:1	4
5	Operating System and Unix	2:0:2	4
6	Computer Graphics	3:0:1	4
7	Software Engineering	3:1:0	4
8	Theory of Languages	3:0:1	4
9	DBMS	2:1:1	4

SOFT CORE:

Sl. No.	Course	L:T:P	Credit Value
1	Principles of Programming Language and C	2:1:1	4
2	Internet Technology	2:0:2	4
3	Java Programming	2:0:2	4
4	Multimedia	3:1:0	4
5	Microcontroller	3:1:0	4
6	Discrete Mathematics	3:1:0	4
7	Simulation and Modeling	3:1:0	4
8	Operations Research	3:1:0	4
9	Mobile Communication	3:1:0	4
10	C++	2:0:2	4
11	Pattern Recognition	3:0:1	4
12	Image Processing	2:1:1	4
13	Software Testing	3:0:1	4
14	Computational Techniques	3:0:1	4
15	Graph Theory	3:1:0	4
16	OOAD	2:1:1	4

17	Probability and Statistics	3:1:0	4
18	Data Mining	2:1:1	4
19	Artificial Intelligence	3:1:0	4
20	.NET Technologies	2:0:2	4
21	Object Oriented Modeling and Design with UML	2:1:1	4
22	Android Application Development	2:0:2	4
23	Advanced Database Management Systems	2:1:1	4
24	Compiler Design	3:0:1	4

SCHEME OF EXAMINATION AND ASSESMENT:

In view of the CBCS syllabus, Each Course is Assess with Components . Component 1 (C1), Component 2 (C2), and Component 3 (C3),

The following is the scheme which will be followed for the assessment of marks for both theory (HC/ SC/ OE) as well as practicals (HC/ SC) irrespective of the Credits associated with each Course. Thirty percent of the marks will be assessed for the internals (C1 and C2) and remaining seventy percent will be for the semester end examinations (C3). Each Course carries 100 marks and hence thirty marks for internal assessment and remaining seventy marks will be for Semester End Examinations. Out of thirty marks for internals, fifteen marks will be allotted to each C1 and C2 components.

Each theory Course (HC/ SC/ OE) consists of three components namely C1, C2 and C3. C1 and C2 are designated as Internal Assessment (IA) and C3 as Semester End Examination. Each Course (HC/ SC/ OE) carries 100 Marks and hence the allotment of marks to C1, C2 and C3 Components will be fifteen, fifteen and seventy marks respectively. i.e.,

C1 Component : 15 Marks C2 Component : 15 Marks	Internal Assessment Marks
C3 Component : 70 Marks	Semester End Examination
Total : 100 Marks	

The above will be followed in common for all the theory (HC/ SC/ OE) Courses in all the four semesters.

DATA STRUCTURES & ALGORITHMS **3:0:1**

Course Code: CSA100

Course Outcomes: At the end of the course students will be able to:

CO1. Select appropriate data structures as applied to specified problem definition.

CO2. Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.

CO3. Implement Linear and Non-Linear data structures.

CO4. Implement appropriate sorting/searching technique for given problem.

CO5. Design advance data structure using Non Linear data structure.

UNIT I: Introduction

Introduction to Stages in Problem Solving, Difference between Data Type, Data Structure and Storage Structure, Formal Definition of Data Structure, Classification of Data Structure

Analysis of Algorithms: Algorithm, Time Complexity and Space Complexity, O-Notation, Omega Notation and Theta Notation.

Primitive Data Structure: Integer, Real, Character and Boolean and Its Storage Representation

UNIT II: Non-Primitive Data Structures

Arrays: Introduction to Array Data Structure and Its Representation, Sparse Matrix Representation. Introduction to Structures

Stacks: Introduction, Implementation Using Arrays, Applications - Tower Of Hanoi, Expression Evaluation, Conversion of Expressions

UNIT III: Stacks and Queues

Queue: Introduction, Types – Ordinary, Circular, Doubly Ended, Priority, Implementation Using Arrays

Linked List: Introduction, Types, Operations, Implementation of Stacks and Queues Using Linked List

UNIT IV: Non-Linear Data Structures

Graphs: Introduction, Basic Terminologies, Graph Representation – Adjacency and Incidence Matrix Representation

Trees: Introduction, Binary Tree Representation – Array and Linked List Representations, Traversals – Preorder, In-order, Post order, Binary Search Tree, Introduction to B-Trees

Hash Tables: Direct Address Tables, Hash Tables, Hash Functions, Open and Closed Addressing

References:

1. Data Structures and Algorithms, 2nd Edition, 2006 , Andrew Tanenbaum
2. "An Introduction to Data Structures, with Applications" McGraw Hill, Kongakusha 1976, Trembley and Sorenson
3. "Data Structures" SBCS Publication, 1980, Horowitz and Sahni
4. Data Structures using c, A K Sharma
5. Data Structures and program design in C, Kruse Robert L
6. Data Structures and analysis in C, Mark Allen Weiss
7. Data Structures and Algorithms, Alfred V AHO and Jeffrey D Ullman

SYSTEM SOFTWARE **2:1:1**

Course Code:CSA110

Course Outcomes:

At the end of the course students will be able to:

CO1. Understand fundamentals of language processing and grammar

CO2. Apply knowledge of compilation and code optimization steps to mimic a simple compiler

CO3. Demonstrate the working of various system software like assembler, loader, linker, editor and device driver

UNIT 1

Background: Machine Structure, Evolution of the components of a programming system, evolution of operating system, operating system user view point functions, facilities

General Machine Structure, General Approach to a new machine, Machine Structure – 360 and 370, Assembly Language

UNIT 2

Assemblers: General design procedure, design of an assembler.

Macro language and macro processor, macro instructions, features of macro, implementation

UNIT 3

Loaders, different types of loaders, loader schemes, design of an absolute loader, design of direct linking loader.

Compilers: Structure and phases

UNIT 4

Lex and yacc: The Simplest lex Program, Recognizing Words with Lex, Parser-Lexer Communication, Regular Expressions, Grammars, Shift/Reduce Parsing, Structure of lex and yacc Programs, Programs in lex and yacc

References:

1. Systems Programming by Donovan
2. Principles of Compiler design by Ullman
3. System programming by Dhamdhare
4. Lex and yacc by John R Levine, Tony Mason and Doug Brown
5. System Software- Prof. Liland L Beck.
6. System Software- Prof. John R Levine

COMPUTER NETWORKS **2:1:1**

Course code:CSA120

Course Outcomes:

At the end of the course students will be able to:

CO1. Master the terminology and concepts of the OSI reference model and the TCP-IP reference model.

CO2. Study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.

CO3. Master the concepts of protocols, network interfaces, and design/performance issues in local area networks and wide area networks

CO4. Acquire knowledge of Application layer and Presentation layer paradigms and protocols.

CO5. Study Session layer design issues, Transport layer services, and protocols.

CO6. Gain core knowledge of Network layer routing protocols and IP addressing.

CO7. Study data link layer concepts, design issues, and protocols.

CO8. Read the fundamentals and basics of Physical layer, and will apply them in real time applications.

CO9. Familiar with wireless networking concepts

CO10. Familiar with contemporary issues in networking technologies
CO11. Familiar with network tools and network programming

UNIT 1

USES OF COMPUTER NETWORK: Business Applications, Home Applications, Mobile Users, Social Issues

NETWORK HARDWARE: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks, Home Networks, Internetworks

NETWORK SOFTWARE: Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Service, Service Primitives, the Relationship of Services to Protocols

REFERENCE MODELS: The OSI Reference Model, The TCP/IP Reference Model, A comparison of OSI and TCP/IP Reference Model

UNIT 2

THE PHYSICAL LAYER

THE THEORETICAL BASIS FOR DATA COMMUNICATION: Fourier Analysis, Bandwidth-Limited Signals, The Maximum Data Rate of a Channel

GUIDED TRANSMISSION MEDIA: Magnetic Media, Twisted Pairs, Coaxial Cable, Fiber Optics

WIRELESS TRANSMISSION: The Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared and Millimeter Waves, Light wave Transmission

COMMUNICATION SATELLITES: Geostationary Satellites, Medium-Earth Orbit Satellites, Low-Earth Orbit Satellites, Satellites versus Fiber

THE DATA LINK LAYER

DATA LINK LAYER DESIGN ISSUES: Services Provided to the Network Layer, Framing, Error Control, Flow Control

ERROR DETECTION AND CORRECTION: Error-Correcting Codes, Error-Detecting Codes

ELEMENTARY DATA LINK PROTOCOLS: A Utopian Simplex Protocol, A Simplex Stop-and-Wait Protocol

SLIDING WINDOW PROTOCOLS: A One-Bit Sliding Window Protocol, A Protocol Using Go-Back-N

UNIT 3

THE MEDIUM ACCESS CONTROL SUBLAYER

THE CHANNEL ALLOCATION PROBLEM: Static Channel Allocation, Dynamic Channel Allocation

MULTIPLE ACCESS PROTOCOLS: ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols

ETHERNET: Ethernet Cabling, Manchester Encoding, The Ethernet MAC sub layer protocol, the binary exponential back off algorithm, Ethernet Performance, Switched Ethernet, IEEE 802.2: Logical Link Control

THE NETWORK LAYER

NETWORK LAYER DESIGN ISSUES: Store-and-Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection-Oriented Service, Comparison of Virtual-Circuit and Datagram Networks

ROUTING ALGORITHMS: The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing

CONGESTION CONTROL ALGORITHMS: Approaches to Congestion Control, Traffic-Aware Routing, Admission Control, Traffic Throttling, Traffic Shaping

INTERNETWORKING: How Networks Differ, How Networks Can Be Connected, Tunneling, Internetwork Routing, Fragmentation

THE NETWORK LAYER IN THE INTERNET: The IP Protocol, IP Addresses, IPv6

UNIT 4

THE TRANSPORT LAYER

THE TRANSPORT SERVICE: Services Provided to the Upper Layers, Transport Service Primitives

ELEMENTS OF TRANSPORT PROTOCOLS: Addressing, Connection Establishment, Connection Release, Error Control and Flow Control, Multiplexing, Crash Recovery

THE INTERNET TRANSPORT PROTOCOLS: UDP: Introduction to UDP, Remote Procedure Call, Real-Time Transport Protocols

THE INTERNET TRANSPORT PROTOCOLS: TCP: Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP Connection Management Modeling, TCP Sliding Window, TCP Timer Management

THE APPLICATION LAYER

DNS—THE DOMAIN NAME SYSTEM: The DNS Name Space, Resource Records, Name Servers

ELECTRONIC MAIL: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

NETWORK SECURITY:

CRYPTOGRAPHY: Introduction to Cryptography, Substitution Ciphers, Transposition Ciphers, Two Fundamental Cryptographic Principles

SYMMETRIC-KEY ALGORITHMS: DES—The Data Encryption Standard, Cipher Modes

PUBLIC-KEY ALGORITHMS: RSA, Other Public-Key Algorithms

DIGITAL SIGNATURES: Symmetric-Key Signatures, Public-Key Signatures

MANAGEMENT OF PUBLIC KEYS: Certificates

Reference Books:

1. Computer Networks, 5th Edition, Prentice Hall, 2006, Andrew S. Tanenbaum & David J. Wetherall
2. Data & Computer Communications, 6th Edition, Pearson Education, 2002, William Stallings
3. Computer Networks: 3rd Edition, Elserier, 2003, Larry L. Peterson & Bruce S. Davie
4. Data Communication & Networking, 4th Edition, Mc Graw Hill, 2006, Behrouza Forouzan
5. Computer & Networks with Internet Applications, 4th Edition, Pearson Education, 2004, Douglas E. Comer

ANALYSIS AND DESIGN OF ALGORITHMS 2:1:1

Course Code:CSB060

Course Outcomes:

At the end of the course students will be able to:

CO1. Analyze different scenarios for running time of algorithms using asymptotic notations and Design using Recursion.
CO2. Apply divide and conquer strategy for design of various algorithms.
CO3. Develop algorithms for well known problems using greedy methods.
CO4. Describe and apply dynamic-programming approach for designing graph and matrix based algorithms.
CO5. Understand the concept of backtracking for traversal and search algorithms.
CO6. Apply the knowledge earned to determine the efficiency of algorithms considering time and space tradeoffs.

UNIT 1

INTRODUCTION**:** Algorithm specification, pseudo code conventions

PERFORMANCE ANALYSIS: Space Complexity, Time Complexity, Asymptotic Notation, Mathematical Analysis: Recursive and Non recursive algorithms

BRUTE FORCE – Bubble Sort, Selection Sort, Sequential Search, String Matching

UNIT 2

DIVIDE- AND – CONQUER: General Method, Binary Search, Finding the Maximum and Minimum, Merge Sort, Quick Sort, Strassen's Matrix Multiplication

THE GREEDY METHOD: The General Method, Knapsack Problem, Tree Vertex Splitting, Job Sequencing with Deadlines, Minimum-Cost Spanning Trees - Prim's Algorithm, Kruskal's Algorithm, Optimal Storage on Tapes, Optimal Merge Patterns, Single-Source Shortest Paths.

UNIT 3

DYNAMIC PROGRAMMING: The General Method, Binomial Coefficient, Multistage Graphs, All Pairs Shortest Paths Single-Source Shortest Paths: General Weights, String Editing, 0/1 Knapsack, the Traveling Salesperson Problem

BACKTRACKING: The General Method, the 8-Queens Problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycles

UNIT 4

Elementary Graph Problems: Depth First Search, Breadth First Search, Topological Sort

NP-Hard and NP-Complete Problems: Basic Concepts, Nondeterministic Algorithms, The Classes NP-Hard And NP-Complete

NP-Hard Graph Problems: Clique Decision Problem (CDP), Node Cover Decision Problem, Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP), AND/OR Graph Decision Problem (AOG)

References:

1. Analysis and Design of Algorithms: Horowitz Sahani
2. Analysis and Design of algorithms: Trembly
3. Introduction to Algorithms: Thomas H. Cormen
4. Analysis and Design of Algorithm: Padma Reddy
4. Introduction to the design and analysis of algorithm: Anany Levitin.
5. Design and analysis of algorithm: S Shridhar.

OPERATING SYSTEM and UNIX **2:0:2**

Course Code:CSB070

Course Outcomes:

At the end of the course student will be able to:

CO1. Understand device drivers
CO2. Write applications with improved performance and stability
CO3. Write set of small commands and utilities that do specific tasks well
CO4. Run multiple programs each at the same time without interfering with each other or crashing the system.
CO5. Implement Commands of UNIX.
CO6. Implement various file processing commands and shell Programming.

UNIT 1

Introduction to Operating System, Operating System Structures

Process Management: Processes, CPU Scheduling

UNIT 2

Deadlocks, Storage Management: Memory management, Virtual Memory, File-System Interface

UNIT 3

Introduction: Why UNIX? The Unix Environment, UNIX Structure, accessing UNIX, UNIX commands

File Systems: File Names, File Types, Regular Files, Directories, File System Implementation, Operations unique to directories, Operations unique to regular files, Operations common to both.

Vi editor, local commands, range commands in vi, global commands in vi, rearrange text in vi, ex editor.

UNIT 4

Introduction to shells: Unix Session, Standard Streams, Redirection, pipes, tee command, command execution, command line editing, quotes, command substitution, job control, aliases, variables, predefined variables, options, shell/environment customization.

Security and file permission: User and groups, Security levels, changing permissions, User masks, Changing ownership and group, Regular expressions: Atoms, Operators, grep: operation, grep family, Searching for file content, sed and awk.

C Shell Programming: Basic script concepts, Expressions, Decision making selections,, Built in commands, Scripting techniques, Shell environment & Script, Script examples

References:

1. Unix and Shell Programming, Behrouz A Forouzan and Richard F.Gilberg, 2nd Edition, 2003, Thomson.

2. System Programming and Operating Systems, Dhamdhare. D.M., 4th Edition, TataMcGraw Hill, 2006

3. A Practical Guide to Linux, Mark G. Sobell, 1st Edition, 2002, Pearson Education (Chapters:1 to 5, 8, 10, 11, 15)

4. UNIX: The Complete Reference, Kenneth Rosen and others, 2nd Edition, 2002,Obsborne/McGraw Hill

5. Design of the UNIX Operating System, Maurice J Bach.

6. Operating System: A Modern Perspective , Gary J Nutt.

COMPUTER GRAPHICS **3:0:1**

Course code:CSB080

Course Outcomes:

At the end of the course students will be able to:

CO1. Utilize the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.

CO 2. Learn the basic principles of 3- dimensional computer graphics.

CO3. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.

CO4. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.

CO 5. Implement the applications of computer graphics concepts in the development of computer games, information visualization, and business applications.

CO6. Comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles

UNIT 1

Introduction, Video Display Devices, Refresh Cathode-Ray Tubes, Raster-Scan Display, Random-Scan Displays, Color CRT Monitors, Flat-Panel Displays, Raster Scan Systems, Input devices.

Output primitives: Points & Lines, Line Drawing Algorithms, Loading the Frame Buffer, Circle Generating Algorithms, Pixel Addressing and Object Geometry

UNIT 2

Two dimensional transformations Basic & other transformations, Matrix representations, Homogeneous coordinates Composite transformations, General-pivot-point transformations.

Three Dimensional Transformations: Introduction to 3D Translation, Rotation & Scaling, Other Transformations, Modeling and Co-ordinate Transformations.

UNIT 3

Three Dimensional Viewing :Viewing Pipeling, window to viewport transformations, Projections, Types of projections.

Graphical User Interface & Interactive Input Methods : The User Dialogue, Windows & Icons, feedback, Input of Graphical Data, Interactive Picture Construction Techniques, Basic Positioning Methods, Constraints, Grids, Gravity Field, Rubber-Band Methods, Dragging, Painting & Drawing

UNIT 4

Curves & Surfaces: Properties, Bezier curves properties, Design techniques, Bezier surfaces, Displaying curves & surfaces

Hidden line removal algorithms

Introduction to fractals, Serpinsky's triangle, Construction, Koch curves.

Windowing & Clipping: Clipping operations, Line clipping algorithms, point clipping, text clipping, polygon clipping algorithms, Exterior clipping

Reference:

1. "Computer Graphics", Pearson Education, Donald D. Hern and M. Pauline Baker
2. " Principles of Interactive Computer Graphics" McGraw Hill 1989, W. M. Newman and Robert Sproull
3. "Computer Graphics a Programming Approach" McGraw Hill 1987, Steven Harrington
4. " Schaums outline of theory and problems of Computer Graphics" 2^{nd} printing 1987, 1986 Edition, Roy A Plastock and Gardon Kelley
5. " Procedural Elements of Computer Graphics" McGraw Hill 2^{nd} edition 1990, David F Frogers and J Alan Adams
6. Computer Graphics, James.D.Foley, A Vandam etal

SOFTWARE ENGINEERING **3:1:0**

Course Code:CSC040

Course Outcomes:

At the end of the course students will be able to:

CO1. Understand the nature of software development and software life cycle process models, agile software development, SCRUM and other agile practices.

CO2 Learn methods of capturing, specifying, visualizing and analyzing software requirements.

CO3. Understand concepts and principles of software design and user-centric approach and principles of effective user interfaces.

CO 4. Basics of testing and understanding concept of software quality assurance and software configuration management process.

CO 5. Understand need of project management and project management life cycle.

CO 6. Understand project scheduling concept and risk management associated to various types of projects.

UNIT 1

INTRODUCTION TO SOFTWARE ENGINEERING: Software and Software Engineering, phases in Software Development, Software Development Process models, Agile modeling, Introduction to metrics.

UNIT 2

SOFTWARE REQUIREMENT SPECIFICATION: Role of SRS, Problem Analysis, Requirement specification, validation, metrics, Monitoring and control

PLANNING A SOFTWARE PROJECT: Cost Estimation, Project Scheduling, Staffing personal planning, Team Structure, Software Configuration Management, Quality Assurance Plans, Project Monitoring plans, Risk Management.

UNIT 3

SYSTEM DESIGN: Design Objectives, design principles, Module level Concepts, Design methodology – object oriented approach Design Specification, Verification, Metrics, monitoring and control.

DETAILED DESIGN: Module Specification, Detailed design and process design Language, Verification

UNIT 4

CODING: Programming practice, Verification, Metrics

TESTING: Testing Fundamentals, Fundamental testing, Structural Testing. Testing process Clean Room approach

References:

1. "An Integrated approach to the Software Engineering" 2ed. Narosa Publishing House, New Delhi, 2002, Pankaj Jalote
2. Software Engineering Principles & Practice - 3rd Edition, Tata Mc Graw Hill Companies – 2006, Waman S Jawadekar
3. Software Engineering A Practitioner's Approach - 6th Edition McGraw Hill – 2005, Roger S Pressman
4. Software Engineering - 7th Edition : Pearson Education Ltd- 2006, Sommerville

THEORY OF LANGUAGES **3:1:0**

Course Code:CSC070

Course Outcomes:

At the end of the course students will be able to:

CO1. Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator.

CO2. Understand, design, analyze and interpret Context Free languages, Expression and Grammars.

CO3. Design different types of Push down Automata as Simple Parser.

CO4. Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine.

UNIT - 1

INTRODUCTION TO FINITE AUTOMATA**:** Introduction to Finite Automata; The central concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata.
FINITE AUTOMATA, REGULAR EXPRESSIONS: An application of finite automata; Finite automata with Epsilon-transitions; Regular expressions; Finite Automata and Regular Expressions

UNIT - 2

REGULAR LANGUAGES, PROPERTIES OF REGULAR LANGUAGES: Regular languages; Proving languages not to be regular languages; Closure properties of regular languages; Equivalence and minimization of automata.
CONTEXT-FREE GRAMMARS AND LANGUAGES: Context –free grammars; Parse trees; Ambiguity in grammars and Languages.

UNIT – 3

PUSHDOWN AUTOMATA: Definition of the Pushdown automata; the languages of a PDA; Equivalence of PDA's and CFG's; Deterministic Pushdown Automata.
PROPERTIES OF CONTEXT-FREE LANGUAGES: Normal forms for CFGs; The pumping lemma for CFGs; Closure properties of CFL

UNIT - 4

TURING MACHINE: The turing machine; Extensions to the basic Turing Machines; UNDECIDABILITY: A Language that is not recursively enumerable; An Undecidable problem that is RE; Post's Correspondence problem

REFERENCES:

1. Introduction to Automata Theory, Languages and Computation – John E.. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman:, 3rd Edition, Pearson education, 2007.
2. Fundamentals of the Theory of Computation: Principles and Practice – Raymond Greenlaw, H.James Hoove, Morgan Kaufmann, 1998.
3. Introduction to Languages and Automata Theory – John C Martin, 3rd Edition, Tata McGraw-Hill, 2007.

DATABASE MANAGEMENT SYSTEM **2:1:1**

Course Code:CSC060

Course Outcomes:

At the end of the course students will be able to:

CO1. Explain the features of database management systems and Relational database.
CO2. Design conceptual models of a database using ER modelling for real life applications and also construct queries in Relational Algebra.
CO3. Create and populate a RDBMS for a real life application, with constraints and keys, using SQL.
CO4. Retrieve any type of information from a data base by formulating complex queries in SQL.
CO5. Analyze the existing design of a database schema and apply concepts of normalization to design an optimal database.
CO6. Build indexing mechanisms for efficient retrieval of information from a database

UNIT 1

Introduction and conceptual modeling databases and Database users, Data modeling using the entity relationship (ER) model, the enhanced entity – relationship (EER) model.

UNIT 2

Relational model: Concepts constraints, Languages, Design and programming.

The relational data model and relational database constraints, Relational algebra and relational calculus, Introduction to SQL Programming technique

UNIT 3

Database design theory and methodology functional dependencies and Normalization for relational database, Relational database design algorithms and further dependencies, practical database design methodology and use of UML diagrams.

UNIT 4

Introduction to transaction processing concepts and theory recovery

REFERENCES

1. Fundamentals of database system – 5th Edition – Ramez elmasri, Navathe – Person edition

2 .An introduction to database system – 8th Edition – C. J. Date, Kannan – Person Education

3.Database system concepts – 5th Edition – Korth, Sudarshan – McGraw Bill Edition

4. Database Management System- Raghuramakrishnan.

5. An Introduction to Database System- Bipin Desai

6. Principles of Database System- J D Ullman

Softcore:

PRINCIPLES OF PROGRAMMING LANGUAGES AND 'C' 2:1:1

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1. Analyzing semantic issues associated with function implementations, including variable binding, scoping rules, parameter passing, and exception handling.

CO2. Implementation techniques for interpreted functional languages.

CO3. Using object-oriented languages.

CO4. Familiar with design issues of object-oriented and functional languages.

CO5. Familiar with language abstraction constructs of classes, interfaces, packages, and procedures.

CO6. Familiar with implementation of object-oriented languages.

CO7. Familiar with using functional languages

.

UNIT 1: Preliminaries

Reasons for studying concepts of programming languages, Programming domains, Language evaluation criteria, Implementation methods Names, Bindings, Type Checking, and Scopes Introduction, Names, Variables, The concept of Binding, Type Checking, String Checking, Type Compatibility, Scope, Scope and Lifetime, Referencing Environments, Named Constants, Variable Initialization.

UNIT 2: Data Types

Introduction, Primitive Data types, Character String Types, User-Defined Ordinal Types, Array Types and Associative Arrays, Record Types, Union Types, Set Types, Pointes Types.

Expression, Assignment Statements and Statement Level Control Structures

Introduction, Arithmetic Expressions, Overloaded Operators, Type Conversions, Relational And Boolean Expressions, Short-Circuit Evaluation, Assignment Statements, Mixed-Mode assignment.

UNIT 3

Compound Statements, Selection Statements, Iterative Statements, Unconditional Branching, Guarded Commands, Conclusion.

Subprograms: Introduction, fundamentals, design issues, local referencing environments, parameter passing methods, overloaded programs, generic subprograms, coroutines, user defined overloaded operators

UNIT 4

C LANGUAGE: C Fundamentals, Operation data input and output, Control statements, Function Storage classes, Arrays, Pointers, structures and unions, Enumeration, Command line parameters, Macros, 'C' processor.

Reference:

1. Concepts of Programming Languages, Eight Edition, Pearson, Robert W. Sebesta
2. Foundation for Programming Languages, John C Mitchell
3. Principles of Programming Language, Chopra Rajiv
4. Principles of Programming Language, Dowek
5. Types and Programming Languages, Benjamin C Pierce
6. Programming Languages: Principle and Practices ,3rd Edition, Kenneth C Louden

INTERNET TECHNOLOGY **2:0:2**

Course Code:CSD220

Course Outcomes:

At the end of the course students will be able to:

CO1. Develop analytical ability in network technology.

CO2. Create quality websites

CO3. Work individually as a web designer and set up their own business

CO4. Get the job opportunities in most companies for professional web designers and build websites more visually elegant and interactive

CO5. Implement interactive web page(s) using HTML, CSS and JavaScript.

CO6. Design a responsive web site using HTML5 and CSS3.

UNIT 1

Fundamentals: introduction to the Internet, WWW, Web Browsers, Web Servers, URL, Multipurpose Internet Mail Extensions (MIME), HTTP, Security,

Introduction to HTML: Origins and Evolution, Basic Syntax, Document Structure, Basic tags, Images, Links, Lists, Tables, Forms, Frames.

UNIT 2

Introduction to XML: Syntax of XML, XML Document Structure, Document Type Definition.

Introduction to XHTML: Origins and Evolution, Basic Syntax, Document Structure, Basic tags, Images, Links, Lists, Tables, Forms, Frames, Syntactic difference between HTML and XHTML.

Cascading Style Sheets (CSS): Introduction, levels of style sheets, Selector Forms, Property value forms, Font properties, Color, Alignment of Text, Box model, Background Images, <span> and <div> tags.

UNIT 3

The basics of JavaScript: Overview, Object Orientation and JavaScript, General syntactic characteristics, Primitives, Operations and Expressions, Screen Output and Keyboard Input, Control Statements, Objects, Arrays, Functions, Constructors, Errors.

JavaScript and XHTML Documents: Element access, Events and Event Handling, Handling Events from Body elements, Handling Events from Button elements, Handling Events from Text Box and password elements.

Dynamic Documents with JavaScript: Introduction, Positioning Elements, Moving Elements, Element Visibility, Changing Colors and Fonts, Dynamic Content, Stacking Elements, Locating Mouse Cursor, Reacting to Mouse Click, Slow Movement of Elements, Dragging and Dropping Elements.

UNIT 4

Introduction to PHP: Origins and Uses, Overview, General Syntactic Characteristics, Primitive, Operations and Expressions, Output, Control Statements, Arrays, Functions, Form Handling, Cookies.

REFERENCES:

1. Programming the World Wide Web – by Robert W. Sabesta 4th Edition Pearson Publications
2. HTML and XHTML the Complete Reference.
3. How to program the World Wide Web – by Deitel and Deitel
4. Mastering in HTML – by Ray and Ray.
5. Web programming and Internet Technologies: An E Commerce approach- By Porter ` Seobey and Pawan Lingras.
6. Internet Technology and Information services by Joseph Miller

JAVA Programming **2:0:2**

Course Code:CSA270

Course Outcomes:

At the end of the course students will be able to:

C01. Understand concept of Object Oriented Programming & Java Programming Constructs.

C02. Understand basic concepts of Java such as operators, classes, objects, inheritance, packages ,Enumeration and various keywords.

C03. Understand the concept of exception handling and Input/Output operations.

C04. Design the applications of Java & Java applet.

C05. Analyze & Design the concept of Event Handling and Abstract Window Toolkit.

UNIT 1

History and evolution of Java, An overview of Java, Data types, variables and arrays, Operators, Control statements- Introducing classes ,A closer look at methods and classes, Inheritance, Packages and interfaces.

UNIT 2

Exception handling, Multithreaded Programming, Enumeration, Autotoxins, I/O, Applets

UNIT 3

Networking, Event handling, Swings.

UNIT 4

String handling, Collection framework, Introduction to J2EE, Java servlet, Java server pages (JSP) and HTML, JDBC objects.

REFERENCES:

1. The complete reference Java – 7th Edition – Herbert Schildt – Tata Mcgraw hill Edition.
2. The complete reference J2EE – Jem Keogh – Tata Mcgraw hill Edition.
3. Object Oriented Programming with Java- M T Somashekara, D S Guru and K S Manjunatha.
4. The Complete Reference 7th Edition Herbert Schiidt
5. Introduction to Java Programming – E Balaguruswamy
6. Head First Java – 2nd Edition
7. Core Java- Horst Mann, C S –8th Edition-Cornell.

8. Core Servelet and Java Server pages- Hall, M-Brown L

MULTIMEDIA **3:1:0**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1. Understand various file formats for audio, video and text media.

CO2. Develop various Multimedia Systems applicable in real time.

CO3. Design interactive multimedia software.

CO4. Apply various networking protocols for multimedia applications.

CO5. Develop understanding of technical aspect of Multimedia Systems

UNIT 1

Introduction to Multimedia (MM) Communication, Scope, Range, Feasibility and Challenges of MM Communication Key aspects of MM: Compression, Coding, Transmission and Replay.

UNIT 2

Types of Compression: Quantization, Coding as PCM, DPCM, ADPCM. Simple Encoder and Decoders based on PCM Samples. Introduction to Transform domain Compression. Introduction to Audio part of MPEG, Psychoacoustics

UNIT 3

Compression in Spatial Domain Algorithms for Data Compression in Transform Domain: DCT. Variable Length Coding, Huffman code. Variable Length Coding: Arithmetic Coding. Introduction to JPEG 2000 Standard, Encoders-Decoders based on this. Audio Compression and MPEG Audio

UNIT 4

Fundamental concepts of Video. MPEG Architecture Details: Audio-Video- Systems. Video Coding standard related to H.263 and H. 264. MPEG- 1, 2 Video. MPEG- 4 : Video. Streaming and Transport Issues: Multiplexing, Synchronization and File formats. Errors in MPEG and Error handling, Concealment. Buffer structures and Buffer Management

Introduction to MPEG-7 and MPEG-21., HDTV. Content based Image Retrievals and Digital Libraries.

References:

1. Fundamentals of Multimedia, 2nd Ed, Pearson, 2005, Ze-Nian Li and Mark Drew
2. Multimedia Communications., Pearson, 2005, Fred Halsall
3. Introduction to Data Compression, 3rd Ed, Morgan Kaufman (India Ed), 2005, Khalid Sayood
4. The DATA compression; The Complete Reference, 3rd Ed, Springer (India Ed), 2006, David Solomon
5. Multimedia foundations: A Core Concepts of for Digital Design, Vic Cost Ello
6. Multimedia: Making it work, 9th edition, Tay Vaughan

MICROCONTROLLERS **3:1:0**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1. Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller.

CO2. Design the interfacing for 8051 microcontroller.

CO3. Understand the concepts of ARM architecture.

CO4. Demonstrate the open source RTOS and solve the design issues for the same.

CO5. Select elements for an embedded systems tool.

CO6. Understand the concept and architecture of embedded systems

UNIT 1

Introduction, Numbering system and binary arithmetic,

UNIT 2

The 8051 Architecture, Basic assembly language programming concepts, Moving data,

UNIT 3

Logical operations, Arithmetic operations Jump and call instructions

UNIT 4

An 8051 Microcontroller design, Applications

References

1. "The 8051 Microcontroller", 3rd Edition, Thomson India edition, 2007, Kenneth Ayala
2. "Programming and customizing the 8051 microcontroller", Tata McGraw-Hill edition, 2006, Myke prick
3. "The 8051 Microcontroller and embedded systems", Pearson India, 2006, Muhammad Ali Mazidi & Janice Gillispie Mazidi,
4. Microcontroller and Embedded System, Mazidi, M A- Mazidi
5. Microcontroller: Architecture, Programming and application, Ayala, Kenneth

DISCRETE MATHEMATICS **3:1:0**

Course Code:CSA260

Course Outcomes:

At the end of the course students will be able to:

CO1. Construct simple mathematical proofs and possess the ability to verify them.
CO2. Have substantial experience to comprehend formal logical arguments .
CO3. skillfull in expressing mathematical properties formally via the formal language of propositional logic and predicate logic.
CO4. Specify and manipulate basic mathematical objects such as sets, functions, and relations and will also be able to verify simple mathematical properties that these objects possess.
CO5. Apply basic counting techniques to solve combinatorial problems .
CO6. Use various techniques of mathematical induction (weak, strong and structural induction) to prove simple mathematical properties of a variety of discrete structures

UNIT 1

Set Theory: Sets and Subsets. Operations on sets, Countable and uncountable sets, The addition principal, the concept of probability.

Mathematical Logic: Propositions, Logical Connectives, Tautologies; Contradictions, Logical equivalence, Application to switching networks, Duality, Commentates NAND and NOR, Converse, Inverse and Contrapositive, Rules of inference.

UNIT 2

Open statements; Quantifiers, Logical Implication involving Quantifiers, Statements with more than one variable, Methods of proof and disproof, Mathematical Induction.

UNIT 3

Relations and Ordering: Cartesian products of sets, Relations, Paths in relations and digraphs, Operations on relations, Composition of relations, Properties of relations, Equivalence relations, Partial orders, Total Orders, External elements in posets, Lattices.

Functions: Functions, Types of functions, Composition of function, Invertible functions, Permutation Function.

UNIT 4

Fundamental principles of counting: Principles of inclusion and exclusion: The rule of sum and product, Permutations, combinations: The binomial theorem, combinations with repetition, Ramsey number, the Catalan numbers, sterling number and bell numbers, Generalizations of principles, the pigeonhole principle, Derangements-Nothing is in its Right place, Rook polynomials, Arrangements with Forbidden positions.

References:

1. Discrete Mathematics by Dr. Chandrashekar S .
2. Discrete and combinational Mathematics by Ralph P. Grimaldi, 5th edition, Addison Wesley, 2004
3. Discrete mathematical structures by Kolman, Robert C Busby and Sharon., 6th Edition, Prentice Hall, 2008
4. Discrete Mathematics and Application by Kenneth H Rosen.
5. Discrete Mathematics by Norman L Biggs.

SIMULATION & MODELLING **3:1:0**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1. Understand the definition of simulation and how to develop and analyze a simulation model

CO2. Understand the fundamental logic, structure, components and management of simulation modeling

CO3. Demonstrate knowledge of how to use Arena

CO4. Build a simulation model with basic operations and inputs

CO5. Build a simulation model with detailed operations

CO6. Perform statistical analysis of output from terminating simulation

UNIT 1

Introduction, Simulation of prepursuit problem, A system & its model, Simulation of an inventory problem, The basic nature of simulation

Simulation of continuous systems: A chemical reactor, Numerical integration vs continuous system simulation, Selection of an integration formula, Runge Kutta integration formulas, simulation of a servo system, Simulation of a water reservoir system, Analog vs digital simulation

UNIT 2

Discrete system simulation

Fixed time-step vs event to event model, On simulating randomness, Generation of random numbers, Generation of non uniformly distributed random numbers, Monte Carlo computation vs stochastic simulation

UNIT 3

Simulation of queuing systems

Rudiments of queuing theory, simulation of single server queue, Simulation of two server queue, Simulation more general queues.

Simulation of PERT network

UNIT 4

Network model of a project, Analysis of an activity network, Critical path computation, Uncertainties in activity duration, Simulation of an activity network, Computer program for simulation, Resource allocation and cost considerations, Inventory control & forecasting Elements of inventory theory, More complex inventory models, simulation examples, Generation of Poisson & erlang variates, Forecasting & regression analysis

Design and Evaluation of Simulation Experiments

Length of simulation runs, Variance reduction techniques, Experimental layout, validation

References:

1. System Simulation with Digital Computer Narsingh Deo
2. System Simulation and Modeling - Sengutta
3. Computer Methods for solving Dynamic Seperation problems- C D Holland and A I Liapis.
4. Fundamentals of Modeling separation Process- C D Holand.
5. Process Modeling-M M Denn

OPERATIONS RESEARCH **3:1:0**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1: Formulate and solve mathematical model (linear programming problem) for a physical situations like production, distribution of goods and economics.

CO2: Apply the concept of simplex method and its extensions to dual simplex algorithm.

CO3: Solve the problem of transporting the products from origins to destinations with least transportation cost.

CO4: Convert and solve the practical situations into non-linear programming problem.

CO5: Identify the resources required for a project and generate a plan and work schedule

UNIT 1

Introduction: formulation of LP problems, graphical solution of LP problems, General formulation of L P problems, Slack & Surplus variables, Standard form, Matrix form, Simplex method, Revised Simplex method, Dual simplex

UNIT 2

Assignment model, Transportation model, Game theory

Probability: Introduction, Basic terms of probability, The Addition law of probability, discrete & continuous, variables, random variables, probability distribution of random variables, Mean variance& standard deviation, Mathematical expectation of a random variable.

UNIT 3

Queuing theory

Introduction, queuing system, distribution, Kendall's Notation, Classification, model I (m/m/1).

UNIT 4

Project management by PERT CPM

Introduction, history, Applications, Basic steps, Network diagram representation, rules of drawing network diagram, labeling Fulkerson's I-J rule, Time estimates & Critical path, PERT, Resource allocation, Uses of PERT/CPM.

References:

1. Operations Research - S D Sharma
2. Operations Research - R K Gupta & D S Hira
3. Introduction to Operation research – Frederick S Hillier ,Gerald J and Liberman.
4. Operation research: An Introduction by Hamdy A Taha.
5. Operation research: Application and algorithm by Wayne L Winston.

MOBILE COMMUNICATION **3:1:0**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1. Design a mobile cellular network

CO2. Optimize a radio channel system

CO3. Select the apt diversity scheme for a given wireless system to improve the performance.

CO4. Perform efficient spectral allocation using multiple access techniques such as CDMA, and OFDM.

CO5. Select the correct MAC protocol and routing algorithm for mobile ad-hoc networks.

CO6. Optimize the mobile ad-hoc network, MAC protocols and routing algorithms as per application.

UNIT 1

Introduction, Applications, History of wireless communication, reference model,
Wireless transmission, Frequencies for radio transmission, signals, Antennas, Signal propagation
Multiplexing, Modulation, Spread spectrum

UNIT 2

Cellular Systems, Medium Access control, Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, Comparison.

UNIT 3

Telecommunications Systems, GSM, DECT, TETRA, UMS & IMT 2000
Satellite Systems, history, Applications, Basics, Classical TCP improvements, TCP over 2.5/3G wireless networks, performance enhancing proxies

UNIT 4

Support for mobility, File Systems World Wide Web, Wireless Application protocol

References:

1. Cellular and Mobile Communication- Krishna.
2. Cellular Mobile Communication – V S Bhagat
3. Cellular and Mobile Communication- V Jeyasri Arokiamary.
4. Wireless Communication and Networks – William Stallings.

5. Cellular Communication; A Comprehensive and practical guide- Nishith Tripathi and Jeffreyhreed.

C++ **2:0:2**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1 . Understand the features of C++

CO2. Understand the relative merits of C++ as an object oriented programming language

CO3. Understand how to produce object-oriented software using C++

CO4. Understand how to apply the major object-oriented concepts to implement object oriented programs in C++, encapsulation, inheritance and polymorphism

CO5 Understand advanced features of C++ specifically stream I/O, templates and operator overloading

Unit I

Quick overview of C : Expressions - Statements - Arrays and Null-Terminated Strings – Pointers - Functions – Structures, Unions, Enumerations and User-Defned Types – C Style Console I/O – File I/O -.

Unit II

An Overview of C++ - Classes and Objects – Arrays, Pointers, References, and the Dynamic Allocation Operators

Unit III

Function Overriding, Copy Constructors and Default Arguments – Operator Overloading - Inheritance – Virtual Functions and Polymorphism

Unit IV

Templates – Exception Handling - The C++ I/O System Basics

References :

1. The Complete Reference C++, 4th Edition, Tata-McGraw-Hill, 2003, Herbert Schildt
2. Object Oriented Programming with C++ , M T Somashekara, D S Guru, H S Nagendraswamy and K S Manjunatha
3. C++ Premier, 5th Edition. Stanley B Lippman
4. C++ Programming language, E Balaguruswamy
5. The C++ programming language, 4th Edition, Bjarne Stroustrup

PATTERN RECOGNITION **3:0:1**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

C01. Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.

C02. Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.

C03. Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.

C04. Apply pattern recognition techniques to real-world problems such as document analysis and recognition.

C05. Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

UNIT 1

Machine perception, pattern recognition systems, Design Cycle, Learning and adaption, models of Pattern recognition

UNIT 2

Bayesian Decision Theory

Introduction, Bayesian, Decision theory- Two category classification, classifiers-Two category case and multi category case, missing and noisy features.

UNIT 3

Nonparametric Techniques

Introduction, Density estimation, Parzen window, KN neighbor estimation, The nearest neighbor rule, Metrics and Nearest Neighbor Classification, Error analysis of nearest decision rule

UNIT 4

Introduction, Heirarchical clustering techniques, partitional clustering techniques Dimensionality reduction techniques Introduction, principle component analysis, Fisher Linear Dicriminant Analysis, Spectral clustering based dimensionality reduction

References:

1. Pattern Classification, 2nd edition, Wiley publications, R. O Duda, P.E. Hart and D G Stork,
2. Pattern Recognition and Image Analysis, Prentice Hall of India, Pvt Ltd, Earl Gose, Richard, Johnsonbaugh, Steve Jost
3. Pattern Recognition and machine Learning, Cristopher M Bishop,
4. Pattern Recognition (Blue Ant) – Willian Gibsom.
5. Pattern Recognition, 4th Edition- Sergios Theodoridis and Konstantios Koutroumbas

IMAGE PROCESSING **2:1:1**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

C01. Analyze general terminology of digital image processing.

C02. Examine various types of images, intensity transformations and spatial filtering.

C03. Develop Fourier transform for image processing in frequency domain.

C04. Evaluate the methodologies for image segmentation, restoration etc.

C05. Implement image process and analysis algorithms.

C06. Apply image processing algorithms in practical applications.

UNIT I

Introduction, digital image fundamentals

UNIT II

Image enhancement in the spatial domain, Image enhancement in the frequency domain

UNIT III

Image restoration, color image processing

UNIT IV

Wavelets and multi-resolution processing image compression

References:

1. Digital Image Processing-Rafel C.Gonzalez and Richard E Words.
2. The Image Processing hand Book- John C Cruss.
3. Fundamentals of Digital Image Processing- Anil K Jain.
4. Digital Image Processing –Jayaraman S.
5. Digital Image Processing- Sanjay M Shah Munesh Chandra Trivedi

SOFTWARE TESTING **3:0:1**

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1.Check Various test processes and continuous quality improvement

CO2.Verify Types of errors and fault models

CO3.Check Methods of test generation from requirements

CO4.Check Behavior modeling using UML: Finite state machines (FSM)

CO5.Test generation from FSM models

CO6.Input space modeling using combinatorial designs

UNIT 1

Assessing Testing Capabilities and Competencies, Building a software Testing Environment: Building a software Testing Strategy, Establishing a Software Testing Methodology, Determining your Software Testing Techniques, Selecting and Installing Software Testing Tools.

UNIT 2

The Eleven-Step Testing Process: Eleven-Step Testing Process Overview, Step1: Access Project Management Development Estimate and status, Step2: Develop Test Plan, Step3: Requirement Phase Testing,

UNIT 3

Step4: Design Phase Testing, step 5: Requirement Phase Testing, Step6: Execute Test and Record Results,

UNIT 4

Step7: Acceptance Test Results Step8: Report Test Results, Step9: Testing Software Installing, Step10: Test Software Changes, Step11: Evaluate Test Effectiveness.

.

REFERENCES:

1. Effective Methods for Software Testing, William E. Perry, 2nd Edition 2003, Wiley
2. *Surviving the Top Challenges of Software Testing*, New York: Dorset House, 1997., Rice, Randall and Peery, William E.,
3. A practitioner's Guide to Software Test Design, By Lee Copelane.
4. The Art of Software Testing By Glenford Myers.
5. Testing Object System: Models, Patterns and Tools by Robert V Binder.

GRAPH THEORY **3:1:0**

Course Code:CSB270

Course Outcomes:

At the end of the course students will be able to:

CO1. Explain basic concepts in combinatorial graph theory

CO2. Define how graphs serve as models for many standard problems

CO3. Discuss the concept of graph, tree, Euler graph, cut set and Combinatorics.

CO4. See the applications of graphs in science, business and industry.

UNIT 1

Introduction to Graph theory: Basic terminologies—direst & undirect graphs, walks, paths & circuits, sub-graphs and complements, Graph Isomorphism, vertex degree and regular graphs,

UNIT 2

Konigsberg bridge problem & Euler graphs. Hamilton graphs & traveling salesman problem, planar graphs- definition & examples, Bipartite & Kuratowskis graphs, Euler's formula & detection of planarity, Dual of Planar graphs,

UNIT 3

Graph Coloring: Proper coloring & chromatic number of graphs, Chromatic polynomial, four color problems, Trees: Optimization & Matching: Trees; Definition & Properties, Rooted & binary rooted trees, ordered trees & trees sorting. Weighted trees & prefix codes

UNIT 4

Spanning trees, optimization, Networks, Cutset, Edge & Vertex connectivity of a graph, Max-flow Min-cut thermo and its applications, Matching theory and its applications

References:

1. Graph Theory, V.K Balakrishnan, Schaum Series, McGrawHill, 1997
2. Graph Theory, by Frank Harary, Westview Press, 1994.
3. Introduction to Graph Theory, Douglas B west.
4. Hand Book of Graph Theory, Jonathan L Gross and Jay Yellen.
5. Graph Theory with application to Engineering and Computer science, Narsingh Deo.

OOAD **2:1:1**

Course Code:

Course Outcomes

At the end of the course students will be able to:

CO1. Analyse, design, document the requirements through use case driven approach.

CO2.Identify, analyse, and model structural and behavioural concepts of the system.

CO3.Develop, and explore the conceptual model into various scenarios and applications.

CO4.Apply the concepts of architectural design for deploying the code for software**UNIT I**

Implementation of Object Oriented concepts using C++

UNIT II

Introduction, Object orientation, OO development, OO themes, OO modeling ,History. Modeling, Abstraction, Models .Class Modeling Object & class, Link & Association concepts, Generalization & Inheritance, sample Class Model, Navigation of class models. Advanced class modeling: advanced object & class concepts, Association end N ary Association, Aggregation, Abstract Classes, Multiple Inheritance, Meta Data, Reification, Constraints, Derived Data.

UNIT III

State modeling: Events, States, Transitions & Conditions, State Diagrams, State Diagram behavior. Advanced state modeling, interaction modeling.

UNIT IV

System design: Overview of System design, Estimating performance, making a Reuse plan, Breaking a System into Subsystems, Identifying concurrency, Allocation of subsystems, Management of Data Storage.

Reference:

1. Object Oriented Analysis and Design – Blaha, Rambaugh.
2. Object Oriented Analysis and Design with the Unified Process- W Satzinger, Robert B Jackson and Stephen D Burd.
3. Object Oriented Analysis and Design with application, 3rd edition- Grady Booch, Robert A Maksimchuk, Michael W Engel
4. Object Oriented Analysis and Design with application- Grady Booch.

PROBABILITY AND STATISTICS **3:1:0**

Course Code:

Course Outcomes

At the end of the course students will be able to:

CO1. Apply probability theory to set up tree diagrams
CO2. Apply probability theory via Bayes' Rule
CO3. Describe the properties of discrete and continuous distribution functions
CO4. Use method of moments and moment generating functions
CO5. Assess the consistency, efficiency and unbiasedness of estimators
CO6. Apply method of maximum likelihood estimation
CO7. Apply the Central Limit Theorem
CO8. Use statistical tests in testing hypotheses on data

UNIT 1

Introduction, basic terminology, Interpretation of probability: Axioms of probability, Some elementary theorems, Conditional probability, Mathematical Exception

UNIT 2

Probability Distributions: Introduction, Discrete probability distributions continuous probability distributions, The expected value of a random variable Chebyshev's Theorem

UNIT 3

Sampling distributions, Populations and samples, Sampling distribution, The sampling distribution of the mean, sampling distributions of proportions, sampling distributions of mean, chi squared distribution, F distribution.

UNIT 4

Estimation and inference theory, introduction, point estimation, interval distribution, bayesian estimation, test of hypot, Introduction to ANOVA.

References:

1. Probability and Statistics: Bheeshma Rao
2. Probability and Statistics, 4th edition, Degroot, Schervish.
3. Probability and Statistics for Engineering and Science, 8th edition, Jay L Devore.
4. Probability and Statistics, Michael Akritas.

5. An Introduction to Probability and Statistics, 3^{rd} edition, Vijay K Rohatgi and A K MD Ehsanes Saleh.

DATA MINING **2:1:1**

Course Code:CSD230

Course Outcomes:

At the end of the course students will be able to:

CO1. Demonstrate an understanding of the importance of data mining and the principles of business intelligence

CO2. Organize and Prepare the data needed for data mining using pre preprocessing techniques

CO3. Perform exploratory analysis of the data to be used for mining.

CO4. Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.

CO5. Define and apply metrics to measure the performance of various data mining algorithms.

UNIT 1

Introduction, what kind of patterns can be mined? which technologies are used? which kind of applications are targeted?, major issues in Data mining.

Getting to know your data: Data objects and attribute types, basic statistical description of data, Data Visualisation, Measuring Data similarity and dissimilarity.

UNIT 2

Data Preprocessing: data cleaning, Data integration, Data Reduction, Data transformation and Data Discretization

UNIT 3

Mining frequent patterns, Associations and correlations: Basic concepts, Frequent mining methods, pattern Evaluation methods, Pattern mining in Multilevel multi dimensional space, Decision tree induction.

UNIT 4

Cluster analysis, partioning methods, heirarchical methods, density based methods, grid based methods, evaluation of clustering.

References:

1. Data Mining: Concepts and Techniques, Third Edition, Jaiwei Han, Micheline Kamber, Jian Pei.
2. Learning Data Mining with Python, 2nd edition, Robert Layton.
3. Data Mining; The Text book, Charu C Aggarwal.
4. Data Mining, 4th edition: Practical Machine learning Tools and Techniques by Lan H Witten and Fibe Frank.
5. Introduction to Data Mining – Pang- Ning Tan and Micheal Steinbach

ARTIFICIAL INTELLIGENCE **3:1:0**

Course Code:

Course Outcomes

CO 1. At the end of the course students will be able to:

CO 1. Create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.

CO 2. Know concepts of a Rational Intelligent Agent and the different types of Agents that can be designed to solve problems

CO 3. Review the different stages of development of the AI field from human like behavior to Rational Agents.

CO4. Impart basic proficiency in representing difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.

CO5. The basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as minimal, resolution, etc. that play an important role in AI programs.

CO6. Introduce advanced topics of AI such as planning, Bayes networks, natural language processing and Cognitive Computing.

UNIT 1

AI problems, AI techniques, defining the problem as state space search, production systems, problem characteristics

Heuristic Search: Generate and test, hill climbing, BFS, Problem Reduction, Constraint Satisfaction, Means-End Analysis

UNIT 2

Knowledge Representation: Representations and mappings, approaches to knowledge representation

procedural v/s declarative knowledge, normal forms in predicate logic and clausal forms, non-monotonic reasoning

Declarative Representations: semantic nets, conceptual dependency, frames, scripts

UNIT 3

Game playing: minimax search procedure, adding alpha-beta cut offs

Planning: An Example Domain – the blocks world, Components, goal stack planning

UNIT 4

Expert systems: expert systems v/s conventional computers, expert system shells, explanation based learning.

Learning: Learning from observation - Inductive learning – Decision trees – Explanation based learning – Reinforcement Learning, Neural Networks, Introduction to Natural Language Processing.

References:

1.Artificial Intelligence, Third Edition, Elaine Rich, Kevin Knight, Shivashankar B Nair, Tata McGraw-Hill.

2. Introduction to Artificial Intelligence, Wolfgang Ertl.

3. Artificial Intelligence,2nd edition, Stuart Russel, peter Norvig.

4. Artificial Intelligence, Jeorge F Luger

5. Artificial Intelligence, Saroj kaushik

.NET TECHNOLOGIES **2:0:2**

Course Code:CSB280

Course Outcomes

At the end of the course students will be able to:

CO1. Design web applications using .NET
CO2. Use .NET controls in web applications.
CO3. Debug and deploy .NET web applications
CO4. Create database driven .NET web applications and web services

Unit 1

Benefits of .NET Framework, Architecture of .NET Framework 4.0, Components of .NET Framework 4.0: CLR, CTS, Metadata and Assemblies, .NET Framework Class Library, Windows Forms, ASP .NET.

Need of C#, C# Pre-processor Directives, Creating a Simple C# Console Application, Identifiers and Keywords. Data Types, Variables and Constants: Value Types, Reference Types, Type Conversions, Boxing and Unboxing, Variables and Constants. Expression and Operators: Operator Precedence, Using the :: (Scope Resolution) Operator and Using the ***is*** and ***as*** Operators. Control Flow statements: Selection Statements, Iteration Statements and Jump Statements.

Unit 2

Arrays and Strings: One Dimensional and Multidimensional Arrays, Jagged Arrays

Classes and Objects: Creating a Class, Creating an Object, Using this Keyword, Creating an Array of Objects, Using the Nested Classes, Defining Partial Classes and Method, Returning a Value from a Method and Describing Access Modifiers. Static Classes and Static Class Members. Properties: Read-only Property, Static Property, Accessibility of accessors and Anonymous types. Indexers, Structs: Syntax of a struct and Access Modifiers for structs. Strings: Constructing Strings, Operating on Strings, Arrays of Strings, The String Class

Unit 3

Encapsulation: Encapsulation using accessors and mutators, Encapsulation using Properties. Inheritance: Inheritance and Constructors, Sealed Classes and Sealed Methods, Extension methods. Polymorphism: Compile time Polymorphism/Overloading, Runtime Polymorphism/

Overriding. Abstraction: Abstract classes, Abstract methods. Interfaces: Syntax of Interfaces, Implementation of Interfaces and Inheritance.
Delegates: Creating and using Delegates, Muticasting with Delegates. Events: Event Sources, Event Handlers, Events and Delegates, Multiple Event Handlers. Exception Handling: The try/catch/finally statement, Checked and Unchecked Statements.

Unit 4

Introduction, Windows Forms, Life Cycle, Event Handling: A Simple Event- Driven GUI, Visual Studio Generated GUI Code, Delegates and Event- Handling Mechanism, Another Way to Create Event Handlers, Locating Event Information. Control Properties and Layout, Labels, TextBoxes and Buttons, GroupBoxes and Panels, CheckBoxes and RadioButtons, ToolTips, Mouse-Event Handling, Keyboard-Event Handling. Menus, MonthCalendor Control, ListBox Control, CheckedListBox Control, ComboBox Control, TreeView Control, ListView Control, TabControl Control ; Building an Multiple Document Interface (MDI) Application. Introduction to ADO.NET

References:

1. Programming in C# 4.0, Tata McGraw Hill, Hebert Shildt
2. C# with .net 4.0 by Andrew Troelsen
3. Programming in C# , 3rd Edition, E Balaguruswamy
4. The Complete Reference C#, Herbert Schildt.
5. The Complete Reference ASP.NET, Robert Standefer III

OBJECT ORIENTED MODELING AND DESIGN WITH UML 2:1:1

Course Code:

Course Outcomes

At the end of the course students will be able to:

CO1. Design & Programming course is a unique course that teaches students how to use object-oriented techniques to build software.
CO2. Gathering requirements & end with implementation.
CO3. Analyze and design classes, their relationships to each other in order to build a model of the problem domain.
CO4. Use common UML diagrams throughout this process, such as use-case, class, activity & other diagrams.
CO5. Create The diagrams through a free tool.
CO6. Capture and manage requirements.

Unit I

INTRODUCTION : Object-Oriented Analysis and Design - Iterative, Evolutionary, and Agile. - Case Studies : The NextGen POS System - INCEPTION : Inception is Not the Requirements Phase – Evolutionary Requirements - Use Cases – Other Requirements:NextGen Example

Unit II

ELABORATION ITERATION 1: Basics – Domain Models – System Sequence Diagrams – Operation Contracts – Requirements to Design-Iteratively – Logical Architecture of UML Package Diagrams

Unit III

On to Object Design – UML Interaction Diagrams – UML class Diagrams - GRASP : Designing Objects with Responsibilities – Object Design Example with GRASP:NextGen POS system – Designing for Visibility – Mapping Designs to Code

Unit IV

ELABORATION ITERATION 2: UML Tools and UML as Blueprint – Quick Analysis Update: NextGen POS – Iteration 2: More Patterns – GRASP: More Objects with Responsibilities – applying GoF Design Patterns

Reference:

1. "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Third Edition, Pearson Education, 2005, Craig Larman,
2. Advanced Object Oriented Analysis and Design using UML , James J Odell.
3. Object Oriented Analysis and Design , Mike O-Docherty.
4. Object Oriented Modeling and Design with UML, 2nd edition, Michael R Blaha, James R Rumbauh.
5. Object Oriented Systems and Analysis and Design using UML, Simon Bennetth, Steve McRovv and Ray Farmer.

ANDROID APPLICATION DEVELOPMENT **2:0:2**

Course Code:

Course Outcomes

At the end of the course students will be able to:

CO1. Describe and compare different mobile application models/architectures and patterns.
CO2. Apply mobile application models/architectures and patterns to the development of a mobile software application.
CO3. Describe the components and structure of a mobile development framework (Google's Android Studio).
CO4. Apply a mobile development framework to the development of a mobile application.
CO5. Demonstrate advanced Java programming competency by developing a maintainable and efficient cloud based mobile application

Unit 1

Introduction to Android & Open Handset Alliance

Installation of Android Studio and other Development Environments like Gradle.

Understanding Android File System.

Creating First Android Application

Understanding Intent, Activity, Service, Content Providers, Broadcast Receivers.

Understanding Android Application, Manifests, Layouts, Drawables, Styles, Android Activity, View

Understanding Android XML based layout (Linear Layout, Relative Layout, Frame Layout).

Introduction to Android Life Cycle Events

initialization and Button Click Listeners.

Unit 2

Development of Simple app containing Dialog Box, Intents,Toast, Spinners, Listeners examples.

Android Listview / GridView and Adapters

Android Date Picker Dialog, Time Picker Dialog

Launching sub Activity

Building Custom ListView and Understanding Adapters in detail

Understanding SQLite database. Populating database.

Developing simple app by using SQLite database (insert, delete, update)

Unit 3

Working with web server basics

Background loading, AsyncTask , Using Threads

Developing simple app by downloading image from web and showing it in ImageView

Understanding Importance of External Libraries and demonstration of simple external library

Image lazy loading, Image loading in list view, grid view

Unit 4

Working with Google Maps

ViewPager

Introduction to fragment, add, remove, replace fragment

ViewPager

Side Navigation Drawer

Action bar/ Toolbar

ViewPager Adapter / Swipe View

References:

1. Android Programming for Beginners by John Horton.

2. Professional Android 4 application development by Reto Meir.

3. Android Book by Lan F Darwin.

4. Learning Android Building application for The Android Market by Marko Gargenta.

5. Programming Android Java programming for the new generation of Mobile Devises by Zigurd Mellieks

ADVANCED DATABASE MANAGEMENT SYSTEM **2:1:1**

Course Code:

Course Outcomes

At the end of the course students will be able to:

CO1. Evaluate and Apply Advanced Database Development Techniques.

CO2. Evaluate Database Systems.

CO3. Administer Database Systems.

CO4. Design & Implement Advanced Database Systems.

Unit 1

Disk storage, Basic file Structures and hashing, indexing structures for files.
Algorithms for query optimization.

Unit 2

Physical database design and tuning, Introduction to transaction, Concurrency control techniques.
Concept for object databases, Object databases standard and design, database security.

Unit 3

Enhanced datamodels for advanced applications, distributed databases and client server architectures, Emerging database technologies and applications.

Unit 4

Definition of NoSQL, History of NoSQL and Different NoSQL products, NoSQL Basics. Exploring one among MongoDB/CouchDB/Cassandra along with Java/Ruby/Python interface : Interfacing and Interacting with NoSQL, NoSQL Storage Architecture, CRUD operations, Querying, Modifying and Managing NoSQL Datastores, Indexing and ordering datasets

References:

1. Fundamentals of Database System :5th Edition ,Navathe

2. Database Management System, Panneerselvam R.
3. Database Management System, Raghu Ramakrishnan and Johannes Gehrke.
4. Data Schemes: Models and algorithms (Advances in Database Systems), Charu C Aggarwal.
5. Multilevel secure Transaction Processing (Advances in Database system), Vijay Atluri and Sushin Jajodia.

COMPILER DESIGN **3:0:1**

Course Code:

Course Outcomes

At the end of the course students will be able to:

CO1. Construct a parse tree, or explain why no parse tree exists, given a BNF grammar and a string over the appropriate alphabet.

CO2. Implement a lexical analyzer from a specification of a language's lexical rules.

CO3. Compute the FIRST set for a BNF grammar.

CO4. Compute the FOLLOW set for a BNF grammar.

CO5. Determine FIRST intersect FIRST constraint satisfaction - determine if a BNF grammar satisfies the constraint on intersection of FIRST sets required for single-symbol-lookahead, top-down, lookahead parsing ()

CO6. Determine FIRST intersect FOLLOW constraint satisfaction - determine if a BNF grammar satisfies the constraint on intersection of FIRST and FOLLOW sets required for single-symbol-lookahead, top-down, lookahead parsing ()

Unit-1

Introduction, Classification of grammars. Context free grammars. Deterministic finite state automata (DFA) Non-DFA.

Lexical analysis :Language processors; The structure of a Compiler; The evolution Of programming languages; The science of building a Compiler; Applications of compiler technology; Programming language basics. Lexical analysis: The Role of Lexical Analyzer; Input Buffering; Specifications of Tokens; Recognition of Tokens.

Unit-2

SyntaxAnalysis

Introduction; Context-free Grammars; Writing a Grammar. Top-down Parsing; Bottom-up Parsing.

Introduction to LR Parsing: Simple LR; More powerful LR parsers (excluding Efficient construction and compaction of parsing tables) ; Using ambiguous grammars; Parser Generators.

Unit-3

Intermediate Code Generation

Variants of syntax trees; Three-address code; Translation of expressions; Control flow; Back patching; Switch-statements; Procedure calls.

Run-Time Environments

Storage Organization; Stack allocation of space; Access to non-local data on the stack; Heap management; Introduction to garbage collection.

Unit-4

Code Generation

Issues in the design of Code Generator; The Target Language; Addresses in the target code; Basic blocks and Flow graphs; Optimization of basic blocks; A Simple Code Generator

Code optimization. Folding, redundant sub-expression evaluation. Optimization within iterative loops.

References:

1. Compilers Principles, Techniques and Tools, 2nd Edition, Addison-Wesley, 2007, Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman

2."The Theory and Practice of Compiler Writing". McGraw Hill, New York, 1985, Tremblay, et. al

3. Principles, Techniques and Tools of Compilers.- Allen I Holob.

4. Elements of Compiler Design.- Meduna

5. Compiler Design - K Muneeswaran.

OPEN ELECTIVES 2:0:2

OP1: COMPUTER FUNDAMENTALS

Course Code:

Course Outcomes:

At the end of the course students will be able to:

CO1. Use technology ethically, safely, securely, and legally.
CO2. Identify and analyze computer hardware, software, and network components.
CO3. Design basic business web pages using current HTML/CSS coding standards.
CO4. Install, configure, and remove software and hardware.
CO5. Use systems development, word-processing, spreadsheet, and presentation software to solve basic information systems problems.

UNIT 1

INTRODUCTION

Computer, Characteristic of Computer, History of Computer, Components of Computer

Key Factors of Computers: Hardware, Software - types of Software (Application and system), forms of software (firmware, shareware, freeware), Translator - Assembler, Compiler and Interpreters. Computer Application – Business, Scientific, Entertainment and educational.

CLASSIFICATION OF COMPUTERS

Mode of operations – Analog, Digital and hybrid Computers

Size and capabilities – Micro, Mini, Main frame and Super computer

UNIT 2

MEMORY UNITS

Primary memory - RAM, ROM, PROM, EPROM, EEPROM, Flash memory

Secondary memory – Magnetic disk (Hard disk, Zip disk, Jaz disk, Super disk)

Optical disk (CD, CD – R, CD – RW, DVD), Magneto-optical disk device

COMPUTER PERIPHERALS DEVICES AND INTERFACES

Input devices – Working principle of Keyboard and mouse, Functional capabilities of Scanner, Digital Camera, OMR, OCR, touch pad, touch screen. Output Devices – Monitor, Printer, Plotter and projector.

Processors, Classification of Processors on speed, Motherboard, Power Supply, I/O Ports and its Maintenance

PROGRAMMING LANGUAGES

Machine, Assembly language and High Level Language

UNIT 3

Introduction to Windows, Elements of Word Processing, Spread Sheet, Presentations .
Nudi/Baraha.

UNIT 4: INTERNET

Basics of Internet: www, HTTP, DNS, IP address, Email, Web browsers, Search Engines

HTML: Introduction to HTML, CSS

E-Commerce: Introduction, Types, Advantages of e-commerce, Applications, survey on popular e-commerce sites

E-governance, Introduction to Cyber Ethics

References:

1. Computer Fundamentals (6th Edition) – Rajaraman.
2. Computer's Today – Suresh K Basandra.
3. Computer Fundamentals-P K Sinha
4. Computer System Architecture (3rd Edition) PHI-2002. Chapters 3.3 & 3.4- Morris Mano,
5. Digital Principles and application (4th Edition) – Malvino Leach, Tata Mc Graw-Hill Edition
6. Computer System Architecture (3rd Edition) – Morris Mano, PHI
7. Microsoft office 365-Katherine Murray.
8. Microsoft office 2016- Nita Rutkosky, Denise Seguin, Audrey Rutkosky Roggenkamp
9. The Complete reference HTML by Herbert Schildt
10. Learn to program HTML and CSS for beginners
11. HTML black book –Steven Holzner.

JSS MAHAVIDYAPEETHA

JSS College of Arts, Commerce & Science (Autonomous)

Ooty Road, Mysuru-25

PG Department of Physics

(Autonomous under University of Mysore, Re-accredited by NAAC with 'A' Grade
Recognised by UGC as "College with Potential for Excellence")

M.Sc. Physics

Course Structure and Syllabus

Under

Choice Based Credit Scheme (CBCS)

&

Continuous Assessment Grading Pattern (CAGP)

2021-22

JSS MAHAVIDYAPEETHA

JSS College of Arts, Commerce & Science (Autonomous),

Ooty Road, Mysuru-25

PG Department of Physics

Details of Courses offered and associated credits

Paper Code	Paper	HC/SC/ EL/OE	Credits L	T	P	Total
I Semester						
PHY101	Classical Mechanics	HC 1	3	-	-	03
PHY102	Mathematical Methods of Physics 1	HC 2	3	-	-	03
PHY103	Mathematical Methods of Physics 2	HC 3	3	-	-	03
PHY104	Classical Electrodynamics & Plasma Physics	HC 4	3	-	-	03
PHY105	Computer Lab CL-A	HC 5	-	-	2	02
PHY106/107	Electronics Lab/Optics Lab	SC 1	-	-	4	04
						18
II Semester						
PHY201	Continuum Mechanics and Relativity	HC 6	3	-	-	03
PHY202	Thermal Physics	HC 7	3	-	-	03
PHY203	Quantum Mechanics 1	HC 8	3	-	-	03
PHY204	Spectroscopy and Fourier Optics	HC 9	3	-	-	03
PHY205	Computer Lab CL-B	HC 10	-	-	2	02
PHY206/207	Optics Lab / Electronics Lab	SC 2	-	-	4	04
						18
III Semester						
PHY301	Quantum Mechanics 2	HC 11	3	-	-	03
PHY302	Condensed Matter Physics	HC 12	3	-	-	03
PHY303	Nuclear and Particle Physics	HC 13	3	-	-	03
PHY311/312	Condensed Matter Physics Lab / Nuclear and Particle Physics Lab	HC 14	-	-	4	04
Students are permitted to choose any one of the following (special paper) and corresponding practical coupled to the special paper						
PHY304	Solid State Physics 1	SC 3	3	-	-	03
PHY313	Solid State Physics Lab 1	SC 4	-	-	2	02
PHY305	Nuclear Physics 1	SC 3	3	-	-	03
PHY314	Nuclear Physics Lab 1	SC 4	-	-	2	02
PHY306	Theoretical Physics 1	SC 3	3	-	-	03
PHY315	Theoretical Physics Lab 1	SC 4	-	-	2	02
Students from other departments can register for any one of the following						
PHY321/322	Modern Physics/Energy Science	OE	3	1	-	04
						22

IV Semester						
PHY421/422	Nuclear and Particle Physics Lab/ Condensed Matter Physics Lab	HC 15	-	-	4	04
A student has to register for one particular discipline in confirmation with the corresponding SC (special paper) opted in III semester						
PHY401	Solid State Physics 2	SC 5	3	-	-	03
PHY402	Solid State Physics 3	SC 6	3	-	-	03
PHY423	Solid State Physics Lab 2	SC 7	-	-	2	02
PHY403	Nuclear Physics 2	SC 5	3	-	-	03
PHY404	Nuclear Physics 3	SC 6	3	-	-	03
PHY424	Nuclear Physics Lab 2	SC 7	-	-	2	02
PHY405	Theoretical Physics 2	SC 5	3	-	-	03
PHY406	Theoretical Physics 3	SC 6	3	-	-	03
PHY425	Theoretical Physics Lab 2	SC 7	-	-	2	02
Students are permitted to choose any one of the following (Elective papers 1)						
PHY407	Accelerator Physics	SC 8	2	-	-	02
PHY408	Liquid Crystals		2	-	-	02
PHY409	Atmospheric Physics		2	-	-	02
PHY410	Numerical Methods		2	-	-	02
Students are permitted to choose any one of the following (Elective papers 2)						
PHY411	Nuclear Spectroscopy Methods	SC 9	3	1	-	04
PHY412	Modern Optics					
PHY413	Electronics					
PHY414	Minor Project					04
						18

Semester	HC	SC	OE	Total
I Semester	14	4		18
II Semester	14	4		18
III Semester	13	5	04	22
IV Semester	04	14		18
Total	45	27	04	76

HC: Hard Core; **SC:** Soft Core; **OE:** Open Elective; **EL:** Elective; **EC:** Extra Credit;

Syllabus for the 4-Semester M.Sc., (Physics)
Choice Based Credit Scheme (CBCS)

PHY-101: Classical Mechanics

Mechanics of a system of particles: Conservation of linear and angular momenta in the absence of (net) external forces and torques using centre of mass. The energy equation and the total potential energy of a system of particles using scalar potential (**Goldstein H).**
The Lagrangean method: Constraints and their classifications. Generalized coordinates. Virtual displacement, D'Alembert's principle and Lagrangean equations of the second kind. Examples of (1) single particle in Cartesian, spherical polar and cylindrical polar coordinate systems, (2) Atwood's machine, (3) a bead sliding on a rotating wire in a force-free space and (4) Simple pendulum. Derivation of Lagrange equations from Hamilton principle **(Goldstein H).**
Central forces: Reduction of two particle equations of motion to the equivalent one-body problem, reduced mass of the system. Conservation theorems (First integrals of the motion). Equations of motion for the orbit, classification of orbits, conditions for closed orbits. The Kepler problem (inverse-square law of force) (**Aruldas G, Goldstein H, Srinivasa Rao K.N**). **[16 hours]**

Hamilton's equations: Generalised momenta. Hamilton's equations. Examples - simple harmonic oscillator, charged particle moving in an electromagnetic field. Hamiltonian for a free particle in different coordinates. Cyclic coordinates. Physical significance of the Hamiltonian function. Derivation of Hamilton's equations from a variational principle **(Goldstein H)**.
Canonical transformations: Definition, Generating functions (Four basic types). Examples of Canonical transformations*.* The harmonic Oscillator*.* Infinitesimal contact transformation. Poisson brackets; properties of Poisson brackets, angular momentum and Poisson bracket relations. Equation of motion in the Poisson bracket notation. The Hamilton-Jacobi equation; the example of the harmonic oscillator treated by the Hamilton-Jacobi method **(Goldstein H).** **[16 hours]**

Mechanics of rigid bodies: Degrees of freedom of a free rigid body. Angular momentum and kinetic energy of rigid body. Moment of inertia tensor, principal moments of inertia, products of inertia, the inertia tensor. Euler equations of motion for a rigid body. Torque free motion of a rigid body. Precession of earth's axis of rotation, Euler angles, angular velocity of a rigid body **(Goldstein H).**
Small oscillations of mechanical system: Introduction, types of equilibria, Quadratic forms of kinetic and potential energies of a system in equilibrium. General theory of small oscillations, secular equation and eigenvalue equation. Small oscillations in normal coordinates and normal modes, examples of two coupled oscillators. Vibrations of a linear triatomic molecule **(Goldstein H).** **[16 hours]**

Total work load **48 hours**

References:

1. Goldstein H., Poole C. and Safko J., Classical mechanics, 3rd Edn., Pearson Education, New Delhi. 2002
2. Upadhaya J.C., Classical mechanics, Himalaya Publishing House, Mumbai. 2006.
3. Srinivasa Rao K.N., Classical mechanics, Universities Press, Hyderabad. 2003.
4. Takwale R.G. and Puranik S., Introduction to classical mechanics, Tata McGraw, New Delhi, 1991.
5. Landau L.D. and Lifshitz E.M., Classical mechanics, 4th Edn., Pergamon Press, 1985.
6. Aruldas G., Classical Mechanics, PHI Learning Private Limited, New Delhi

PHY-102: Mathematical Methods of Physics 1

Curvilinear coordinates and Tensors: Curvilinear coordinates in the Euclidean 3-space, Orthogonal curvilinear coordinates. Differential vector operators; Grad, divergence, curl and Laplacian in arbitrary curvilinear coordinates. Circular cylindrical coordinates, spherical polar coordinates **(Arfken &Weber).**

Tensors: Tensors of rank r as a r-linear form in base vectors. Transformation rules for base vectors and tensor components. Tensor algebra, contraction, Raising and lowering of indices, Associated tensors, quotient rule. Mention of pseudo tensor, dual tensor and non-cartesian tensor. Metric tensor, Covariant and contravariant components of the metric tensor, Christoffel symbols. Tensor derivative operators, Covariant differentiation. The contracted Christoffel symbol **(Arfken &Weber).** **[16 hours]**

Differential equations, Hermite function and Laguerre functions: Partial differential equation Separation of variables - Helmholtz equations in Cartesian, circular cylindrical coordinates Spherical polar coordinates. Regular and irregular singular points of a second order ordinary differential equation. Series solution-Frobenius power series method, Examples of Harmonic oscillator and Bessel's equation. Linear dependence and independence of solutions-Wronskian. Non-homogeneous equations-Green's function, examples **(Arfken &Weber).**
Hermite functions: Hermite`s differential equation and its Solution, Hermite polynomials, Generating functions, Recurrence relations, Rodrigues representation, Orthogonality **(Arfken &Weber).**
Laguerre functions: Laguerre differential equation and its solution, Laguerre polynomials, Generating function, Recurrence relations, Rodrigues representation, Orthogonality. Associated Laguerre functions: Definition, Generating function, Recurrence relations and Orthogonalit **(Arfken &Weber).** **[16 hours]**

Special functions: Sturm - Liouville theory - Self adjoint ODE's, Hermitian operators, completeness of eigenfunction, Green's function—eigenfunction expansion (**Arfken &Weber).**

Bessel functions: Bessel functions of the first kind J_v (x), Bessel differential equation, generating function for J_v (x), Integrals for J_o (x) and J_v (x), recurrence formulae for J_v (x), orthogonal properties of Bessel polynomials **(Arfken &Weber).**

Legendre functions: Legendre differential equation, Legendre polynomials, generating functions, recurrence formulae, Rodrigues representation, Orthogonality. Associated Legendre polynomials; The differential equation, Orthogonality relation **(Arfken &Weber).**

Spherical harmonics: Definition and Orthogonality **(Arfken &Weber).** **[16 hours]**

Total work load **48 hours**

References:

1. Arfken G.B. and Weber H.J., Mathematical methods for physicists, 6th Edn., Academic Press, New York (Prism Books, Bangalore, India), 1995.
2. Harris E.G., Introduction to modern theoretical physics, Vol. 1, John Wiley, New York, 1975.
3. Srinivasa Rao K.N,, The rotation and Lorentz groups and their representations for physicists, Wiley Eastern, New Delhi, 2003.
4. Gupta B.D., Mathematical physics, 4th Edn, 2011.
5. Bali N. P., Engineering Mathematics, Laxmi Publications, New Delhi
6. Dass H. K., Higher Engineering Mathematics, S. Chand, New Delhi
7. Chattopadhay P. K., Mathematical Physics, New Age International.

PHY-103: Mathematical Methods of Physics 2

Linear vector space: Linear vector space **-** Definition. Linear dependence and independence of vectors. Dimension. Basis. Change of basis. Subspace. Isomorphism of vector spaces. Linear operators. Matrix representative of a linear operator in a given basis. Effect of change of basis. Invariant subspace. Eigenvalues and eigenvectors. Characteristic equation. The Schur canonical form. Diagonalization of a normal matrix. Schur's theorm **(Arfken &Weber).** **[16 hours]**

Linear representations of groups: Groups of regular matrices; the general linear groups *GL (n, C)* and *GL (n, R)*. The special linear groups *SL (n, C)* and *SL(n, R).* The unitary groups *U (n)* and *SU(n).* The orthogonal groups *O(n, C), O (n, R), SO(n, C)* and *SO(n, R).* Homogeneous Lorentz group (**Arfken &Weber).**
Rotation group: The matrix exponential function-Definition and properties. Rotation matrix in terms of axis and angle. Eigenvalues of a rotation matrix. Euler resolution of a rotation. Definition of a representation. Equivalence. Reducible and irreducible representations. Schur's lemma. Construction of the $D^{1/2}$ and D^{1} representation of *SO (3)* by exponentiation. Mention of the D^{j} irreps *SO (3).*
(Srinivasa Rao K.N). **[16 hours]**

Fourier transforms and Integral equations: General properties, completeness, use of Fourier series. Applications of Fourier series **(Arfken &Weber).**

Integral transforms; Development of Fourier Integral, Fourier transform - inversion theorem, Fourier transform of derivatives, convolution theorem. Momentum representation (**Arfken &Weber).**

Integral equations: Definitions, transformation of a differential equation into an integral equation, Integral transforms, generating functions, Abel's equation, Neumann series, separable kernels, Numerical solution, non-homogeneous integral equations **(Arfken &Weber).** **[16 hours]**

Total work load **48 hours**

References:

1. Shankar R., Principles of quantum mechanics, 2nd Edn., Plenum Press, New York, 1984.
2. Srinivasa Rao K.N., The rotation and Lorentz groups and their representations for Physicists, Wiley Eastern, New Delhi, 1988.
3. Arfken G.B. and Weber H.J., Mathematical methods for Physicists, 5th. Edn., Academic Press, New York, 2001.
4. Gupta B.D., Mathematical Physics, 4th Edn. (Page no. 8.48–8.83, 8.16-8.48) 2011
5. Bali N. P., Engineering Mathematics, Laxmi Publications, New Delhi
6. Dass H. K., Higher Engineering Mathematics, S. Chand Publications, New Delhi
7. Charlie Harper, Introduction to Mathematical Physics, PHI Publications, 2008.

PHY-104: Classical Electrodynamics, Plasma Physics and Optics

Electric multipole moments: The electric dipole and multipole moments of a system of charges. Multipole expansion of the scalar potential of an arbitrary charge distribution **(Griffiths D.J).**

Potential formulation: Maxwell equations in terms of electromagnetic potentials. Gauge transformations. The Lorentz, Coulomb and radiation gauges **(Griffiths D.J).**

Fields of moving charges and radiation: The retarded potentials. The Lienard-Wiechert potentials. Fields due to an arbitrarily moving point charge; the special case of a charge moving with constant velocity **(Griffiths D.J).**

Radiating systems: Radiation from an oscillating dipole. Power radiated by a point charges - Larmor formula. Lienard's generalisation of Larmor formula. Energy loss in bremsstrahlung and linear accelerators. Radiation reaction - Abraham-Lorentz formula **(Griffiths D.J)** **[16 hours].**

Relativistic electrodynamics: Charge and fields as observed in different frames. Covariant formulation of electrodynamics; Electromagnetic field tensor, Transformation of fields, Field due to a point charge in uniform motion. Lagrangian formulation of the motion of charged particle in an electromagnetic field **(Griffiths D.J).**

Plasma Physics: Quasineutrality of a plasma, plasma behaviour in magnetic fields, Plasma as a conducting fluid. Magnetohydrodynamics; magnetic confinement, Pinch effect, instabilities, Plasma waves.
(Laud B. B.). **[16 hours]**

Electromagnetic waves: Monochromatic plane waves - velocity, phase and polarization. Propagation of plane electromagnetic waves in (1) conducting media and (2) ionised gases. Reflection and refraction of electromagnetic waves; Fresnel formulae for parallel and perpendicular components. Brewster`s law. Normal and anomalous dispersion; Clausius-Mossotti relation **(Born M. and Wolf E).**

Interference: General theory of interference of two monochromatic waves. Two beam and Multiple beam interference with a plane-parallel plate. Fabry-Perot interferometer; etalon construction, resolving power and its application. Interference filters **(Born M. and Wolf E).**

Diffraction: Integral theorem of Helmholtz and Kirchhoff. Fresnel-Kirchhoff diffraction formula; conditions for Fraunhofer and Fresnel diffraction. Fraunhofer diffraction due to a circular aperture.
(Born M. and Wolf E) **[16 hours]**

Total work load **48 hours**

References:

1. Griffiths D.J., Introduction to Electrodynamics, 5th Edn., Prentice-Hall of India, New Delhi, 2006.
2. Jackson J.D., Classical Electrodynamics, 2nd Edn., Wiley-Eastern Ltd, India, 1998.
3. Born M. and Wolf E., Principles of Optics, 6th Edn., Pergamon Press, Oxford, 1980.
4. Matveev A.N., Optics, Mir Publishers, Moscow, 1988.
5. Laud B.B., Electromagnetics, Wiley Eastern Limited, India, 2000.
6. Hecht E., Optics, Addison-Wesley, 2002.
7. Lipson S.G., Lipson H. & Tannhauser D.S., Optical physics, Cambridge University Press, USA, 1995.
8. Ajoy Ghatak, Optics, Tata McGraw – Hill, New Delhi
9. Gupta A. B. Modern Optics, Books and Allied (P) Ltd, Kolkata
10. Sen S .N., Plasma Physics, Pragathi Prakasan

PHY-105: Computer Lab CL-A

- Linux operating system basics (4 sessions) :
  Login procedure; creating, deleting directories; copy, delete, renaming files; absolute and relative paths; Permissions—setting, changing; Using text editor.
- Scientific text processing with LATEX.
  Typeset text using text effects, special symbols, lists, table, mathematics and including figures in documents.
- Using the plotting program GNUPLOT (2 sessions) :
  Plotting commands; To plot data from an experiment and applying least-squares fit to the data points. Including a plot in a LATEX file.
- Using the mathematics package OCTAVE (2 sessions), To compute functions, matrices, eigenvalues, inverse, roots.

Total work load: 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-106: Electronics Lab

Any ten of the following experiments:

1. Regulated power supply.
2. Active filters : low pass (single pole).
3. Active filters : high pass (double pole).
4. Voltage follower.
5. Colpitts' oscillator.
6. Opamp as an integrator and differentiator.
7. Opamp as a summing and log amplifier.
8. Opamp as an inverting and non-inverting amplifier.
9. Coder and encoder.
10. Half adder and full adder.
11. Boolean algebra-Logic gates.
12. Opamp astable multivibrator.

Total work load: 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-107: Optics Lab

Any ten of the following experiments:

1. Verification of the Brewster law of polarisation.
2. Verification of Fresnel laws of reflection from a plane dielectric surface.
3. Determination of the inversion temperature of the copper-iron thermocouple.
4. Birefringence of mica by using the Babinet compensator.
5. Birefringence of mica by using the quarter-wave plate.
6. Experiments with the Michelson interferometer.
7. Determination of the refractive index of air by Jamin interferometer.
8. Determination of the size of lycopodium spores by the method of diffraction haloes.
9. Determination of wavelength by using the Fabry-Perot etalon.
10. Dispersion of the birefringence of quartz.
11. The Franck-Hertz experiment.
12. Experiments with the laser.
13. Determination of the Stokes vector of a partially polarised light beam
14. Determination of the modes of vibration of a fixed-free bar.

Total work load: 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-201: Continuum Mechanics and Relativity

Continuum mechanics of solid media: Small deformations of an elastic solid; the strain tensor. The stress tensor. Equations of equilibrium. The symmetry of the stress tensor. The generalised Hooke`s law for a homogeneous elastic medium; the elastic modulus tensor. Navier equations of motion for a homogeneous isotropic medium. **(Landau L.D. and Lifshitz)**

Fluid mechanics: Equation of continuity. Flow of a viscous fluid; Navier-Stokes equation and its solution for the case of flow through a cylindrical pipe. The Poiseuille formula **(Landau L.D. and Lifshitz).**

[16 hours]

Minkowski space-time: Real coordinates in Minkowski space-time. Definition of 4-tensors. The Minkowski scalar product and the Minkowski metric η_{ij} = diag (1 -1 -1 -1). Orthogonality of 4-vectors. Raising and lowering of 4-tensor indices. Time like, null and space like vectors and world-lines. The light-cone at an event **(Griffiths).**

Relativistic mechanics of a material particle: The proper-time interval $d\tau$ along the world - line of a material particle. The instantaneous (inertial) rest-frame of a material particle; Components of 4-velocity, 4-acceleration and 4-momentum vector, statement of second law of Newton. Determination of the fourth component F_4 of the 4-force along the world-line of the particle. Motion of a particle under the conservative 3-force field and the energy integral. The rest energy and the relativistic kinetic energy of a particle. **[16 hours]**

Einstein's equations: The Principle of Equivalence and general covariance. Inertial mass, gravitational mass, Eötvös experiment. Gravitation as space-time curvature. Einstein Gravitational field equations and its Newtonian limits.

The Schwarzschild metric: Heuristic derivation of the Schwarzschild line element. Motion of particles and light rays in the Schwarzschild field. Explanation of the (1) perihelion advance of planet Mercury, (2) gravitational red shift and (3) gravitational bending of light. A brief discussion of the Schwarzschild singularity and the Schwarzschild black hole. **[16 hours]**

Total work load **48 hours**

References:

1. Landau L.D. and Lifshitz E.M., Fluid Mechanics, Pergamon Press, 1987.
2. Landau L.D. and Lifshitz E.M., Theory of Elasticity, Pergamon Press, 1987.
3. Synge J.L., Relativity: The Special Theory, North-Holland, 1972.
4. Landau L.D. and Lifshitz E.M., The Classical Theory of Fields, 4th Edn., (Sections 1 to 6, 16 to 18, 23 to 25, 26 to 35), Pergamon Press, Oxford, 1985.
5. Wald R.M., General relativity, The University of Chicago Press, Chicago, 1984.
6. Schutz B.F., A first course in general relativity, Cambridge University Press, Cambridge, 1985.
7. Bergman P., Introduction to theory of relativity, Prentice-Hall of India, 1969.
8. Rindler R., Relativity: Special, general and cosmological, Oxford University Press, 2006.
9. Narlikar J. V., An introduction to Cosmology, Cambridge Publications
10. Somnath Datta, Introduction to Special theory of Relativity, Allied Publishers, India, 1998
11. Griffiths D. J. Introduction to Electrodynamics, Pearson Publications, 2013.

PHY-202: Thermal Physics

Thermodynamics Preliminaries: Zeroth law of thermodynamics, vander Walls equation of state second law of thermodynamics **(Huang K., Laud B.B, Satya Prakash).**

Entropy: Change in entropy for reversible an irreversible process, entropy and second law of thermodynamics, thermodynamic functions and Maxwell's relations ***TdS*** equations, heat capacities equations, third law of thermodynamics. Irreversible thermodynamics; Onsager's reciprocal relation **(Huang K., Laud B.B, Satya Prakash).**

Phase equilibria; Equilibrium conditions. Classification of phase transitions; phase diagrams; Clausius-Clapeyron equation, applications. Thermoelectric phenomenon, Peltier effect, Seebeck effect, Thompson effect. Systems far from equilibrium **(Huang K., Laud B.B, Satya Prakash).** **[16 hours]**

Classical Statistical Mechanics: Probability, phase space, division of phase space, ensembles, density distribution in phase space, ergodic hypotheses, Liouville theorem. Statistical equilibrium, postulate of equal *a priori* probability, general expression for probability, Stirlings formula, the most probable distribution, Maxwell Boltzmann distribution law, law of equipartition of energy. Entropy and probability. Microcanonical ensemble, connection between statistical and thermodynamic quantities, Partition function of system of particles, Gibbs paradox, canonical ensemble, perfect monoatmic gas in canonical ensemble, grand canonical ensemble. Vibrational partition function of diatomic molecules (Einstein relations), Rotational partition function of diatomic molecule **(Huang K., Laud B.B, Satya Prakash).**
[16 hours]

Quantum Statistical Mechanics: The postulates of quantum statistical mechanics. Symmetry of wave functions. The Liouville theorem in quantum statistical mechanics; condition for statistical equilibrium; Ensembles in quantum mechanics; the quantum distribution functions (BE and FD), the Boltzmann limit of Boson and Fermion gases, the derivation of the corresponding distribution functions.

Applications of Quantum Statistics: Equation of state of an ideal Fermi gas (derivation not expected), Application of Fermi-Dirac statistics to the theory of free electrons in metals, degeneracy. Application of Bose statistics to the photon gas, derivation of Planck's law, comments on the rest mass of photons. Thermodynamics of Black body radiation. Bose-Einstein condensation **(Huang, Laud, Satya Prakash).**
[16 hours]

Total work load **48 hours**

References:

1. Agarwal B.K. and Eisner M., Statistical mechanics, New Age International Publishers, 2000.
2. Roy S.K., Thermal physics and statistical mechanics, New Age International Pub., 2000.
3. Huang K., Statistical mechanics, Wiley-Eastern, 1975.
4. Laud B.B., Fundamentals of statistical mechanics, New Age International Pub.,2000.
5. Schroeder D.V., An introduction to thermal physics, Pearson Education New Delhi, 2008.
6. Salinas S.R.A., Introduction to statistical physics, Springer, 2004.
7. Mark W Zemansky Heat and Thermodynamics, McGraw – Hill
8. Gupta A. B and Roy H. B., Thermal Physics Books and Allied (P) Ltd, Kolkata
9. Satya Prakash, Statistical Mechanics, Kedarnath Ramnath, 2017.
10. Mike Glazer, J.S. Wark, Statistical Mechanics: A Survival Guide, Oxford Publications, 2001.

PHY-203: Quantum Mechanics 1

The wave function and uncertainty Principle: Wave particle duality, interpretation of the wave function, wave functions for particles having definite momentum, wave packet, Gaussian wave packet. Heisenberg uncertainty principle.

Time independent Schrodinger equation, conservation of probability, expectation values and operators, the Ehrenfest theorem, Time dependent Schrodinger equation, stationary states. Energy quantisation. Properties of energy eigenfunction, general solutions of time dependent Schrodinger equation for a time independent potential. Schrodinger equation in momentum space **(Bransden & Joachain).** **[16 hours]**

Formalism: Hilbert space. The state of a system, Dirac notation. Dynamical variables and operators – Hermitian operators, adjoint operator, projection operators. Inverse and unitary operators. Expansion in eigenfunctions - eigenvalue and eigenfunction of an operator. Commutator algebra. General Uncertainty relation. Unitary transformation, Representation in discrete basis; Matrix representation of wave functions and operators. Change of representation and Unitary transformations. Matrix representation of eigenvalue problem. Representation in continuous bases. The Schrödinger equation and time evolution of a system. The Schrödinger picture and Heisenberg picture.

Schrodinger equation in one dimension: The free particle, the potential step, potential barrier, infinite square well, finite square well, the linear harmonic oscillator (Algebraic and Analytic method), the periodic potential **[Bransden and Joachain, Nouredine Zettili].** **[16 hours]**

Angular Momentum: Orbital angular momentum; Orbital angular momentum and spatial rotations, eigenvalues and eigenfunctions of $\mathbf{L}^2$ and $\boldsymbol{L_z}$. Particle on a sphere and the rigid rotator. General angular momentum. The spectrum of $\mathbf{J}^2$ and $\boldsymbol{J_z}$. Matrix representation of angular momentum operators, spin angular momentum, spin one-half, total angular momentum. Addition of angular momenta - CG Coefficients.

Schrodinger equation in three dimensions: Separation of the Schrodinger equation in Cartesian coordinates -the free particle. Central potential. Separation of the Schrodinger equation in spherical polar coordinates; the Hydrogenic atom and its solutions **(Bransden & Joachain).** **[16 hours]**

Total work load **48 hours**

References:

1. Nouredine Zettili, Quantum Mechanics, WILEY Publications, U K 2009
2. Griffiths D.J., Introduction to quantum mechanics, Prentice-Hall, USA, 1994.
3. Bransden & Joachain, 2004, II edition, Pearson Low Price Edition
4. Sakurai J.J. and Tuan S.F. (Editor), Modern quantum mechanics, AddisonWesley, India, 1999.
5. Shankar R., Principles of quantum mechanics, 2nd Edn., Plenum Press, New York, 1984.
6. Schiff L.I., Quantum mechanics, 3rd. Edn., McGraw-Hill, Kogakusha Ltd., New Delhi, 1968.
7. Aruldas G., Quantum Mechanics, PHI, New Delhi
8. Mathews P. M. and Venkatesan K., Quantum mechanics, Tata - McGraw-Hill, New Delhi
9. Verma H. C., Quantum Physics, Surya Publications, Ghaziabad
10. Merzbacher E., Quantum Mechanics, III edition, Wiley publication.

PHY-204: Spectroscopy and Fourier Optics

Atomic spectroscopy: vector model of atom- orbital magnetic moment , Larmor precession, electron spin, coupling of orbital and spin angular momenta. Spectroscpic terms and their notations, spin-orbit interaction, quantum mechanical relativistic correction. Fine structure of hydrogen, Lamb shift. L-S and J-J coupling. Lande interval rule, selection rules.

Zeeman effect, Examples **1**) $^2D_{3/2} - {}^2P_{1/2}$ **2)** $^2D_{5/2} - {}^2P_{3/2}$ **3)** $^3P - {}^2S$.

Anomalous Zeeman effect, Lande-g factor, Paschen-Back effect – spin-orbit correction. Stark effect – weak field effects and strong field effects. Hyperfine structure of spectral lines. Nuclear spin and hyperfine splitting, intensity ratio and determination of nuclear spin. Breadth of spectral lines, natural breadth. Doppler Effect and external effect **(Rajkumar).** **[16 hours]**

Nuclear magnetic resonance: Quantum mechanical expression for the resonance condition. Relaxation Mechanisms; Expression for spin lattice relaxation. Chemical shift; spin-spin interaction, example of ethyl alcohol. Fourier transform technique in NMR. FTNMR spectrometer and experimental procedure. NMR in medicine.

Microwave spectroscopy: The classification of molecules. The rotational spectra of rigid diatomic rotator, the spectra of non-rigid diatomic rotator, example of HF. Microwave oven.

Infrared spectroscopy: The Born-Oppenheimer approximation. Vibrational energy of diatomic molecule. Anharmonic oscillator. Diatomic vibrating rotator, example of the CO molecule. The vibrations of polyatomic molecules; skeletal and group frequencies. Experimental technique in FTIR.

Raman spectroscopy: The quantum theory of Raman effect. Pure rotational Raman spectra of linear molecules and symmetric top molecules. Vibrational Raman spectra. Rotational fine structure. Instrumentation technique in Raman spectroscopy **(Banwell C.N. and McCash E.M and Aruldas).**
[16 hours]

Fourier optics: Spatial frequency filter; effect of a thin lens on an incident field distribution. Lens as a Fourier transforming element. Application to phase contrast microscopy. **(Hecht)**

Propagation of light in an anisotropic medium: Structure of a plane electromagnetic wave in an anisotropic medium. Dielectric tensor. Fresnel's formulae for the light propagation in crystals. Ellipsoid of wave normals and ray normals. Normal surface and ray surface. Optical classification of crystals. Light propagation in uniaxial and biaxial crystals. Refraction in crystals. **(Born M. and Wolf E.)**

Elements of Nonlinear Optics: Second harmonic generation, optical rectification and phase matching; third harmonic generation **(Lipson, Srivatsava).** **[16 hours]**

Total work load **48 hours**

References:

1. Tralli N. and Pomilla P.R., Atomic theory, McGraw-Hill, New York, 1999.
2. Banwell C.N. and McCash E.M., Fundamentals of Molecular Spectroscopy, 4th Edn., Tata McGraw-Hill, New Delhi, 1995.
3. Mahan B.H., University Chemistry, 3rd Edn. (Chapters 3, 10, 11 and 12), Narosa, New Delhi, 1975.
4. Hecht E., Optics, Addison-Wesley, 2002.
5. Lipson S.G., Lipson H. and Tannhauser D.S., Optical physics, Cambridge University Press, USA, 1995.
6. Rajkumar, Atomic and molecular spectra:Laser, Kedarnath Ramanath Publications, Meerut.
7. Born M. and Wolf E., Principles of optics, 6th Edn., Pergamon Press, Oxford, 1980
8. Srivatsava, P K Optics, CBS Publisher & Distributors I Ediition, 2011

PHY-205: Computer Lab CL-B

Programming in C

- Check whether given number is odd or even.
- Find the largest and smallest number in the input set.
- Compute the Fibonacci sequence.
- Check whether the input number is prime or not.
- Compute the roots of a quadratic equation.
- Generate Pascal's triangle.
- To add two *m X n* matrices.
- To find the sum and average of a data stored in a file.
- Linear least-squares fitting to data in a file.
- To find the trajectory of a projectile shot with an initial velocity at an angle. Also, find the maximum height travelled and distance travelled. Write the trajectory data to a file specified and plot using Gnuplot.

Programming in Perl

- Searching for a pattern in a string.
- Counting the number of characters, words and lines in a given file.
- Sorting strings.
- Check whether the input number is prime or not.
- Compute the roots of a quadratic equation.
- Linear least squares fitting to data in a file.

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-206: Optics Lab

For those who have completed PHY-106

Any ten of the following experiments:

1. Verification of the Brewster law of polarisation.
2. Verification of Fresnel laws of reflection from a plane dielectric surface.
3. Determination of the inversion temperature of the copper-iron thermocouple.
4. Birefringence of mica by using the Babinet compensator.
5. Birefringence of mica by using the quarter-wave plate.
6. Experiments with the Michelson interferometer.
7. Determination of the refractive index of air by Jamin interferometer.
8. Determination of the size of lycopodium spores by the method of diffraction haloes.
9. Determination of wavelength by using the Fabry-Perot etalon.
10. Dispersion of the birefringence of quartz.
11. The Franck-Hertz experiment.
12. Experiments with the laser.
13. Determination of the Stokes vector of a partially polarised light beam
14. Determination of the modes of vibration of a fixed-free bar.

Total work load : 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-207: Electronics Lab

For those who have completed PHY-107

Any ten of the following experiments:

1. Regulated power supply.
2. Active filters : low pass (single pole).
3. Active filters : high pass (double pole).
4. Voltage follower.
5. Colpitts' oscillator.
6. Op-amp as an integrator and differentiator.
7. Op-amp as a summing and log amplifier.
8. Op-amp as an inverting and non-inverting amplifier.
9. Coder and encoder.
10. Half adder and full adder.
11. Boolean algebra-Logic gates.
12. Op-amp astable multivibrator.

Total work load : 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-301: Quantum Mechanics 2

The time-independent perturbation theory: Nondegenerate Perturbation Theory; first and second order perturbation, Perturbed Harmonic Oscillator. Degenerate Perturbation Theory; Fine Structure of Hydrogen, The Zeeman Effect.

The Variational Principle: Theory, the Ground State of Helium.

WKB Approximation: The Classical Region, Tunneling; connection formulae, α-particle decay **(Griffiths).**
[16 hours]

Time-dependent perturbation theory: Time dependent perturbation theory; general features, constant and periodic perturbations. Two-Level Systems; Emission and Absorption of Radiations, Spontaneous Emission, Fermi golden rule, Rabi Oscillations**.**

Adiabatic approximation - The Adiabatic Theorem, Berry's Phase. Sudden approximation.

Scattering: Introduction, scattering cross section, scattering by a spherically symmetric potential. Partial Wave Analysis, phase shifts. Optical theorem, Lippmann- Schwinger equation. Born Approximation, Rutherford scattering **(Griffiths D J)**. **[16 hours]**

Relativistic quantum mechanics: Klein-Gordon equation: free particle, stationary state solutions, continuity equation. The Dirac equation; free-particle, stationary state solutions, continuity equation. Covariant formulation; Covariant form of Dirac equation, Lorentz invariance of the Dirac equation, Plane wave solutions of the Dirac equation -non-relativistic limit. Spin and helicity operators. Normalization of the solutions. Brief discussion of the hydrogen atom according to Dirac theory, Non-relativistic limit of Dirac equation. Negative energy states - Hole theory **(Sakurai J J).** **[16 hours]**

Total work load **48 hours**

References:

1. Bransden and Joachain, II edition, Pearson Low Price Edition
2. Sakurai J.J. and Tuan S.F. (Editor), Modern Quantum Mechanics, AddisonWesley, India, 1999.
3. Shankar R., Principles of Quantum Mechanics, 2nd Edn., Plenum Press, New York, 1984.
4. Schiff L.I., Quantum mechanics, 3rd. Edn., McGraw-Hill, Kogakusha Ltd., New Delhi, 1968.
5. Griffiths D.J., Introduction to Quantum mechanics, Prentice-Hall, USA, 1994.
6. Sakurai J.J., Advanced quantum mechanics, Addison-Wesley, Harlow, England, 1999.
7. Griffiths D., Introduction to Elementary particles, John Wiley and Sons, New York, 1987.
8. Gasiorowicz S., Elementary Particle Physics, John-Wiley, New York, 1966.
9. Muirhead H., The Physics of Elementary Particles, Pergamon Press, London, 1965.

PHY-302: Condensed Matter Physics

X-ray crystallography: Crystalline state. Reference axes, equation of a plane, Miller indices. External symmetry of crystals; symmetry operations. Two and three dimensional point groups. Lattices; two dimensional lattices, choice of unit cell. **(Buerger, p12–20, 23–45).**
Three-dimensional lattices; crystal systems and Bravais lattices. Screw and glide operations. Space groups; Examples of space groups. Diffraction of X rays by crystals; Laue equations. Reciprocal lattice. [**Sherwood, p272–288**]. Bragg equation. Equivalence of Laue and Bragg equations. Significance of structure of solid for applications (**Ladd and Palmer, p55–66, p114-121)**.

Atomic scattering factor (qualitative).

Electron and neutron diffraction: Basic principles. Differences between electron, neutron and X-ray diffractions, applications (qualitative). **(Vainshtein, p 336 – 357).**

Crystal growth techniques: General methods of crystl growth. Czochralski, Kyropoulus, Stockbarger-Bridgman. Zone refining techniques **(Rose et al p 146 – 154).** **[16 hours]**

Disordered materials: Amorphous solids. Aperiodic materials.
Liquid crystals: Introduction, Classification and their applications. Morphology. The smectic (A-H), nematic and cholesteric phases (**DeGennes P.G. and Prost J, Gray and Goodby).**

Crystal lattice dynamics: Vibration of an infinite one-dimensional monoatomic lattice, First Brillouin Zone. Group velocity. Finite lattice and boundary conditions. Vibrations of a linear diatomic lattice; optical and acoustical branches, dispersion relations**. (Wahab, p288–305).**

Magnetic properties of solids: Diamagnetism and its origin. Expression for diamagnetic susceptibility. Paramagnetism; Quantum theory of paramagnetism, Brillouin function. Ferromagnetism; Curie-Weiss law, Spontaneous magnetisation and its variation with temperature. Ferromagnetic domains. Antiferromagnetism. Two sub-lattice model. Susceptibility below and above Neel's temperature.
(Dekker, p446–490). **[16 hours]**

Superconductivity: Experimental facts. Type I and type II superconductors. Phenomenalogical theory. London equations. Meissner effect. High frequency behaviour. Thermodynamics of superconductors; Entropy and Specific heat. Qualitative ideas of the theory of superconductivity. **(Kittel, p333–364).**

Semiconductors: Elemental and compound Semiconductors [Streetman, p61–95]. Crystal structure and bonding. Expressions for carrier concentrations. Fermi energy, electrical conductivity and energy gap in intrinsic semiconductors. Extrinsic Semiconductors; impurity states and ionization energy of donors. Carrier concentrations and their temperature variation **(Mckelvey, p256–277).** **[16 hours]**

Total work load **48 hours**

References:

1. Stout G.H. and Jensen L.H., X-ray structure determination, MacMillan, USA, 1989.
2. Ladd M.F.C. and Palmer R.A., Structure determination by X-ray crystallography, Plenum Press, USA, 2003.
3. Buerger M.J., Elementary crystallography, Academic Press, London.
4. Dekker A.J., Solid state physics, Prentice Hall, 1985.
5. Kittel C., Introduction to solid state physics, 7th Edn., John Wiley, New York, 1996.
6. Mckelvey J.P., Solid state and semiconductor physics, 2nd Edn., Harper and Row, USA, 1966.
7. Streetman B.G., Solid state electronic devices, 2nd Edn., Prentice-Hall of India, New Delhi, 1983.
8. DeGennes P.G. and Prost J.,The physics of liquid crystals, 2nd Edn., Clarendon Press, Oxford, 1998.
9. Wahab M.A., Solid state physics, Narosa Publishing House, New Delhi, 1999.
10. Azaroff L.V., Introduction to solids, McGraw-Hill Inc, USA, 1960.
11. Sherwood D., Crystals, X-rays and proteins, Longman, UK, 1976.
12. Rose R.M., Shepard L.A. and Wulff J., The structure and properties of materials Vol. 4, Electronic properties, Wiley Eastern, 1965.
13. Vainshtein B.K., Modern crystallography, Vol. I, Springer-Verlag, Germany, 1981.
14. Pillai S.O., Solid state physics, New Age International Publications, 2002.

PHY-303: Nuclear and Particle Physics

Properties of the Nucleus: Nuclear radius; determination by mirror nuclei, Mesic X-rays and electron scattering methods. Nuclear moments; spin, magnetic dipole moment. Relation between J and μ on the basis of single particle model. Determination of nuclear magnetic moment by Molecular beam experiment. Electric quadrupole moment – reduced Electric quadrupole moment **.**

Nuclear Models: Liquid drop model; Weissacker's formula and its application to (1) stability of isobars and (2) fission process. Shell model; Infinite square well potential, Magic numbers. Fermi gas model; well depth, level density and nuclear evaporation.

Nuclear reactions: Q-values, threshold energy. Reactions induced by proton, deuteron and particles. Photodisintegration **(Krane & Tayal)**. **[16 hours]**

Nuclear decay modes: Beta decay; Beta ray spectrum, Pauli neutrino hypothesis, mass of the neutrino from beta ray spectral shape, Fermi theory of beta decay, Kurie plot, ft- values and forbidden transitions. Methods of excitation of nuclei; Nuclear isomerism, Mossbauer effect (qualitative only), Auger effect.

Interaction of nuclear radiation with matter: Energy loss due to ionization for proton -like charged particles, Bethe-Bloch formula, Range energy relations. Ionisation and Radiation loss of fast electrons (Bremsstrahlung - qualitative only). Interaction of gamma and X-rays with matter. Detectors; Brief description of NaI (Tl) gamma ray spectrometer. Boron triflouride counter**.**

Nuclear reactors: Condition for controlled chain reactions, slowing down of neutrons, logarithmic decrement in energy. Homogeneous spherical reactor; critical size, effect of reflectors.
Breeder reactor (Qualitative discussion) **(Krane & Tayal)**. **[16 hours]**

Nuclear forces and elementary particles: General features of nuclear force; spin dependence, charge independence, exchange character, saturation other features. Meson theory of nuclear forces; Yukawa's theory. Properties of pi mesons; charge, mass, spin, isospin and parity, decay modes, meson resonances.

Particle interactions and families: Conservation laws; classification of fundamental forces and elementary particles. Associated particle production, Gellmann-Nishijima scheme, strange particles. CP violations in Kaon decay. Symmetries; Eight-fold way symmetry, quarks and gluons. Elementary ideas of the Standard model **(Griffiths D J).** **[16 hours]**

Total work load **48 hours**

References

1. Tayal D.C., Nuclear Physics, Himalaya Publishing House, New Delhi, 2012 (Unit 1. Chapter Page 6-14. Page 30- 35, 40-49. Chapter 9. Page 355-369. Chapter 10. Page 401-411.)
2. Krane K.S., Introductory nuclear physics, Wiley, New York, 1987.
   (Unit 1. Chapter 16 page 605-610.)
3. Ghoshal S.N., Nuclear physics, S.Chand and Company, Delhi, 1994. (Unit 2: Chapter 5 page 137-155, Chapter 6 page 187-204, 222, 262, Chapter 13, page 647-651, chapter 15, page 717-721.)
4. Wong S.S.M., Introductory nuclear physics, Prentice Hall of India, Delhi, 1998.
5. Khanna M.P., Introduction to particle physics, Prentice Hall of India, Delhi, 2008.
6. Kapoor S.S. and Ramamoorthy V., Nuclear radiation detectors, Wiley Eastern, Bangalore,2007

PHY-304: Solid State Physics 1

Dielectric properties of solids: Macroscopic description of static dielectric constant, the static electronic and ionic polarisabilities of molecules, orientation polarization. Local electric field at an atom; Lorentz field, field of dipoles inside cavity. The static dielectric constant of solids; Clausius- Mossotti relation. Complex dielectric constant. Polarization catastrophe. Dielectric losses and Debye relaxation time. Classical theory of electronic polarization and optical absorption.

Ferroelectricity: Basic properties and classification of ferroelectric materials. The dipole theory of ferroelectricity, objections against the dipole theory. Ionic displacements and behavior of Barium titanate above the Curie temperature. Theory of spontaneous polarization of Barium titanate. Thermodynamics of ferroelectric transitions. Landau theory of phase transitions, Dielectric constant near the Curie point. Ferroelectric domain **(Dekker and Kittel).** **[16 hours]**

Magnetic properties: Definition of magnetization and susceptibility. Hund`s rule; calculation of L, S and J for 3d and 4f shells. Setting up of Hamiltonian for an atom in an external magnetic field; explanation of diamagnetism, Van Vleck Paramagnetism and quantum theory of paramagnetism **(Ashcroft & Mermin).** Interpretation of the Weiss field in terms of exchange integral **(Dekker p473-474,).** Calculation of the singlet triplet splitting, spin Hamiltonian and Heisenberg model **(Ashcroft and Mermin).**

Zero-temperature properties: Ground state of the Heisenberg ferromagnet. First excitation of one dimensional ferromagnetism at zero-temperature; spin waves, anti-ferromagnetism. Low-temperature behaviour of ferromagnets; Bloch's $T^{3/2}$ law **(Ashcroft and Mermin, Kittel).**

Magnetic resonance: Phenomenological description, Relaxation mechanisms, Derivation of Casimir Durpe relation. Nuclear Magnetic moments, condition for resonance absorption, setting up of Bloch's equations, solutions for steady state and weak RF field. Expression for power absorption, change of inductance near resonance. Dipolar line width in a rigid lattice **(Dekker p498-512).** **[16 hours]**

Band theory of solids: Statement and proof of Bloch theorem; periodic potentials in solids. Reciprocal lattice, periodic boundary conditions, density of states. Construction of Brillouin zones for a square lattice. Nearly free electron model and solution at the boundary. Energy gap using nearly free electron model. Tightly bound electron approximation, application to SC , BCC and FCC lattices (**Dekker**).

Superconductivity: BCS theory; Cooper pairs, Energy gap, Meissner effect. Flux quantization. Theory for DC and AC bias; Josephson tunnelling, Josephson junction. High T_c superconductors **(Ibach and Luth).**

Elastic constants of crystals: Elastic strains and stresses. Elastic compliance and stiffness constants, applications to cubic crystals and isotropic solids. Elastic waves and experimental determination of elastic constants **(Kittel).** **[16 hours]**

Total work load **48 hours**

References:

1. Dekker A.J., Solid state physics, Prentice Hall, 1985.
2. Kittel C., Introduction to solid state physics, 7th Edn., John Wiley, New York, 1996.
3. Ashcroft N.W. and Mermin N.D., Solid State Physics, Saunders College Publishing, 1996.
4. Ibach H. and Luth H., Solid State Physics Narosa, New Delhi, 1996.
5. Pillai S.O., Solid state physics, New Age International Publications, 2002.
6. Wahab M.A., Solid state physics, Narosa Publishing House, New Delhi, 1999.

PHY-305: Nuclear Physics 1

Nuclear detectors: Scintillation processes in inorganic crystals (NaI(Tl)). Semiconductor detector - Diffused junction, Surface barrier and Lithium drifted detectors. Relation between applied voltage and depletion layer thickness in junction detectors, Hyper pure germanium detectors, Cerenkov detectors.

Nuclear pulse techniques: Preamplifier circuits; charge sensitive and voltage sensitive preamplifiers.
Linear pulse amplifiers; Linearity, stability, pulse shaping, pulse stretching.
Operational amplifiers; analog to digital converters. Scalars, Schmidt trigger as a pulse discriminator, Single channel analyser; Integral and differential discriminators.
Multichannel Analysers, memory devices and online data processing. **[16 hours]**

Shell model: Motion in a mean potential, Square well and simple harmonic oscillator potential well, spin orbit interaction and Magic numbers. Extreme single particle model, Ground state properties of nuclei based on shell model. Nordhiem's Rules.

Collective model: Evidences for collective motion. Nuclear rotational motion; Rotational energy spectrum and nuclear wave functions for even-even nuclei. Odd- A nuclei energy spectrum and wave function.

Nilsson model: Nilsson diagrams.

Many body self-consistent models: Hartree-Fock model. **(Hans H.S)** **[16 hours]**

Timing spectroscopy: Coincidence and anti-coincidence circuits. Delay circuits. Time to amplitude conversion; start-stop and overlap converters.

Gamma ray spectroscopy: Life time measurements. Gamma-gamma, beta-gamma angular correlation studies. Angular distribution of gamma rays from oriented nuclei. Polarization of gamma rays. **[16 hours]**

Total work load **48 hours**

References:

1. Mermier P. and Sheldon E., Physics of the nuclei and particles, Vol. 1 and 2, Academic Press, New York 1970.
2. Segre E., Nuclei and particles, Benjamin Inc, New York, 1977.
3. Arya A.P., Fundamentals of nuclear physics, Allyn and Bacon, USA, 1968.
4. Blatt J.M. and Weisskopf V.F., Theoretical nuclear physics, Wiley and Sons, New York, 1991.
5. Siegbahn K., The alpha, beta and gamma ray spectroscopy: Vol. 1 and 2, North Holland, Amsterdam, 1965.
6. Price J.W., Nuclear radiation detectors, McGraw Hill, New York, 1965.
7. Kapoor S.S. and Ramamoorthy V., Nuclear radiation detectors, Wiley Eastern, Bangalore, 1993.
8. Kowalski E., Nuclear electronics, Springer Verlag, Berlin,1970.
9. Leo W.R.,Techniques for nuclear and particle physics experiments, Springer Verlag, 1992.
10. Roy R.R. and Nigam B.P., Nuclear physics, New Age International, New Delhi, 1986.
11. Hans H.S., Nuclear physics—Experimental and theoretical, New Age International Publishers, 2001.
12. Tayal D.C., Nuclear Physics, Himalaya Publishing House, New Delhi, 2012

PHY-306: Theoretical Physics 1

General theory of relativity: Tensor Calculus and Riemannian geometry : Covariant Differentiation, Parallel Transport, Geodesies, The Curvature Tensor.

Riemannian geometry: Riemannian space, The determinant of $g_{\mu\nu}$. Metrical Densities, The Connection of a Riemannian Space: Christoffel Symbols, Geodesies in a Riemannian Space, The Curvature of a Riemannian Space: The Riemann Tensor. **[16 hours]**

Gravitational field: The Principle of Equivalence, The Field Equations of General Relativity, Metrics with Spherical Symmetry, The Schwarzschild Solution. Geodesies in the Schwarzschild Space, Advance of the Perihelion of a Planet, The Deflection of Light Rays, Red Shift of SpectralLines, The Schwarzschild Sphere. Gravitational Collapse. Black Holes. **[16 hours]**

Quantum field theory-1: Classical and quantum fields: Particles and fields, Discrete and continuous mechanical systems, Classical scalar fields, Maxwell fields Quantum Theory of Radiation: Creation, annihilation, and number operators, Quantized radiation field, Fock states, Emission and absorption of photons by atoms, Rayleigh scattering, Thomson scattering, and the Raman effect. **[16 hours]**

Total work load **48 hours**

References:

1. Papapetrov A., Lectures on general relativity, D. Reidel Publishing Company, USA, 1974.
2. Dirac P.A.M., The general theory of relativity, John Wiley and Sons, New York, 1975.
3. Adler R., Bazin M. and Schiffer M., Introduction to general relativity, McGraw-Hill Kogakusha, Ltd. New Delhi, 1965.
4. Hartle J.B., Gravity: An introduction to Einstein's general relativity, Benjamin-Cummings Pub. Co., USA, 2002.
5. Sakurai J.J., Advanced quantum mechanics, Addison-Wesley, Harlow, England, First ISE Reprint, 1999.
6. Griffiths D., Introduction to elementary particles, John Wiley and Sons, New York, 1987.
7. Gasiorowicz S., Elementary particle physics, John-Wiley, New York, 1966.
8. Muirhead H., The physics of elementary particles, Pergamon Press, London, 1965.

Open Elective Papers

Paper to be offered to Non-Physics Postgraduate students

PHY-321: Modern Physics

Nuclear physics: A brief overview of nuclear physics. Nuclear reactions, a brief description of nuclear models. Interactions of X-rays and γ-rays with matter, slowing down and absorption of neutrons. Fundamental particles, classification of fundamental particles, fundamental forces, conservation laws in particle physics, a brief outline of the quark model.
Nuclear power: Nuclear fission, fission chain reaction, self sustaining reaction, uncontrolled reaction, nuclear bomb. Nuclear reactors, different types of reactors and reactors in India. Nuclear waste management. Nuclear fusion, fusion reactions in the atmosphere. Radiation effects; dosage calculation. Nuclear energy; applications and disadvantages. **[16 hours]**

Condensed matter physics: Amorphous and crystalline state of matter. Crystal systems. Liquid crystals. X-ray diffraction; Bragg equation. Structure of NaCl. FTIR; Experiment analysis. NMR; Experiment and analysis. Electrical conductivity of metals and semiconductor. Magnetic materials; para,ferro, ferri and anti-magnetism. Dielectrics—para, ferro, pyro and piezo properties. Symmetry in physics. **[16 hours]**

Quantum physics: Qualitative discussion. Molecules, atoms, nucleus, nucleons, quarks and gluons. Particle physics (qualitative). Stern-Gerlach experiment and consequences. Uncertainty relation. Hydrogen atom. Positron annihilation. Laser trapping and cooling. Ion traps. Electromagnetic, strong, weak and Gravitational forces. Big Bang theory, String theory. Large Hadron Collider experiment, consequences. Higgs Boson. **[16 hours]**

Tutorial **[16 hours]**

Total work load **64 hours**

References:

1. Ghoshal S.N., Atomic and nuclear physics, Vol.2., S. Chand and Company, Delhi, 1994.
2. Evans R.D., Atomic nucleus, Tata Mc Grow Hill, New Delhi, 1976.
3. Penrose R., Road to Reality, Vintage Books, 2007.
4. Ladd M.F.C. and Palmer R.A., Structure determination by X-ray crystallography, Plenum Press, USA, 2003.
5. De Gennes P.G. and Prost J., The physics of liquid crystals, 2nd Edn., Clarendon Press, Oxford, 1998.
6. Myer R., Kennard E.H. and Lauritsern T., Introduction to modern physics, 5th Edn., McGraw- Hill, New York, 1955.
7. Halliday D., Resnick R. and Merryl J., Fundamentals of physics, Extended 3rd Edn., John Wiley, New York, 1988.

PHY-322: Energy Science

Renewable energy resources: Forms of Energy, Basics of Thermodynamics: Heat capacity, Heat transfer mechanism, entropy, First and second law of thermodynamics Carnot Cycle, Rankin cycle. Fossil fuels, time scale of fossil fuels. Solar energy: Sun as the source of energy and its energy transport to the earth, Extraterrestrial and terrestrial solar radiations, Measurement techniques of solar radiations using Pyranometer and Pyrheliometer. **[16 hours]**

Materials and solar cell technology : Single, poly and amorphous silicon, GaAs, CdS, fabrication of single and polycrystalline silicon solar cells, amorphous silicon solar cells, photovoltaic systems and technical problems. Wind Energy Origin and classification of winds, Aerodynamics of windmill: Maximum power and Forces on the Blades and thrust on turbines; Wind data collection and field estimation of wind energy, Site selection, Basic components of wind mill, Types of wind mill, Wind energy farm, Hybrid wind energy systems: The present Indian Scenario. **[16 hours]**

Biomass energy and biogas technology: Nature of Biomass as a fuel, Biomass energy conversion processes, Direct combustion: heat of combustion, combustion with improved Chulha and cyclone furnace; Dry chemical conversion processes: pyrolysis, gasification, types of gasification. Importance of biogas technology, anaerobic decomposition of biodegradable materials, Factors affecting Bio-digestion, Types of biogas plants, Applications of biogas. **[16 hours]**

Tutorial **[16 hours]**

Total work load **64 hours**

References:

1. Peter A., Advances in energy systems and technology, Academic Press, USA, 1986.
2. Neville C.R., Solar energy conversion: The solar cell, Elsevier North-Holland, 1978.
3. Dixon A.E. and Leslie J.D., Solar energy conversion, Pergamon Press, New York, 1979.
4. Ravindranath N.H., Biomass, energy and environment, Oxford University Press, 1995.
5. Cushion E., Whiteman A. and Dieterle G., World Bank Report, 2009.

PHY-311: Condensed Matter Physics Lab

Any eight of the following experiments:

1. Determination of the paramagnetic susceptibility of the given salt by Quincke's method
2. Study of mercury spectrum by superimposing it on brass spectrum
3. Sodium spectrum analysis by using Edser-Butler fringes
4. Temperature coefficient of resistance of a thermistor
5. Analysis of the powder X-ray photograph of a simple cubic crystal
6. Thermionic work function of a metal (Richardson-Dushmann formula)
7. Energy gap of a semiconductor
8. Frank Hertz experiment
9. Measurement of magneto resistance of semiconductors
10. Stefan's Constant of Radiation
11. Thermal Conductivity of Poor Conductor
12. Di-electric constant of a Non polar liquid
13. Dipole moment of an organic Molecule
14. High Resistance by Leakage

Total work load : 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-312: Nuclear and Particle Physics Lab

Any eight of the following experiments:

1. Half-life of Indium-116 measurement.
2. Energy Resolution of a NaI(Tl) scintillation spectrometer.
3. Compton scattering—determination of the rest energy of an electron.
4. Beta absorption coefficient measurement.
5. Dekatron as a counter of signals.
6. Gamma-ray absorption coefficient measurement.
7. End-point energy of Beta particles by half thickness measurement.
8. Common Source amplifier.
9. Astable multivibrator using timer IC 555.
10. Dead time of the G.M. counter.

Total work load : 2 day(s) per week × 4 hours × 16 weeks =**128 hours**

Reference: 1. Varier K. M., Antony Joseph and Pradyumman P. P., Advanced experimental techniques in Modern Physics, Pragati Prakashan, 2011

PHY-313: Solid State Physics Lab 1

For those who have opted for ***Solid State Physics Specialisation***

Any five of the following experiments:
1. Optical rotatory dispersion of a uniaxial crystal.
2. Birefringence of quartz using spectrometer.
3. Paramagnetic susceptibility by Gouy balance method.
4. Fermi energy of copper.
5. Cell parameter(s) from an X-ray powder diffractogram.
6. Verification of Langmuir-Child's law.
7. Thermoluminescence.
8. Curie temperature of a ferroelectric material.
9. Dielectric constant and its temperature variation.
10. Determination of the polarisabilities of the molecules of an uniaxial crystal using spectrometer.
11. Photoelasticity in crystalline solids.
12. Thermal expansion coefficient in solids.
13. Determination of Stefan's constant using Photo Cell
14. Calibration of Si Diode
15. Measurement of Electrical and Thermal Conductivity of Copper
16. Verification of Curie-Weiss law
17. BH Curve in a ferromagnetic Material

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-314: Nuclear Physics Lab 1

For those who have opted for ***Nuclear Physics Specialisation***

Any five of the following experiments:
1. Cockroft-Walton voltage multiplier.
2. Coincidence circuit.
3. Linear amplifier.
4. Transistorised binary circuit.
5. Pulse shaping circuits.
6. Linear Gate.
7. Randomocity of radioactive decay.
8. Nomogram method : Measurement of endpoint energy of beta rays.
9. Study of linearity of the NaI(Tl) gamma ray spectrometer.
10. Determination of the energy of an unknown gamma ray source.

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-315: Theoretical Physics Lab 1

For those who have opted for ***Theoretical Physics Specialisation***

Any five of the following experiments:
1. Calculation of Christoffel symbols.
2. Geodesics and curvature calculations.
3. Exterior Schwarzschild metric calculations.
4. Robertson-Walker metric calculations.
5. Lagrangian and Hamiltonian, Euler Lagrange equations for Schroedinger field.
6. Lagrangian for Maxwell's field and The field equations.
7. Symmetries of the Lagrangian and Constants of motion.
8. Operator algebra-BCH formula.
9. Relativistic kinematics-1: Relations between center of momentum and laboratory frames.
10. Relativistic kinematics-2: Non-relativistic limit of relativistic kinematics.

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-401: Solid State Physics 2

X-ray diffraction by crystals: The reciprocal lattice. Ewald sphere and construction. Scattering by an electron and atom; Atomic scattering factor. Anomalous scattering. Fourier analysis and inversion of Fourier series; Physical significance. Geometrical structure factor of the unit cell. Absent reflections and space groups. **(Sherwood, P290 – 358).**

Experimental techniques: Brief introduction to Laue, Powder and single crystal methods. Use of Synchrotron radiation for structure studies. Weissenberg and precession methods. Cell parameter and space group determination. Molecular weight determination. **(Stout and Jensen,p 90–211). [16hours]**

Structure analysis: Low angle scattering. Reduction of intensities to structure amplitudes. Various corrections. Absolute scale factor and temperature factor from statistical methods. Statistical method for finding the presence of center of symmetry Fourier analysis of electron density. Patterson synthesis. Harker sections and lines. Heavy atom methods. Direct methods for phase determination. The inequality relations. Difference Patterson synthesis and error Fourier synthesis. Figure of merit. Cyclic Fourier refinement, Difference Fourier synthesis. Refinement of structures: The least squares method. Accuracy of the parameters. Bond lengths and angles. **(Sherwood, Ladd and Palmer)**

SAXS; Particle Size study of Fibre structure **[16 hours]**

Imperfections in solids: Different types of imperfections. Schottky and Frenkel defects; expression for energy for the formation of Frenkel and Schottky defects. Diffusion in metals; Kirkendall effect. Ionic conductivity in pure and doped halides. Photoconductivity **(Kittel).**

Dislocations: Buerger's Vector. Expression for strain in edge and screw dislocations **(Wahab and Kittel).**

Synthesis and Device fabrication of Nanomaterials: Nanomaterials**.** Bottom-Up approach; Sol-gel synthesis, hydrothermal growth, thin-film growth, physical vapor depositon, chemical vapor depostion. Top- Down Approach; Ball milling, Microfabrification, Lithography, Ion-beam lithography**(Ramachandra rao and Shubra singh, p129-142).**

Luminescence: Excitation and Emission. Franck-Condon principle. Decay mechanisms;Temperature dependent and independent decays. Thermoluminescence and glow curve. Gudden-Pohl effect **(Dekker).**
[16 hours]

Total work load **48 hours**

References:

1. Stout G.H. and Jensen L.H., X-ray structure determination, MacMillan, USA, 1989.
2. Ladd M.F.C. and Palmer R.A., Structure determination by X-ray crystallography, Plenum Press, USA, 2003.
3. Sherwood D., Crystals, X-rays and proteins, Longman, London, 1976.
4. Wahab M.A., Solid state physics, Narosa Publishing House, New Delhi, 1999.
5. Azaroff L.V., Introduction to solids, McGraw-Hill Inc, USA, 1960.
6. Weertman J. and Weertmann J.R., Elementary dislocation theory, McMillan, USA, 1964.
7. Pillai S.O., Solid state physics, New Age International Publications, 2002.

PHY-402: Solid State Physics 3

Free electron theory of metals: Boltzmann transport equation, Sommerfeld's theory of electrical conductivity, mean free path in metals, dependence of resistivity on temperature and impurities. Matthiessens rule. Electron-phonon collisions. Electrical conductivity of metals at high frequencies. Plasma frequency. Transparency of alkali metals to UV radiation. Anomalous skin effect. Plasmons. Field enhanced emission, Schottky effect. Hall effect and magnetoresistance in metals. Cyclotron frequency **(Kittel & Pillai).** Thermal conductivity of insulators; Umklapp processes **(Dekker, p275-292)**. **[16 hours]**

Impurity semiconductors: A brief discussion on Elemental and Compound Semiconductors and their properties. Carrier concentrations; effect of temperature and impurity density. Electrical neutrality condition. Fermi energy; Variation with temperature and impurity density, when the Boltzmann approximation is valid,. Effect of impurity density at very low temperatures. Mobility of current carriers; effect of temperature and impurity. Electrical conductivity; effect of temperature, impurity density and the energy band gap.

Hall effect in semiconductors; Expression for Hall co-efficient,
Magneto-resistance phenomenon (qualitative) **(M A Wahab).**
Cyclotron resonance; Cyclotron resonance in Si and Ge semiconductors. Effective mass tensor. Variation of cyclotron resonance frequency with orientation of the crystal in the magnetic field **(Mckelvey, p270–300).** **[16 hours]**

Excess carriers in semiconductors: Generation and recombination rates. Continuity equations; Einstein equations, Expression for the diffusion length of electrons and holes **(Mckelvey, p320–335).**
High field transport in semiconductors; electron temperature. Gunn effect, Expression for drift velocity. Superlattice Phenomenon **(Roy, p29–39).**

Semiconductor devices: The pn junction; space charge region, effect of the applied field on barrier potential, barrier thickness and contact field. Transition capacitance. Current density for excess carriers. Characteristics and applications of phototransistors, JFET, SCR and UJT **(Mckelvey, p390–441).**
[16 hours]

Total work load **48 hours**

References:

1. Dekker A.J., Solid state physics, Prentice Hall, 1985.
2. Mckelvey J.P., Solid state and semiconductor physics, 2nd Edn., Harper and Row, USA, 1966.
3. Roy D.K., Physics of semiconductor devices, University Press, Hyderabad, 1992.
4. Schur M., Physics of semiconductor devices, Prentice-Hall of India, New Delhi, 1999.
5. Wilson J. and Hawkes J.F.B., Optoelectronics—An introduction, 2nd Edn., Prentice-Hall of India, New Delhi, 1996.
6. Streetman B.G., Solid state electronic devices, 2nd Edn., Prentice-Hall of India, New Delhi, 1983.
7. Omar M.A., Elementary solid state physics, Addison Wesley, New Delhi, 2000.
8. Wahab M.A., Solid state physics, Narosa Publishing House, New Delhi, 1999.
9. Pillai S. O. Solid State Physics, ew Age International Publications, New Delhi.

PHY-403: Nuclear Physics 2

Nuclear fission: Nuclear fission, Mass-energy distribution of fission fragments. Statistical model of fission.

Reactor theory-1: Neutron and its interaction with matter-collision kinematics, differential elastic scattering cross sections, isotropic scattering, the criticality condition for a reactor. Neutron transport equation using elementary diffusion theory. One group critical equation, critical size on the basis of Fermi age theory. **[16 hours]**

Reactor theory-2: Reactors; One group theory, spherical and cylindrical homogeneous reactor. Effective multiplication factor. Reflector reactors: effects of reflector. One group method of a homogeneous reactor with reflector. reflector savings. Infinite multiplication factor, critical size and critical mass.
Heterogeneous reactor system; calculation of thermal utilization factor. Fast Breeder reactor, Evaluation of Buckling using one group model. **[16 hours]**

Beta decay: Classification of beta interactions. Matrix elements. Fermi and Gamow-Teller selection rules for allowed beta decay. The non conservation of parity in beta decay. Wu et al experiment. The universal Fermi interaction.

Gamma decay: Electromagnetic interactions with nuclei. Multipole transitions. Transition probabilities in nuclear matter. Weisskopf's estimates. Structure effects. Selection rules. Internal conversion Photo disintegration of deuteron and radiative capture of neutron by proton. **[16 hours]**

Total work load **48 hours**

References:

1. Glasstone S. and Edlund M.C., Elements of nuclear reactor theory, D. Van Nostrand Co., USA, 9th Print, 1963.
2. Garg S., Ahmed F. and Kothari I.S., Physics of nuclear reactors, Tata McGraw-Hill, New Delhi, 1986.
3. Roy R.R. and Nigam B.P., Nuclear physics, New Age International, New Delhi, 1986.
4. Hans H.S., Nuclear physics—Experimental and theoretical, New Age International Publishers, 2001.
5. Ghoshal S.N., Nuclear physics, Vol. 2., S.Chand and Company, Delhi, 1994. Chapter 15, page 714-730.

PHY-404: Nuclear Physics 3

Two particle systems: Deuteron; Schrodinger equation for a two nucleon system, Theory of the ground state of the deuteron under central and non central forces, Excited states of the deuteron. Rarita-Schwinger relations. Deuteron magnetic and Quadrupole moments.

Nucleon-nucleon scattering processes: Theory of s-wave scattering of neutrons by free protons and experimental results. Wigner's formula for n-p scattering. Theory of scattering of slow neutrons by bound protons (Ortho and Para hydrogen) and experimental results. Effective range theory for n-p scattering.
S wave theory of proton-proton scattering. Mott's modification of Rutherford's formula. Pion-nucleon scattering experimental results, (3/2, 3/2) resonance. **[16 hours]**

Nuclear reactions-1: Plane wave theory of direct reactions. Born approximation (Plane wave); Butler's theory. Cross section for nuclear scattering and reactions. Shadow scattering, Breit-Wigner resonance formulae.

Nuclear reactions-2: Bohr's independence hypothesis. The compound nucleus (CN) reactions, decay rates of CN, Statistical theory of nuclear reactions. Evaporation probability and cross sections for specific reactions. **[16 hours]**

Optical model: Giant resonances, Kapur-Pearls' dispersion formula for potential scattering. Direct reactions: Kinematics of stripping and pickup reactions. Theory of stripping and pickup reactions. Inverse reactions.

Heavy ion physics: Special features of heavy ion Physics. Remote heavy ion electromagnetic interactions. Coulomb excitations. Close encounters. **[16 hours]**

Total work load **48 hours**

References:

1. Roy R.R. and Nigam B.P., Nuclear physics—Theory and experiment, New Age International Ltd, New Delhi, 1986.
2. Hans H.S., Nuclear physics—Experimental and theoretical, New Age International Publishers 2001.
3. Sachtler G.R., Nuclear reactions, Addison Wesley, New York, 1983.
4. Mermier P. and Sheldon E., Physics of nuclei and particles, Vol. 2 Academic Press, USA, 1971.
5. Jackson D.F., Nuclear reactions, Chapman and Hall, London, 1975
6. Mermier P. and Sheldon E., Physics of nuclei and particles, Vol. 3 Academic Press, USA, 1971.

PHY-405: Theoretical Physics 2

Relativistic quantum mechanics: Probability conservation in relativistic quantum mechanics, The Dirac equation, Conserved current, Representation independence, large and small components, approximate Hamiltonian for an electrostatic problem, free particle solutions, Relativistic covariance, Space inversion, Bilinear covariants and their properties, Klein's paradox, Hole theory and charge conjugation. **[16 hours]**

Quantization of the Dirac field: Second quantization, positron operators and positron spinors, Electromagnetic and Yukawa couplings. Weak interactions and parity nonconservation: Classification of interactions, parity and hyperon decay, Fermi theory of beta decay, the two-component neutrino. Pion decay and the CPT theorem. **[16 hours]**

Covariant perturbation theory: Natural units and dimensions, S-matrix expansion in the Interaction representation. Unitarity, First order processes: Matrix element for electron scattering. Cross section for Mott scattering. Helicity change and spin projection operator. Pair annihilation, pair creation, hyperon decay. S -matrix for two photon annihilation, electron propagator, Matrix element for Compton scattering, Feynman rules. Cross section for two photon annihilation. **[16 hours]**

Total work load **48hours**

References:

1. Sakurai J.J., Advanced quantum mechanics, Addison-Wesley, Harlow, England, First ISE Reprint, 1999.
2. Griffiths D., Introduction to elementary particles, John Wiley and Sons, New York, 1987.
3. Gasiorowicz S., Elementary particle physics, John-Wiley, New York, 1966.
4. Muirhead H., The physics of elementary particles, Pergamon Press, London, 1965.

PHY-406: Theoretical Physics 3

Angular momentum theory and applications: Angular momentum: Transformations under rotations. Coupling of three and four angular momenta. Racah coefficients, Wigner 9j symbols, applications. Wigner-Eckart theorem. Projection theorem. j-j and L-S coupling. Angular momentum in nuclear reactions, Spherical tensors. Evaluation of matrix elements between coupled angular momentum states. Vector spherical harmonics. Gradient theorem (without proof). Multipole radiation. **[16 hours]**

Spin density matrix: Spin and helicity in a relativistic process. Effect of Lorentz and discrete transformations on helicity states. Wick and Wigner rotations, pure rotation, pure boost, parity, time reversal and charge conjugation. The spin density matrix (ρ), general properties, multipole parameters, combined systems, Diagonalization of ρ. Oriented and non-oriented systems, Polarized and aligned systems, Spherical tensor basis and SU(N) basis. **[16 hours]**

Relativistic density matrix: Helicity multipole parameters and their transformation laws. Helicity amplitudes for elastic reactions and their symmetry properties. Polarization in scattering of spin ½ particles, Final state density matrix. Observables of a reaction, reactions involving polarized beam and polarized targets. **[16 hours]**

Total work load **48 hours**

References:

1. Sakurai J.J. and Tuan S.F. (Editor), Modern quantum mechanics, AddisonWesley, India, 1999.
2. Leader E., Spin in particle physics, Cambridge University Press, London, 2001.
3. Rose M.E., Elementary theory of angular momentum, John Wiley and Sons, USA, 1957.
4. Blum K., Density matrix theory and applications, Plenum Press, New York, 1981.

Elective Papers 1

PHY-407: Accelerator Physics

Ion sources: Brief introduction to ion sources for positive and negative ions. Ion production. Semi classical treatment of ionization, Townsend theory-comparison of theory and experiment for ion production. Examples of ion sources-properties of ion sources. Insulation at high voltages-Spark voltage. Paschen's law for gas breakdown.

Ion optics and focussing: Focussing properties of linear fields. Electrostatic and magnetic lenses.

[16 hours]

Particle accelerators: Introduction, development of accelerators. Direct-voltage accelerators: Cockroft-Walton generator, Van de Graff generator, Tandem accelerators, Pelletron. Resonance accelerators: Cyclotron - fixed and variable energy, principles and longitudinal dynamics of the uniform field cyclotron. Linear accelerators. **[16 hours]**

Electron accelerators: Betatron; Beam focusing and Betatron Oscillation. Microtron. Synchronous accelerators; Principle of phase stability, Mathematical theory for Principle of phase stability. Electron synchrotron. Proton synchrotron.

Alternating gradient machines; Alternating gradient principle, AG proton synchrotron. **[16 hours]**

Total work load **48 hours**

References:

1. Townsend P.D., Kelly J.C. and Hartley N.E.W., Ion implantation, sputtering and their applications, Academic Press, London, 1976.
2. Humphrey S. Jr., Principles of charged particle acceleration, John Wiley, 1986.
3. Arya A.P., Fundamentals of nuclear physics, Allyn and Bacon, USA, 1968.
4. Ghoshal S.N., Atomic and nuclear physics, Vol. 2, S.Chand and Company, Delhi, 1994.
5. Varier K.M., Joseph A. and Pradyumnan P.P., Advanced experimental techniques in modern physics, Pragathi Prakashan, Meerut, 2006.

PHY-408: Liquid Crystals

Anisotropic fluids: Main Types and properties: Introduction. The building blocks. Small organic molecules. Long helical rods. Associated structures. Nematics and Cholesterics. Nematics proper. Static pretransitional effects above T_{N-1}^{i}. The cholesterics. A distorted form of the nematic phase. Smectic. Smectic A. Smectic B. Smectic C. Other mesomorphic phases. Exotic smectics; long range order in a system of long rods. Lyotropic systems. Remarkable features of liquid crystals. Applications of liquid crystals.
[De Gennes and Prost] **[16 hours]**

Long and short range order in nematics: Definition of an order parameter. Microscopic approach. Order parameter from optical method, from diamagnetic anisotropy. Mean field theory with S2 interaction (Maier-Saupe).

Static distortion in nematics: Long range distortions, distortion free energy. Magnetic field effects—Molecular diamagnetism, Magnetic coherence length.

Defects and textures in nematics: Observations. Black filaments. Schlieren structures. Types of defects (qualitative discussion only).

Smectics: Continuum description of smectics A and C, Mean field description of S_A-N transition.
[De Gennes and Prost] **[16 hours]**

Dynamical properties of nematics: Experiments measuring the Leslie coefficients-Laminar flow under a strong orienting field, Attenuation of ultrasonic shear waves, Laminar flow in the absence of external fields. Convective instabilities under electric fieldsb - Basic electrical parameters, Experimental observations at low frequencies, The Helfrich interpretation. Extension to higher frequencies (qualitative).

Cholesterics: Optical properties of an ideal helix—The planar texture, Bragg reflection, Transmission properties at arbitrary wavelengths (normal incidence), The Mauguin limit, Rotatory Power. Agents influencing the pitch—Physicochemical factors, External fields (qualitative). Textures in cholesterics.
[De Gennes and Prost] **[16 hours]**

Total work load **48 hours**

References:

1. De Gennes P.G. and Prost J., The physics of liquid crystals, 2nd Edn., Clarendon Press, Oxford, 1998.
2. Chandrashekhar S., Liquid crystals, Cambridge University Press, 1977.
3. Gray G.W., Molecular structure and the properties of liquid crystals, Academic Press, 1962.
4. Maier G., Sackmann E. and Grabmanier I.G., Applications of liquid crystals, Springer Verlag, 1975.
5. Gray G.W. and Goodby J.W., Smectic liquid crystals (Textures and structures), Leanard Hill, London, 1984.

PHY-409: Atmospheric Physics

Atmospheric composition: Energy in the atmosphere, heating of the atmosphere, motions in the atmosphere. Variations in atmospheric composition, Structure on the basis of composition. Thermal structure of the atmosphere.

Thermodynamics: Entropy of dry air, vertical motion of saturated air, tephigram, potential energy of an air column.

Dynamics: Escape of hydrogen, photodissociation of oxygen, photo chemical processes. Equations of motion, the geostrophic approximation, cyclostrophic motion. **[16 hours]**

Terrestrial and extra terrestrial radiation: General features of direct, diffuse and global radiation-attenuation of direct solar radiation-Rayleigh and Mie scattering. Angstrom turbidity formula for all aerosols. Direct transmittance due to continuum attenuation, diffuse spectral irradiance due to Rayleigh and aerosol scattering.

Aerosols: Production and properties of aerosols. Aerosol optical depth, Beer's law - Sun Photometer. Optical filters.

Clouds: Microphysics of clouds, Macro characterization of clouds. Radiative transfer in clouds and aerosols. **[16 hours]**

Atmospheric radioactivity: Background Radiation, Radioactivity in Atmosphere, Radon, Properties of radon, Origin of radon, Radon entry into the atmosphere: Diffusion, Advection and Convection. Health Effects: Dose.

Atmospheric electricity: The generation of an ion, The mobility of ions, Ion size, recombination of ions. Ions in an electric field, Ionizing agencies, radioactivity. The conductivity of the atmosphere and its origin, Measurement of conductivity of the atmosphere near the ground. Relationship between ions and conductivity. The current voltage characteristics in a gas under conditions of volume ionization.
[16 hours]

Total work load **48 hours**

References:

1. Salby M.L., Fundamentals of atmospheric physics, Academic Press, USA, 2006.
2. Houghton J., The physics of the atmosphere, Cambridge University Press, 2002.
3. Siddhartha K., Atmosphere, weather and climate, Kisalaya Publications, 2000.
4. Lutgens F.K. and Tarbuk E.K., The atmosphere: An introduction to meteorology, Prentice Hall USA, 1986.
5. Holton, J.R., Dynamic meteorology, 3rd edition, Academic Press, USA, 1992.
6. Keshvamurthy R.N. and Shankar Rao M., The physics of monsoons, Allied Publishers, 1992.
7. Iqbal M., An introduction to solar radiation, Academic Press, USA, 1983.
8. Wilkening M., Radon in the environment, Elsevier Science Publishers, The Netherlands, 1990.
9. Israel H., Atmospheric electricity-Vol II, Israel Program for Scientific Translations, Jerusalem. 1973.

PHY-410: Numerical Methods

Computer arithmetic: Integers; Floating point representation of numbers; Arithmetic operations with normalisation; Errors in representation; Commonly used number types and their limits like max. and min. integer, float, double precision, long, etc.

Iterative methods: Bisection method, Newton-Raphson method, Secant method, the method of successive approximations. Solution of a polynomial equation. **[16 hours]**

Linear algebraic equations: The Gauss elimination method, LU decomposition method, Gauss-Jordon method, An introduction to the solution of simultaneous non-linear equations.

Interpolations: Introduction, Newton interpolation formulae, extrapolation, Lagrange interpolation. spline interpolation.

Least-squares approximation of functions: Introduction, linear regression, algorithm for linear regression. Polynomial regression, fitting exponential and trigonometric functions. **[16 hours]**

Numerical integration. Trapezoidal method, Simpson rule. Errors in integration formulae (Romberg method). Algorithms for integration of a tabulated function. Algorithms for integrating a known function. Gaussian quadrature formulae.

Numerical solution of differential equations: Euler method, Runge - Kutta methods, Runge - Kutta 4th order formulae, predictor - corrector method. comparison of predictor-corrector and Runge- Kutta methods. **[16 hours]**

Total work load **48 hours**

References:

1. Atkinson K.E., An introduction to numerical analysis, John Wiley and Sons, USA, 1988.
2. Press W.H., Flannery B.P., Teukolsky S.A. and Vetterling W.T., Numerical recipes in C, Cambridge University Press, UK, 1989.
3. Krishnamurthy E.V. and Sen S.K, Numerical algorithms, Affiliated East West Press Pvt. Ltd., India, 1993.
4. Rajaraman V., Computer oriented numerical methods, Prentice Hall of India Pvt. Ltd., India,m 2001.

Elective Papers 2

PHY-411: Nuclear Spectroscopy Methods

Ion implantation and backscattering spectroscopy: Ion implantation, Implantation technique, Ion beam diffusion, Thermal annealing and sputtering, Analysis techniques. Backscattering, Energy loss and straggling. Kinematics factor, differential scattering cross sections, depth scale, backscattering yield, instrumentation. Application to elemental and compound targets. Axial and planar half angles. Estimates of minimum yield. Lattice location of impurities, alignment procedures. Ion induced X-rays. Application of ion implantation. **[16 hours]**

Compton scattering: Compton scattering from free electrons. Effects of external potential. Klein-Nishina cross sections for polarized and unpolarized radiation. Compton profiles, momentum distributions and impulse Compton profiles. Calculation of Compton profiles for electron models. Relativistic profile corrections: experimentation. Discussion of methodology including sources, detectors and geometry. Data accumulation, analysis and multiple scattering corrections. Discussion of experimental results for some simple metals, ionic and covalent crystals. **[16 hours]**

Positron annihilation spectroscopy: The positron and its discovery, Positronium, its characteristics, formation. Spur model and Ore gap model of positronium formation. Quenching and enhancement. Theory of 2-gamma and 3-gamma annihilations. Positron and positronium states in solids: trapping of positrons. Two state trapping model.

Experimental methods of positron annihilation spectroscopy: Positron lifetime techniques (PLT), Angular Correlation of Annihilation Radiation (ACAR), Doppler broadening (DB) and Coincidence DB. Methods of data analysis: PLT and ACAR. Experimental results of some metals and defected materials. Interpretation of the experimental results. PAS in the study of polymers. Multiparameter techniques.
A brief mention of slow positron beams. **[16 hours]**

Tutorial **[16 hours]**

Total work load **64 hours**

References:

1. Townsend P.D., Kelly J.C. and Hartley N.E.W., Ion implantation, sputtering and their applications, Academic Press, London, 1976.
2. ChuW.K., Mayer J.W. and Nicholate Mar A.O., Backscattering spectroscopy, Academic Press, New York, 1978.
3. Mayer J.W. and Rimini B. (Eds.), Ion beam handbook for material analysis, Academic Press, 1977.
4. Williams B. (Ed.), Compton scattering, McGraw-Hill, New York, 1977.
5. Hautojarvi P. (Ed.), Positrons in solids, Springer Verlag, New York, 1979.
6. Fava R.A. (Ed.), Methods of experimental physics, Academic Press, New York, 1980.
7. Schradev D.M. and Jean Y.C., Positron and positronium chemistry, Elsevier Science Publication, Amsterdam, 1988.
8. Jayaram B., Mass spectrometry–Theory and applications, Plenum Press, New York, 1966.

PHY-412: Modern Optics

Polarization of light: Pure states and mixed states. Density operator, properties and equation of motion. Polarization of light, states of polarized light, Jones matrices, Jones formalism, Stokes parameters, Poincar´e sphere, Mueller matrices and Mueller formalism, Mueller matrices and their characterization, Few illustrative examples; comparison of Jones and Mueller formalisms. Pancharatnam phase, dynamical phase, cyclic evolution of polarization state on Poincar´e sphere; Applications of the concept of Pancharatnam phase. **[16 hours]**

Quantum features of radiation field: Planck's law of radiation and Einstein coefficients, Thermal equilibrium, Semi-classical theory of two level atoms, quantum theory of B coefficient, Optical resonance, damping, Theory of chaotic light, coherence, temporal, spatial, mutual coherence, line broadening, natural and Doppler width, collision broadening. **[16 hours]**

Quantized radiation field: Quantization of radiation field, States of radiation field; Fock states and phase eigenstates; Interaction of radiation with matter, theory of spontaneous emission; Coherent states and their properties, BCH formula, P, Q and Wigner distribution functions, Squeezed states of light and their properties; applications. Correlation functions, Brown-Twiss correlations. **[16 hours]**

Tutorial **[16 hours]**

Total work load **64 hours**

References:

1. Loudon R., The quantum theory of light, Clarendon Press, Oxford, 1973.
2. Mandel L. and Wolf E., Optical coherence and quantum optics, Cambridge University Press, 1995.
3. Louisell W.H., Quantum statistical properties of radiation, John Wiley and Sons, New York, 1973.
4. Blum K., Density matrix theory and applications, Plenum Press, New York, 1981.
5. Pancharatnam S., Collected works, Oxford University Press, 1975.

PHY-413: Electronics

BJT AC Analysis: Amplification in AC domain. BJT transistor modeling, common emitter voltage divider bias configuration. Emitter follower configuration. Darlington connection. Hybrid equivalent model, Approximate Hybrid equivalent circuit ; Voltage divider configuration, Complete hybrid equivalent model.
Feedback and Oscillator Circuit: Feedback concept, Feedback connections types, Practical feedback circuits. Feedback amplifier; Phase and frequency considerations. Oscillator operation, Phase - shift Oscillator, Wien-bridge Oscillator, Crystal Oscillator—BJT version.
FET amplifiers: JFET small signal model, Biasing of FET, Common drain, common gate configurations, FET amplifier and its frequency response. MOSFET – types and E – MOSFET Voltage divider configurations
(Boylestad and Nashelsky) **[16 hours]**

Operational amplifiers: Concepts of differential amplifier, Ideal op-amp, op-amp parameters, ideal voltage transfer curve, open loop and closed op-amp configurations, inverting amplifier, non inverting amplifier, limitations of open loop op-amp configurations.
Operational amplifier applications: Summing, scaling and averaging amplifiers, voltage to current converter with grounded load, current to voltage converter, integrator, differentiator,. V to I and I to V converters, Log and antilog amplifiers, Wave form generators, phase shift oscillator, Wein bridge oscillator. Non-linear circuit applications: Crossing detectors, 555 timer as a mono-stable and astable multivibrators, Active Filters—First and second order Low pass and High pass filters, Butterworth filters
(Gaekwad R.A) **[16 hours]**

Digital electronics: Boolean Laws and Theorems, addition and subtraction based on 1's and 2's complements, Families of gates, RS and JK flip-flops, The Master-Slave JK Flip-Flop, D and T flipflops. Karnaugh maps for 3 and 4 variables, Decoders-BCD decoders, Encoders.
Combinational logic circuits: Shift registers-series, series in-series out and parallel in parallel out. Half and full adders, Registers, Counters - Binary Ripple Counters, Synchronous Binary counters, Counters based on Shift Registers, Synchronous counters, Synchronous Mod-6 Counter using clocked JK Flip-Flops. Synchronous Mod-6 Counter using clocked D, T, or SR Flip-Flops. Memory cells, memory registers
[16 hours]

Tutorial **[16 hours]**

Total work load **64 hours**

References:

1. Boylestad R.L. and Nashelsky L., Electronic devices and circuit theory, 4th Edn., Pearson Education, 2006.
2. Bell D.A., Operational amplifiers and linear circuits, 2nd Edn., Pearson Education, 2004.
3. Gayakwad R.A., Operational amplifiers and linear integrated circuits, Prentice-Hall of India, New Delhi, 1993.
4. Malvino A.P. and Leach D.P., Digital principles and applications, 4th Edn., Tata McGraw Hill, 1988.
5. Arivazhagan S. and Salivahananan S., Digital circuits and design, Vikash Publishing House Pvt. Ltd.New Delhi, 2001.
6. Op-amps and linear integrated circuits, ramakanth A Gaekwad, 3rd edition,Pearson education Asia, 2002
7. Linear ICs and applications Uday A Bakshi & Atul P Godse, Technical Publications
8. Linear integrated Circuits, Roy & Choudary
9. Digital fundamentals, Thomos L Floyd

PHY-414: Minor Project

Total work load 64 hours

PHY-421: Nuclear and Particle Physics Lab

*For those who have completed **Condensed Matter Physics Lab PHY311***

Any eight of the following experiments:

1. Half-life of Indium-116 measurement.
2. Energy Resolution of a NaI(TI) scintillation spectrometer.
3. Compton scattering determination of the rest energy of an electron.
4. Beta absorption coefficient measurement.
5. Dekatron as a counter of signals.
6. Gamma-ray absorption coefficient measurement.
7. End-point energy of beta particles by half thickness measurement.
8. Common source amplifier.
9. Astable multivibrator using timer IC 555.
10. Dead time of the G.M. counter.

Total work load : 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-422: Condensed Matter Physics Lab

*For those who have completed **Nuclear Physics Lab PHY 312***

Any eight of the following experiments :

1. Determination of the paramagnetic susceptibility of the given salt by Quincke's method.
2. Study of mercury spectrum by superimposing it on brass spectrum.
3. Sodium spectrum analysis by using Edser-Butler fringes.
4. Temperature coefficient of resistance of a thermistor.
5. Analysis of the powder X-ray photograph of a simple cubic crystal.
6. Thermionic work function of a metal (Richardson-Dushmann formula).
7. Energy gap of semiconductor.
8. Determination of Stefan's constant.
9. Frank Hertz experiment
10. Magnetic hysteresis.
11. Measurement of magneto resistance of semiconductors.

Total work load : 2 day(s) per week × 4 hours × 16 weeks = **128 hours**

PHY-423: Solid State Physics Lab 2

For those who opted for ***Solid State Physics Specialisation***

Any five of the following experiments:

1. Photovoltaic cell.
2. Photoconductive cell.
3. Hall effect in semiconductors.
4. Determination of the energy gap of semiconductors by four-probe method.
5. Temperature variation of the junction voltage of a p-n diode.
6. Temperature variation of the reverse saturation current in a p-n diode.
7. Depletion capacitance of a junction diode.
8. Determination of material constant of an intrinsic semiconductor.
9. Schottky effect.
10. Ionic conductivity of an alkali halide crystal.
11. Dielectric constant and its temperature variation.
12. Ultrasonic velocity and elastic constants of a solid.
13. Determination of Curie temperature of a magnetic material
14. Magnetic field variation along with axis of the solenoid
15. Magnetic Hysteresis
16. Thermal Diffusivity of Brass
17. Temperature co-efficient of resistance of copper

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-424: Nuclear Physics Lab 2

For those who opted for ***Nuclear Physics Lab Specialisation***

Any five of the following experiments:

1. Schmitt trigger.
2. Variable delay line.
3. Pulse recorder.
4. Display devices.
5. Feather analysis: End-point energy of beta rays measurement.
6. Z dependence of external Bremsstrahlung radiation.
7. Fermi-Kurie plot : Determination of the end-point energy of beta rays using a plastic scintillation detector.
8. Determination of the resolving time of a coincidence circuit.
9. Determination of source strength by gamma-gamma coincidence.
10. Determination of source strength by beta-gamma coincidence.
11. Multichannel analyser : Study of the variation of energy resolution as a function of gamma ray energies.
12. Verification of Mosley's law
13. Beta ray absorption studies – relation between $\frac{\mu}{\rho}$ and end point energy.
14. Absorption coefficient of Al using Sr-90 and Y-90 beta sources.

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

PHY-425: Theoretical Physics Lab 2

For those who opted ***Theoretical Physics Lab Specialisation***

Any five of the following experiments:

1. Density matrix description of polarization of light.
2. Double scattering of spin-1/2 particles on spin-zero targets.
3. Second order QED processes (Compton scattering).
4. Evolution of matrix elements between coupled angular momentum states.
5. Dirac matrix representations.
6. Algebra of Dirac matrices.
7. Electron-proton scattering, Rosenbluth formula.
8. Relativistic kinematics-3: Study of decay and production processes.
9. Feynman diagrams and calculations.
10. Energy matrix calculation.

Total work load : 1 day(s) per week × 4 hours × 16 weeks = **64 hours**

BIOSTATISTICS, BIOINFORMATICS AND BIOENTREPRENEURSHIP (SOFT CORE) – 48 HRS

COURSE CODE:

Course Outcome

CO1-Application of statistics to understand and analyse the experimental results of biological sciences

CO2-retrival of biological data

CO3-phylogenetic analysis

CO4-primer designing

CO5-drug discovery and molecular docking

Unit I **12 Hrs**

Statistical concept: Data structure, sampling methods, collection, classification and tabulation of data, graphical and diagrammatic representation, histogram, frequency polygon, frequency curve, bar graph, pie chart.

Measure of central frequency: **Mean, median, mode, mean deviation, standard deviation, standard error**

Types of distribution of data: Normal, binomial, Poisson, Z-test, t-test and ANOVA.

Correlation and regression

Unit II **18 Hrs**

Bioinformatics: Introduction, history, internet and bioinformatics, knowledge, discovery and data mining, problems faced in bioinformatics area, opportunities in bioinformatics, human genome project.

Biological databases and their management: database concept, introduction, history of databases, databases management systems, types of database, Codd rules, data normalization biological databases – introduction, application and its importance, biological database and their functioning, types of biological database, microbiological database, primary sequence database, carbohydrate database, RNA database, genome database, organism database, biodiversity.

Sequence database: Introduction, nucleotide sequence database, protein sequence database, the EMBL nucleotide sequence database, structure databases.

Bioinformatics software: Clustal V Multiple sequence alignment, Clustal W Version 1.7, Ras Mol, Oligo, Mol script, TREEVIEW, ALSCRIPT, genetic analysis software, Phylip.

Computational biology: Introduction, data mining and sequence analysis, database similarities searches, practical aspects of multiple sequence alignment, phylogentic analysis, predictive methods using nucleic acid and protein sequences, submitting DNA sequences to the databases.

Unit III **10 Hrs**

Innovation: Idea to enter into business, Designing and development of new products as per market demands and their future prospective. Needs of customer, branding, distribution, promotion and advertising.

Types of bio-industries and IPR: biopharma, bioagri and bioservices. IP protection & commercialization strategies- freedom to operate.

Accounting and Finance : Business plan preparation, contracts, partnerships, business feasibility analysis by SWOT, socio-economic costs benefit analysis; funds/support from Government agencies like MSME/banks and private agencies like venture capitalists:/angel investors for bio entrepreneurship; business plan proposal for virtual start up company. statutory and legal requirements for starting a company/venture; basics in accounting practices: concepts of balance sheet, profit and loss statement, Valuation, Cash flow, double entry. Information technology for business administration and expansion. Technology transfer.

Incubation centres: Govt. (C-CAMP, KBITS, CFTRI) and Private incubation centres for start-ups.

Unit IV **8 Hrs**

Marketing : Market conditions, segments, prediction of market changes; identifying needs of customers; Market linkages, branding issues; developing distribution channels - franchising; policies, promotion, advertising; branding and market linkages for virtual start-up company.

Business Strategy & HR: Entry and exit strategy; pricing strategy; negotiations with financiers, bankers, government and law enforcement authorities; dispute resolution skills; external environment/ changes; avoiding/managing crisis; broader vision–global thinking; mergers & acquisitions.

Regulatory understanding:- GLP, GMP, GCP, PCB, IBSC, ISO

Bioentrepreneurship and case study: Importance of entrepreneurship; advantages of being entrepreneur - freedom to operate; introduction to bioentrepreneurship – biotechnology in a global scale; Scope in bioentrepreneurship; innovation – types, out of box thinking; skills for successful entrepreneur – creativity, leadership, managerial, team building, decision making, Risk assessment, opportunities for bioentrepreneurship- development programs of public and private agencies (MSME, DBT, BIRAC, Start-up & Make in India).

References:

1. Singh Narendra, Project management and control, (Himalaya publishing house)
2. Prasanna Chandra, Projects: Planning, Analysis, selection, implementation& review (Tata McGrow Hill)
3. P. GopalaKrishna& V.E. Rama Moorthy, Project management (Mac Millan India)
4. Chandra prasanna, proect preparation, Appraisal and Implementation (Tata Mcgrow Hill)
5. A. N. Desai, The dynamics of Entrepreneurial development and management (Himalaya publishing house)
6. Biostatistical Analysis. Zar J. H. Printice-Hall International.
7. Methods in Biostatistics. Mahajan, B. K. Smt. Hindu Mahajan

8. Bioinformatics. David W. Mount.
9. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins Andreas D. Baxevanis and B. F. Francis Ouellette. A John Wiley & Sons, Inc., Publication.
10. Biostatistics. Daniel.
11. Handbook of Biostatistics A Review and Text. Christopher and Carvounis.

JSS COLLEGE OF ARTS COMMERCE AND SCIENCE

(An Autonomous College of University of Mysore; Re-Accredited by NAAC with ‘A’ Grade)

OOTY ROAD, MYSURU- 25

PG DEPARTMENT OF BOTANY

Choice - Based Credit System (CBCS)

BOTANY

M.Sc. DEGREE SYLLABUS

2018-19 ONWARDS

(MODIFIED ON 2022)

JSS MAHAVIDYAPEETHA
JSS COLLEGE FOR ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS) OOTY ROAD, MYSURU- 25

POST GRADUATE DEPARTMENT OF BOTANY

M.Sc., Botany Choice - Based Credit System (CBCS) Syllabus
(CBCS-CGPA-Modified (2018-19)
CORE SUBJECT: BOTANY – [POST GRADUATE]

DEGREE: M.Sc., BOTANY

1st and 3rd semester Changes made at BOS meeting held on 13.01.2022 (in %)
HC 1.3 Systematics of Angiosperms (5.17%)
HC 3.3 Plant Biotechnology (40.22%)
SC 3.3 Plant Propagation and Plant Breeding (1.7%)
OE 3.1 Plant Propagation Techniques (1.35%)
(CHANGES MADE ARE HIGHLIGHTED IN THE TEXT)

FIRST SEMESTER				Credits: 22
No.	**Course/Paper Code**	**Title of the Course/ Paper**	**Hrs/Week L:T:P**	**Credits**
1	HARD CORE 1.1	Virology, Bacteriology, Mycology and Plant Pathology	2:2:2	2:1:1
2	HARD CORE 1.2	Phycology, Bryophytes, Pteridophytes and Gymnosperms	2:2:2	2:1:1
3	HARD CORE 1.3	Systematics of Angiosperms	2:2:2	2:1:1+ (2 credits for submission of tour report) 2:1:3
4	SOFT CORE 1.1**	Fungal Biology and Biotechnology	2:2:2	2:1:1
5	SOFT CORE 1.2**	Algal Biology and Biotechnology	2:2:2	2:1:1
6	SOFT CORE 1.3**	Lichenology and Mycorrhizal Technology	2:2:2	2:1:1
7	SOFT CORE 1.4**	Phytopathology	2:2:2	2:1:1

*Field Study/Tour: The student shall undertake a field trip for a minimum of 2-3 days and shall submit the herbaria and tour report for evaluation-2 credits.
**Any two soft core papers shall be studied.

SECOND SEMESTER				Credits: 18
No.	Course/Paper Code	Title of the Course / Paper	Hrs/Week L:T:P	Credits
1	HARD CORE 2.1	Reproductive Biology of Angiosperms and Plant Morphogenesis	2:2:2	2:1:1
2	HARD CORE 2.2	Cell Biology and Genetics	2:2:2	2:1:1
3	HARD CORE 2.3	Plant Breeding and Evolutionary Biology	2:2:2	2:1:1
4	SOFT CORE 2.1*	Plant Anatomy and Histochemistry	2:0:2	2:0:1
5	SOFT CORE 2.2*	Ethno-Botany and Intellectual Property Rights (IPR)	2:0:2	2:0:1
6	SOFT CORE 2.3*	Economic Botany	2:0:2	2:0:1
7	OPEN ELECTIVE 2.1	Medicinal Plants	2:2:0	2:1:0
	** Any two soft core papers shall be studied.			

THIRD SEMESTER				Credits: 16
No.	Course/Paper Code	Title of the Course /Paper	Hrs/Week L:T:P	Credits
1	HARD CORE 3.1	Biochemistry and Plant Physiology	2:2:2	2:1:1
2	HARD CORE 3.2	Molecular Biology	2:2:2	2:1:1
3	HARD CORE 3.3	Plant Biotechnology	2:2:2	2:1:1
4	SOFT CORE 3.1*	Molecular Genetics of Plants	2:2:2	2:1:1
5	SOFT CORE 3.2*	Molecular Plant Pathology	2:2:2	2:1:1
6	SOFT CORE 3.3*	Plant Propagation and Plant Breeding	2:2:2	2:1:1
7	SOFT CORE 3.4*	Phyto-chemistry and Herbal Technology	2:2:2	2:1:1
8	OPEN ELECTIVE 3.1	Plant Propagation Techniques	2:2:0	2:1:0
	* Any one soft core courses/papers shall be studied.			

FOURTH SEMESTER Credits: 16				
No.	Course/Paper Code	Title of the Course /Paper	Hrs/Wk L:T:P	Credits
1	HARD CORE 4.1	Ecology, Conservation Biology and Phytogeography	2:2:2	2:1:1
2	HARD CORE 4.2	Project Work *	4:2:2	8
3	SOFT CORE 4.1*	Seed Technology	2:2:2	2:1:1
4	SOFT CORE 4.2*	Seed Pathology	2:2:2	2:1:1
5	SOFT CORE 4.3*	Bio -Analytical Techniques	2:2:2	2:1:1
6	OPEN ELECTIVE 4.1	Plant Diversity and Human Welfare	2:2:0	2:1:1
	***Project Work:** The student shall undertake a Project Work in the Department or in any other University or Institute under the guidance of a Research Supervisor and shall submit a Project Report duly signed by Student and Research Supervisor for Evaluation.			

Semester- Wise Credit Pattern:
I Semester= 22 [HC- 12+2=14 + 08 (SC)]
II Semester= 24 [HC- 12 + 08 (SC) + 04 (OE)]
III Semester= 18 (HC- 08 + 06 (SC) + 04 (OE)]
IV Semester= 20 (HC-12 +04 (SC) + 04 (OE)]

In total= 46 HC + 26 (SC) + 12 (OE)= The Department is offering 84 Credits of B.Sc. Honors/ M.Sc. Botany (CBCS) Course including three Open Elective Course to the outside Department Students/

Important Note:
Student is required to earn the credit for qualifying B.Sc. Honors/ M.Sc. Botany from Department of Botany as follows:

Hard Core offered by the Department= 46 (Against maximum of 56)
Soft Core offered by the Department = 26 (Against minimum of 16)
Minimum Open Elective to be earned by the Student (Outside the Department) = 04
A total of 76 Credit is required for qualifying B.Sc. Honors/ M.Sc. Botany Course.

SCHEME OF EXAMINATION/ASSESSMENT
MODEL QUESTION PAPER (THEORY)
JSS COLLEGE FOR ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS) OOTY ROAD, MYSURU- 25

POST GRADUATE DEPARTMENT OF BOTANY

M.Sc., Degree ------Semester Examination May/June-20--
BOTANY
Course/Paper: ……………………………………………………
Course/Paper Code……………………………………………..

Time: 3 Hrs **Max Marks: 70**

Instructions: 1) Answer all questions.
2) Draw neat and labelled diagrams wherever necessary.

I. Answer the following; (10MCQs of 1 Marks each) **10 X 1 = 10**

2 from Unit I
3 from Unit II
2 from Unit III
3 from Unit IV

II. Answer the following; **4 X 5 = 20**

2 from Unit I with internal choice
2 from Unit II with internal choice
2 from Unit III with internal choice
2 from Unit IV with internal choice

III. Answer the following; **4 X10 = 40**

2 from Unit I with internal choice
2 from Unit II with internal choice
2 from Unit III with internal choice
2 from Unit IV with internal choice

SCHEME OF PRACTICAL EXAMINATION/ASSESSMENT
MODEL QUESTION PAPER (PRACTICALS)

JSS COLLEGE FOR ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS) OOTY ROAD, MYSURU- 25

POST GRADUATE DEPARTMENT OF BOTANY

M.Sc., Degree I Semester Examination May/June-2018
BOTANY
Course/Paper: ……………………………………………………
Course/Paper Code………………………………………………..

Time: 3 Hrs **Max Marks: 70**

Q I. Conducting Experiment/Micro-preparation /Plant identification 15
Q II. Minor experiment/ Demonstrations/ Procedure Writing 10
Q III. Critically comments (3x5 Marks) 15
Q IV. Identification 5x2 Marks) 10
Q V. Viva-voce examination 10
Q VI. Class Records/ Submissions 10

PO M.SC. BOTANY

Sl. No.	PO
1.	Conduct investigations of complex problems by the use of research-based knowledge on an independent term project.
2.	Transfer of appropriate knowledge and methods from one topic to another within the subject.
3.	Carry out practical work, in the field and in the laboratory, with minimal risk.
4.	Able to think logically and organize tasks into a structured form and assimilate knowledge and ideas based on wide reading of text books and through the internet.
5.	Apply the scientific knowledge of basic science, life sciences and fundamental process of plants to study and analyse any plant form.
6.	Knowledge and understanding of the range of plant biology in terms of structure, function and environmental relationships.
7.	Apply reasoning informed by the contextual knowledge to assess plant diversity, and the consequent responsibilities relevant to the biodiversity conservation practice.

PSO M.SC. BOTANY

Sl. No.	COURSE	PSO
1.	Algal Biology and Biotechnology	Phylogeny, thallus organisation, economic and ecological importance of alagal community
2.	Biochemistry and Plant Physiology	Biomolecules, metabolic pathways and stress physiology in plants
3.	Cell Biology and Genetics	Cell originals and Mendelian principles
4.	Ecology, Conservation Biology and Phytogeography	Diversity of vegetation, distribution and its conservation
5.	Economic Botany	Economic values of different crop plants and their applications
6.	Major Project	Hands on experience in various fields of plant science
7.	Molecular Biology	Molecular level organisation in prokaryotes and eukaryotes with respect to various mechanisms involved
8.	Plant Anatomy and Histochemistry	Anatomical features and organisation of cells in plants
9.	Plant Breeding and Evolutionary Biology	Plant breeding methods, procedures and their application for crop improvement
10.	Plant Biotechnology	Tissue culture techniques and its application in development of resistant varieties
11.	Plant Propagation and Plant Breeding	Propagation methods and plant breeding procedures and their application in different fields
12.	Plant Propagation Techniques	Propagation methods and procedures and their application in different fields
13.	Phycology, Bryophytes, Pteridophytes and Gymnosperms	Distribution, classification and phylogeny of lower plant communities
14.	Phytopathology	Concepts of plant diseases defence mechanisms in plants and study of plant diseases
15.	Reproductive Biology of Angiosperms and Plant Morphogenesis	Embryological study of growth and development using plant models
16.	Seed Technology	Industrial scale processing of seeds up to marketing

17.	Systematics of Angiosperms	Angiospermic plant family study with their phylogeny
18.	Virology, Bacteriology, Mycology and Plant Pathology	Diversity, distribution of microorganism with respect to their economic aspects

CO M.SC. BOTANY

Sl. No.	COURSE	CO
1.	Algal Biology and Biotechnology	Specify in depth of thallus organization and phylogeny in algae
2.	Algal Biology and Biotechnology	Understand the details of toxins, blooms and distributions of algae
3.	Algal Biology and Biotechnology	Deliberate in depth about cultivation and marketing algae
4.	Algal Biology and Biotechnology	Specify the details of Algal products and uses
5.	Biochemistry and Plant Physiology	Learn in details with biomolecules and their function
6.	Biochemistry and Plant Physiology	Understand in depth about solute transport and photosynthesis in plants
7.	Biochemistry and Plant Physiology	Specify the details of metabolism of nitrogen, lipids and plant hormones
8.	Biochemistry and Plant Physiology	Understand in depth about Stress physiology
9.	Cell Biology and Genetics	Learn in detail about cell membranes transport and proteins
10.	Cell Biology and Genetics	Deliberate the Functions of cell organelles, programed cell death
11.	Cell Biology and Genetics	Specify the extensions of Mendelian principles
12.	Cell Biology and Genetics	Learn about Sex determination and dosage compensation
13.	Ecology, Conservation Biology and Phytogeography	Understand the diversity of ecosystem and types of ecosystems
14.	Ecology, Conservation Biology and Phytogeography	Learn the in details of pollution and environmental biology
15.	Ecology, Conservation Biology and Phytogeography	Study the importance of biodiversity and conservation biology
16.	Ecology, Conservation Biology and Phytogeography	Detailed study of phytogeography and crop distribution
17.	Economic Botany	Specify the details of cereals, millets, pulses, oil yielding plants and study of horticultural plants and floriculture
18.	Economic Botany	Deliberate the characteristics of sugar yielding plants, spices and condiments
19.	Economic Botany	Understand the importance of fibre, timber and gum yielding plant
20.	Economic Botany	Deliberate on the medicinal plants and their applications
21.	Major Project	Learn the details of literature survey and methodology in research
22.	Molecular Biology	Identify the characteristics of genetic materials and its replication
23.	Molecular Biology	Learn the details of molecular basis of mutation, repair and recombination
24.	Molecular Biology	Deliberate the details of RNA formation, processing of RNA and post-RNA
25.	Molecular Biology	Understand in depth of gene regulation in prokaryotes and eukaryotes
26.	Plant Anatomy and Histochemistry	Learn in details of primary vegetative body of the plants
27.	Plant Anatomy and Histochemistry	Deliberate in details of differentiation in vascular tissues and study of apical meristems in shoot and root
28.	Plant Anatomy and Histochemistry	Deliberate the characteristics of secondary growth
29.	Plant Anatomy and	Understand the details of plant histochemistry

	Histochemistry	
30.	Plant Breeding and Evolutionary Biology	Learn in depth about plant breeding methods and techniques
31.	Plant Breeding and Evolutionary Biology	Understand the details of breeding for specific purposes
32.	Plant Breeding and Evolutionary Biology	Learn the details of Nature of evolution
33.	Plant Breeding and Evolutionary Biology	Identify the characteristics of variation and speciation
34.	Plant Biotechnology	Understand in depth about plant tissue culture and its techniques
35.	Plant Biotechnology	Specify the genetic engineering and tools used in it
36.	Plant Biotechnology	Understand the details of genetic manipulation, transgenic approaches to produce resistant plants
37.	Plant Biotechnology	Learn the details of engineering of crop plants for production of secondary metabolites
38.	Plant Propagation and Plant Breeding	Learn the details of importance of plant propagation, vegetative propagation and micro propagation
39.	Plant Propagation and Plant Breeding	Understanding of basic concepts of plant breeding and genetics
40.	Plant Propagation and Plant Breeding	Study types, purposes of plant breeding
41.	Plant Propagation and Plant Breeding	Deliberate study of advanced breeding aspects
42.	Plant Propagation Techniques	Learn the details of importance of plant propagation
43.	Plant Propagation Techniques	Understand in depth about types of vegetative propagation
44.	Plant Propagation Techniques	Learn the techniques of budding and layering
45.	Plant Propagation Techniques	Deliberate in details with examples of micro propagation in forestry and horticulture plants
46.	Phycology, Bryophytes, Pteridophytes and Gymnosperms	Understand the details of diversity, distribution, pigmentation and life cycle of algae
47.	Phycology, Bryophytes, Pteridophytes and Gymnosperms	Deliberate in depth of Bryophytes life cycle, classification, phylogeny and Economic importance
48.	Phycology, Bryophytes, Pteridophytes and Gymnosperms	Understand the details of Pteridophytes life cycle, phylogeny, classification, economic importance and anatomy
49.	Phycology, Bryophytes, Pteridophytes and Gymnosperms	Write down in details with examples Gymnosperms history, reproduction, edconomic importance and interrelationship
50.	Phytopathology	Learn the details of the concept, causative agents and disease cycle of plant pathogens
51.	Phytopathology	Deliberate the details of defense mechanisms in plants and its genetics
52.	Phytopathology	Study of Management of plant diseases
53.	Phytopathology	Identify in details with examples of diseases in crop plants
54.	Reproductive Biology of Angiosperms and Plant Morphogenesis	Understanding the microsporogenesis and historical overview
55.	Reproductive Biology of Angiosperms and Plant Morphogenesis	Specify in details with examples about megasporogeneis, fertilization, endosperm and embryo
56.	Reproductive Biology of Angiosperms and Plant Morphogenesis	Specify the details of models and concepts of plant morphogenesis
57.	Reproductive Biology of Angiosperms and Plant Morphogenesis	Understand in details with examples of plant growth and development, photomorphogenesis
58.	Seed Technology	Understand the seed science and concepts
59.	Seed Technology	Study the seed production and processing methods

60.	Seed Technology	Learn about seed quality parameters and tests
61.	Seed Technology	Deliberate the procedure of seed certification
62.	Systematics of Angiosperms	Understand the principles and applications of Taxonomy of angiosperms
63.	Systematics of Angiosperms	Specify the details of taxonomic literature
64.	Systematics of Angiosperms	Deliberate in details with examples Dicot and monocot family and features of classification systems
65.	Systematics of Angiosperms	Specify in details molecular systematics with examples of softwares and databases
66.	Virology, Bacteriology, Mycology and Plant Pathology	Learn the classification and characteristics of viruses, viroids, prions and diseases of it
67.	Virology, Bacteriology, Mycology and Plant Pathology	Deliberate in details with examples of Bacteria, archeabacteria, actinomycetes and mycoplasma and its economic importance
68.	Virology, Bacteriology, Mycology and Plant Pathology	Specify the Fungal diversity, life cycle and economic importance of fungi
69.	Virology, Bacteriology, Mycology and Plant Pathology	Understand in details of etiology, distribution and management of plant disease

BOTANY: I SEMESTER- HARD CORE 1.1

VIROLOGY, BACTERIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Theory-32 Hrs

Unit-1: Virology: Origin and evolution of viruses; Classification of viruses-ICTV and Baltimore Systems; Genome diversity in viruses; Methods of cultivation of viruses; Purification and detection of viruses; Transmission of viruses; Mechanism of replication of DNA and RNA viruses; Viroids - Structure and multiplication; Prions - structure and multiplication; Prion diseases.

Unit-2: Bacteriology: Introduction and classification of Bacteria by Bergey's Manual of Determinative and Sytematic Bacteriology; C. R. Woese- Three domain classification of Bacteria; Archaebacteria and Eubacteria - diversity and evolution; Nutritional types of bacteria; Bacterial growth; Recombination in bacteria (conjugation transformation, and transduction); Brief account on actinomycetes; Structure and multiplication of Mycoplasma and Phytoplasmas; Economic importance of bacteria.

Unit -3: Mycology: Present status of fungi; Outline classification of fungi (Ainsworth-1973). Vegetative organization in fungi; Nutrition in fungi (saprotrophs, biotrophs, necrotrophs; symbiotrophs); Methods of reproduction in fungi - Asexual and sexual methods; Spore liberation in fungi; Evolution of sex in fungi; Heterothallism and parasexuality; Life cycle pattern and phylogeny of Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina; Fungi and their economic importance.

Unit-4: Plant Pathology: Concepts and scope of plant pathology; Plant diseases and crop losses; Classification of plant diseases; Parasitism and disease development; Effect on physiology of host; Host range of pathogens; Defence Mechanisms in Plants; Plant Disease epidemics and plant disease forecasting; Methods of plant disease management; Study of plant diseases- Sandal Spike, Citrus Canker, Bacterial Blight of Paddy, Late Blight of Potato, Downy Mildew of Bajra, Tikka Disease of Ground nut, Grain Smut of Sorghum. Phloem Necrosis of Coffee, Root Knot Disease of Mulberry.

Practicals-32 Hrs

1) Laboratory guidelines, design, tools, equipments and other requirements for studying microorganisms.
2) Measuring the dimensions of microorganisms using Micrometry.
3) Determining total count of microbes using Haemocytometer.
4) Gram and special staining of bacteria.
5) Preparation of NA, PDA, sterilization, pouring, inoculation and culturing of bacteria/fungi.
6) Staining of fungi including VAM fungi.
7) Identification of fungi.
8) Measurement of bacterial growth by Spectrophotometer.
9) Recording environmental factors (Temperature, RH, and Rainfall and wind velocity).
10) Splash liberation of spores from diseased tissue.
11) Estimation of total phenols in diseased and healthy plant tissues.
12) Study of the following diseases: Sandal Spike, Citrus canker, Bacterial Blight of paddy, Late Blight of Potato. Downy Mildew of Bajra, Tikka disease of ground nut, Grain smut of Sorghum, Phloem Necrosis of Coffee, Root Knot disease of Mulberry.

References

1) Madigan, M .T. 2012. Brock Biology of Microorgasms, 13t edn. Benjamin Cummings.
2) Willey, J, Sherwood, L. and Woolverton, C.J. 2013. Prescott`s Microbilogy 9th edn. Mc Graw- Hill Educations.
3) Wagner, E.K, and Hewlett, M.J. 2009. Basic Virology. Blackwell Science Ltd. 2nd edn. USA.
4) Kodo, C.I. and Agarwal, H.O. 1972. Principles and Techniques in Plant Virology, Van Nostrand, Reinhold Company, New York.
5) Conrat, F.H., Kimball, P.C. and Jay, L. 1988.V irology. Prentice Hall, Englewood Chiff, New Jercy.
6) Jawaid, A. Khan and Jeanne Dijkstra. 2002. Plant Viruses as Molecular Pathogens. Food Products Press, NY
7) Alexopoulos, C.J. Mims, C.W. and Blackwell, M. 2013. Introductory Mycology 4th edn. Wiley.
8) Singh, R. S. 2009. Plant Disease. 9th edn. Oxford and IBH Pub.Co., New Delhi.
9) Agrios, G. N. 2005. Plant Pathology 5th edn. Academic Press, San Diego.
10) Rangaswamy, G. and Mahadevan, A. 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
11) Mehrotra, R. S. 2003. Plant Pathology. 2nd edn. Tata Mc Graw-Hill Pub. Co. Ltd., New Delhi.
12) Cann, A.J. 2012. Principles of Molecular Virology 5th edn. Elsevier Ltd, USA.
13) Flint, S.J. Enaquist, L.W., Rancnicllo, V. R. and Skalka, A.M. 2009. Principles of Virology pathogenesis and control. 3rd edn. APS Press, USA.
14) Hall, R. 2014. Plant Virology, 5th edn. Elsevier, USA.
15) Aneja, K.R. 2003. Experiments in Microbiology plant Pathology and Biotechnology, 4th edn. New Age International Publishers, New Delhi.
16) Holt, J.G., Krige, N.R., Sneath., P.H.A. Stuley, J.T. and Williams, S.T. 2010. Bergey`s Manual of Determinative Bacteriology, 9th edn. Williams and Wilkins, USA.

BOTANY: I SEMESTER - HARD CORE 1.2
PHYCOLOGY, BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Theory-32 Hrs

Unit-1: Phycology: Diversity and distribution of algae; Unicellular, colonial, filamentous, heterotrichous, parenchymatous, pseudoparenchymatous, siphonous forms; General characteristics, classification and phylogeny of algae; Pigmentation in algal groups; Role of photosynthetic and accessory pigments; Life cycles in algae - haplontic, diplontic, isomorphic, heteromorphic; Economic importance of algae.

Unit -2: Bryophytes: Introduction, general characteristics, classification and phylogeny of Bryophytes; Distribution, habitat, external and internal morphology and reproduction; Comparative account on gametophytes and sporophytes of bryophytes; Economic and ecological importance.

Unit -3: Pteridophytes: Introduction, classification and phylogeny; Morphology, anatomy reproductive biology and phylogeny; Psilophytes, Lycophytes, Sphenophytes, Filicophyta; Evolution of sorus; evolution of sporangium; Gemetophyte development - homosporous and heterosporous ferns; Heterospory and seed habit; Stelar evolution in Pteridophytes; Ecology of Pteridophytes; Economic importance.

Unit- 4: Gymnosperms: Distribution, general characteristics, classification and phylogeny of Gymnosperms; Range in morphology, anatomy, reproduction and interrelationships of - Cycadales, Ginkgoales, Coniferales, Gnetales; Pteridosperms; Economic importance of Gymnosperms.

Practicals-32 Hrs

1-4) Algae: Study of Cyanophyceae: *Anabaena, Oscillatoria*; Study of Chlorophyceae: *Oedogonium*, *Pediastrum;* Study of Phaeophyceae: *Turbinaria, Ectocarpus*; Study of Rhodophyceae: *Gracilaria*, *Batrachospermum*; Economic products of algae.

5-7) **Bryophytes:** Study of morphology, anatomy and reproductive morphology - Hepaticopsida- *Marchantia, Dumortiera*; Anthocerotopsida- *Anthoceros, Notothylas*; Bryopsida- *Bryum* and *Polytrichum*.

8-10) **Pteridophytes:** Study of vegetative habit, anatomy and reproductive morphology of *Psilotum, Lycopodium, Isoetes, Ophioglossum, Botrychium, Angiopteris, Pteris, Hymenophyllum, Marselia, Salvinia, Azolla;* **Paleobotany**- Study of Lepidodendrales, Calamitales, Sphenophyllales and Coenopteridales (Fossil Pteriodophytes).

11-12) **Gymnosperms:** Study of morphology, anatomy and reproductive morphology of *Zamia, Pinus* and *Ephedra, Ginkgo, Auracaria, Podocarpus, Gnetum, Agathis, Cupressus*, *Thuja*; Economic importance of Gymnosperms.

References:

1) Bower, F.O. 1935. Primitive land plants, Macmillan, London.
2) Campbell, D. H. 1972. Evolution of land plants (Embryophytes), Central Book Department Allahabad.

3) Watson, E.V. 1971. The structure and life of Bryophytes Hutchinson and Co. Ltd. London.
4) Parihar, N.S. 1970 An Introduction to Embryophyta Vol. 1. Bryophyta. Central Book Department, Allahabad.
5) Prempuri, 1981. Bryophytes, Morphology, Growth and Differentiation. Atmaram and sons, New Delhi.
6) Nayar, M.C., Rajesh, K.P. and Madhusoodanan, P.V. 2005. Bryophytes of Wyanad.
7) Murthy, A.V.S.S. 2005. A text book of algae. IK International Pvt., Ltd., New Delhi.
8) Bold, H. C. and Wynne, M.J. 1978. Introduction to the algae. Structure and reproduction. Prentice Hall.
9) Chapman and Chapman. 1973. The Algae. Macmillan Co., New York.
10) Fritsch, F. E. 1935. Structure and Reproduction of Algae Vol. I & II. Cambridge Univ. Press, London.
11) Odum, E.P. Fundamentals of Ecology. 3rd edn. Toppan Co., Ltd., Japan.
12) Round, F. E. 1973. Biology of the algae. Edward Arnold Ltd., London.
13) Smith, G.M. 1951. Manual of Phycology. Pub. Co. Waltham., Mass.
14) Venkataraman, G.S. 1974. Algae form and function. Today & Tomorrow's Pub., New Delhi.
15) South, G. R. And Whittick, A. 1987. Introduction to Phycology. Blackwell Scientific Publication, UK.
16) Hoek, V., Mann, D. G. And Jahns, H. M. 1995. An introduction to Phycology. Cambridge University Press, UK.
17) Biswas, C. and Johri, B. M. 1997. The Gymnosperms. New Age Publishers, New Delhi.
18) Rashid A. 1986. An Introduction to Pteridophytes. Vikas, New Delhi.
19) Sporne K. R. 1969. Morphology of Gymnosperms. Hutchinson University Library, London.
20) Sporne, K. R. 1969. Morphology of Pteridophytes. Hutchinson University Library, London.
21) Chase, M.W. and Reveal, J.L. 2009. A phylogenetic classification of the land plants to accompany APG III. Botanical Journal of the Linnean Society, 161: 122-127.
22) Sundararajan, S. 2007. Introduction to Pteridophyta. New Age International Publishers, New Delhi.
23) Vashishta, P.C. (2008). Botany for Degree Students: Pteridophyta. S. Chand & Co. Ltd., New Delhi.

BOTANY: I SEMESTER - HARD CORE 1.3
SYSTEMATICS OF ANGIOSPERMS

Theory-32 Hrs

Unit-1: Introduction to plant systematics; Plant classification systems-artificial, natural and phylogenetic systems; Contributions of Carolus Linnaeus, Michel Adanson, de Jussieu, de Candolle to plant classification; Concepts of taxonomic hierarchy; Taxonomic Categories-Genus concept; Species concept; Intraspecific categories; subspecies; varieties and forms; History of botanical nomenclature; ICBN and ICN aims and principles; Rules and recommendations; Rule of priority; Typification; Author citation, Legitimate and illegitimate names; Name changes and synonyms; Effective and valid publication; Herbarium and its significance; Botanical gardens.

Unit-2: **Taxonomic Literature:** General taxonomic indices, world floras and manuals; Monographs and revisions; Bibliographies, catalogues and reviews; Periodicals, glossaries and dictionaries; Hortus Malabaricus; Taxonomic websites-IPNI, Plant List, Tropicos, Botanico-Periodicum-Huntianum (BPH); Biodiversity Heritage Library (BHL); Botanicus, Index Herbariorum; Taxonomic Keys- bracketed keys, indented keys, numbered keys, edge punched and body punched keys.

Unit-3: Study of plant classification Systems; Broad outlines of Bentham and Hooker's system, Engler and Prantl's system, Hutchinson's system, Takhtajan's system, and Cronquist's system; Numerical Taxonomy-principles, selection of characters, merits and demerits; Angiosperm Phylogeny Group (APG) III & IV classification; Study of angiosperm families-Magnoliaceae, Nympheaceae, Urticaceae, Papaveraceae, Euphorbiaceae, Acanthaceae, Rubiaceae, Alismataceae, Cyperaceae, Commelinaceae, Zingiberaceae, Liliaceae, Dioscoreaceae and Orchidaceae.

Unit-4: Molecular Systematics: Nuclear, mitochondrial and chloroplast genes. Gene sequencing, analysis of molecular data, alignment of sequences; Phylogenetic tree construction-Maximum Likelihood and Neighbour Joining Methods; Phylogenetic analysisrooted and unrooted trees; Data analysis- alignment, substitution, model building; Phylogentic softwares-CLUSTAL W, MEGA, Mesquite, PAUP, PHYLIP, Treefinder, TreeBase.

Practicals-32 Hrs

1) Methods of preparation and maintenance of Herbaria.
2-4) A field trip of three days to a floristically rich area to study plants belonging to different families (Every student shall submit a report for evaluation for two credits).
5-10) Identification of the flowering plants in and around Mysore using keys, floras and monographs.
11-12) Construction of phylogenetic tree based on molecular data of plant species retrieved from GenBank.

References:

1. Cronquist, A. 1981. An Integrated system of classification of flowering plants. Columbia University Press, New York.
2. Simpson, M.G. 2006. Plant Systematics. Elsevier, Amsterdam.

3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.A. and Donoghue, M.J. 2002. Plant Systematics: A phylogenetic Approach. Sinauer Associates, Inc., Massachusetts.
4. Gurucharan Singh. 2004. Plant Systematics: Theory and Practice, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Jeffrey, C. 1982. An introduction to Plant Taxonomy. II Edn., Cambridge Uni. Press.
6. Mondal, A.K. 2009. Advanced Plant Taxonomy. New Central Book Agency Pvt. Ltd., Kolkata, WB.
7. Pullaiah, T. 1998. Taxonomy of Angiosperms. Regency Publications, New Delhi.
8. Johri, B.M. and Bhatacharjee, S.P. 1994. Taxonomy of Angiosperms. Narosa Publishers, New Delhi.
9. Lawrence, G.H.M. 191. Taxonomy of Vascular Plants. MacMillan, London.
10. Chase, M.W. and Reveal, J.L. 2009. A phylogenetic classification of the land plants to accompany APG III. Botanical Journal of Linnaean Society, 161: 122-127.
11. Nei, M. and Kumar, S. 2000. Molecular Evolution and Phylogenetics. Oxford Univ. Press, New York
12. APG-IV. 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants APG-IV. Botanical Journal of Linnaean Society, 181: 1-20.

BOTANY: I SEMESTER - SOFT CORE 1.1
FUNGAL BIOLOGY AND BIOTECHNOLOGY

Theory-32 Hrs

Unit-1: Introduction and historical overview of mycology; General characteristics and importance of fungi in human life; Fungi –Taxonomy and Systematics; Fungi in genetic and applied research; Estimation of Fungal diversity; Quantitative Indices- species richness, species evenness and species abundance; Molecular methods used for fungal diversity estimation-nuclear genome, messenger RNA transcripts, Ribosomal/DNA sequence comparisons and mitochondrial genome.

Unit-2: Macro fungi and micro fungi living on plant substrata; Lignicolous macrofungi; Lichenized fungi; Sequestrate fungi; Endophytic fungi; Saprobic soil fungi; Fungi in stressful environment; Mutualistic, arbuscular, and endomycorrhizal fungi; Yeasts; Fungicolous fungi; Fungi in fresh and marine water habitats; Fungi associated with aquatic animals; Fungi as parasites of humans and plants; Fungi associated with animals, insect, arthropod and nematodes; Coprophilous fungi.

Unit-3: Fungal Fermentation and Food Products: Food and Beverages; Single cell proteins-Myco-proteins; Food processing by fungi-bread, soybean products, cheese and fermented milk; Fungal secondary metabolites-antibiotics, immunosuppressive agents, anti-tumour agents, fungal toxins as medicines; Fungal pigments; Steroid transformation; Fungal enzymes; Bio-control agents; Application of molecular biology in fungal biotechnology.

Unit-4: Mushrooms and fungi in medicine; Toxic macromycetes; Mushroom cultivation; Model organisms- *Saccharomyces cerevisiae*/*Neurospora crassa*; Bio-deterioration of food grains and mycotoxins; Fungal communities of herbivore dung; The fungal communities of composts; Fungal interactions and practical exploitation; Heavy metals in fungi-accumulation and sorption; Biotechnology of wood rotting fungi.

Practicals-32 Hrs

1) Study of Myxomycetes and Chytridiomycetes
2) Study of Plasmodiophoromycetes and Oomycetes
3) Study of Zygomycetes
4) Study of Ascomycetes
5) Study of Basidiomycetes
6) Study of
Deuteromycetes 7)Study of
Lichens
8) Study of VAM fungi
9) Detection of aflatoxin B1
10) Cultivation of Oyster mushroom.
11) Alcoholic fermentation of grape juice by *Saccharomyces*.
12) Cultivation of *Penicillium* and testing antibiotic principle.
13) Study of edible and poisonous mushrooms.
14) Study of fungal model organisms - *Saccharomyces cerevisiae*/*Neurospora crassa*

References:

1) Alexopoulos, C. J., Mims, C. W. and Blakwell, M. 2007. Introductory Mycology 4th edn. Wiley India, New Delhi.
2) Deacon, J. W. 1997. Modern Mycology 3rd edn. Blackwell Science publishers, London.

3) Mehrotra, R.S. and Aneja, K.R. 1990. An Introduction to Mycology, New Age International (P) Limited, New Delhi.
4) Mueller, G M; Bills, GF and Foster, M.S. 2004. Biodiversity of Fungi, Elsevier Academic Press, New York.
5) Rai, M. and Bridge, P.D. 2009. Applied Mycology, CABI International, UK.
6) Carlile, M.J. Watkinson,S.C. and Gooday, G.W. 2001.The Fungi, 2nd edn. Academic Press, USA.
7) Webster, J. and Weber, R.W.S. 2007. Introduction to Fungi. 3rd edn. Cambridge University Press, Cambridge.

BOTANY: I SEMESTER - SOFT CORE 1.2
ALGAL BIOLOGY AND BIOTECHNOLOGY

Theory-32 Hrs

Unit-1:Algal Biology: Historical development of Phycology and contributions of Phycologists; Thallus organization in algae-Cyanophyceae, Chlorophyceae, Charophyceae, Euglenophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae; General characteristics, algal classification, affinities and phylogeny- polyphasic approach; Molecular markers for phylogenetic study; Algal physiology- ultra-structure of cells; Photosynthesis and respiration.

Unit-2: Algal blooms and Toxins: Blooms produced by algal groups; Toxins produced by cyanobacteria, diatoms, dinoflagellates, prymnesiophytes and eugleoids; bioaccumulation and biomagnification; effects of toxins on aquatic life and humans; Scenario in coastal waters of India- monitoring and safety measures; Algal communities of extreme environments- Thermal hot springs, cold springs, snow and ice; **Fresh water algae**-Ecological classification of fresh water organisms; Lentic communities of algae (pond, lake, bog, swamp); Lotic communities (streams, rivers, rapids; **Marine algae-** Marine biota; zonation; quantitative study of phytoplanktons, marine communities of algae.

Unit-3: Algal Biotechnology: Algal culture techniques; general principles; physical parameters; culture media; strain improvement; **Algal cultivation methods-**conventional, advanced; **Cultivation of microalgae-*Spirulina*** and ***Dunaliella***; Media, seeding, cultivation systems, harvesting; processing, drying methods, packaging, marketing; Algal cultivation and production in India; **Cultivation of macroalgae- *Porphyra;*** Nutritional value; importance of life cycle; methods of cultivation in advanced countries; Pillar, semi raft floating and open sea cultivation.

Unit-4: Applications of algae/products: Pollution indicators, treatment of waste water plants, heavy metal toxicity and phyco-remediation; Bio-fouling and biofuel production; Algal products as sources of nutraceuticals; Food colorants; Aquaculture feed; Therapeutics and cosmetics; Medicines; Dietary fibres from algae and uses; Biotechnological applications of algal silica and oils.

Practicals-32 Hrs

1) Study of fresh water planktonic forms in the lake samples.
2) Study of fresh water diatoms.
3) Chlorophyceae: *Ulva, Caulerpa, Halimeda, Acetabularia.*
4) Xanthophyceae: Mounting of *Botrydium* from soils.
5) Phaeophyceae: *Dictyota, Sargassum, Cystophyllum.*
6) Rhodophyceae: *Gracilaria, Gelidium.*
7) Cyanophyceae: *Microcystis*, *Nostoc, Spirulina.*
8) Estimation of carotene content in algal cells .
9) Culturing of microalgae: *Spirulina/ Chlorella/Scenedesmus/Dunaliella.*
10) Applications of algal products: Agar, spirulina tablets/powder, beta-carotene, phycobiliproteins, triglycerides, Mycosporine like amino acids (MAA), diatom silica as nanoparticles.
11) Visit to National Institute of Oceanography, Goa.
12) Study of algal herbaria.

References

1) Bold, H. C. and Wynne, M. J. 1978. Introduction to the algae. Structure and reproduction. Prentice Hall, New York.

2) Chapman and Chapman, V.J. 1973. The Algae. Macmillan Co., New York.

3) Fritsch, F. E. 1935. Structure and reproduction of Algae Vol. I and II. Cambridge University Press, London.

4) Hoek, V., Mann, D. G. and Jahns, H. M. 1995. An introduction to Phycology, Cambridge University Press, UK.

5) Murthy, A.V.S.S. 2005. A text book of algae. I.K. International Pvt., Ltd., New Delhi.

6) Odum, E. P. Fundamentals of Ecology. 3rd edn. Toppan Co., Ltd., Japan.

7) Round , F. E. 1973. Biology of the algae. Edward Arnold Ltd., London.

8) Southcott, G. R. and Whittick, A. 1987. Introduction to Phycology. Blackwell Scientific Publication, UK.

9)Venkataraman, G.S.1974. Algae form and function. Today and Tomorrow's Pub., New Delhi.

10) Bux *et al.* (eds.). 2016. Algae Biotechnology: Products and Processes, Springer, ISBN 9783319123332 (P), 9783319123349 (Online).

11) Chu, W. 2012. Biotechnological Applications of Microalgae. IeJSME 6(1): S24-S37.

BOTANY: I SEMESTER - SOFT CORE 1.3
LICHENOLOGY AND MYCORRHIZAL TECHNOLOGY

Theory-32 Hrs

Unit-1: Introduction: Photobionts- identification, reproduction, and taxonomy of photobionts; Occurrence within lichens; Mycobionts- Lichenized versus nonlichenized fungi; Bryophilous and folicolous lichens; Thallus morphology and anatomy; Growth forms - crustose lichens, foliose lichens, fruticose lichens; Vegetative structures- Homoiomerous thallus, stratified thallus, cortex, epicortex, and epinecral layer, photobiont layer and medulla, lower cortex, Attachment organs and appendages; Cyphellae and pseudocyphellae; Cephalodia (Photosymbiodemes); Reproductive structures- sexual reproduction in lichen-forming ascomycetes; Mating systems, dikaryon formation, Ascomal ontogeny, Ascosporogenesis; Ascus structure and function; Generative reproduction: ascoma, perithecia, apothecia, Thallinocarpia, Pycnoascocarpia, Hysterothecia, Asci, Basidioma; Vegetative reproduction- aposymbiotic propagules, symbiotic propagules; Systematics of lichenized fungi- History, classification and phylogeny.

Unit-2: Morphogenesis- Acquisition of a compatible photobiont; Recognition and specificity; Structural and functional aspects of the mycobiont–photobiont interface; Genotypes and phenotypes, growth patterns; Biochemistry and secondary metabolites- intracellular and extracellular products; The fungal origin of the secondary metabolites; Major categories of lichen products; Application to pharmacology and medicine; Harmful properties of lichen substances, lichens in perfume, lichens in dyeing; Stress physiology and the symbiosis- stress tolerance, limits to stress tolerance; harmful effects of stress, constitutive and inducible stress tolerance, evolution of stress tolerance in lichens; Modes of water uptake, light, temperature, carbon dioxide; The carbon economy of lichens.

Unit-3: Nitrogen, its metabolism and potential contribution to ecosystems, Methods of determination of nitrogen fixation; Nutrients- chemical and physical properties of nutrients and metals; Nutrient requirements, sources of nutrients, accumulation mechanisms, compartmentalization of elements within lichens; Metal toxicity, metal tolerance; Environmental role of lichens- dispersal, establishment, pedogenesis and biodeterioration; Community structure, succession, ecosystem dynamics; Animal and lichen interactions; Forest management, conservation, environmental monitoring; Lichen sensitivity to air pollution- lichens in relation to sulfur dioxide, oxidants and lichens, hydrogen fluoride and organopollutants.

Unit-IV: Mycorrhizal fungi: Introduction and classification; Types of mycorrhizas- Arbutoid mycorrhizas, ectomycorrhizas, vesicular arbuscular mycorrhizas or arbuscular mycorrhizas, ectendomycorrhizas, ericoid mycorrhizas, monotropoid mycorrhizas and orchid mycorrhizas; Phoshate solubilisation; Ecological significance of AM fungi; Importance of mycorrhiza in evolution of land plants; Role of mycorrhiza in agriculture, horticulture and forestry.

Practicals-32 Hrs

1-3) Survey of lichen vegetation in the study area: Frequency, density and abundance.
4) Determination of species richness and species diversity.
5) Isolation and maintenance of cyanobionts and phycobionts
6) Isolation and maintenance of mycobionts

7) Analysis of secondary metabolites of lichens.
8) Biological activity of secondary metabolites of the lichens.
9) Culture methods for lichens and lichen symbionts.
10) Root clearing and staining technique to study arbuscular mycorrhizal fungi.
11) Assessment of % root colonization of arbuscular mycorrhizal fungi.
12) Isolation and identification of arbuscular mycorrhizal fungi.

References:

1) Thomas H. Nash , 2008. Lichen Biology, 3rd edn. Cambridge University Press, The Edinburgh Building, Cambridge CB2 8RU, UK
2) Awasthi D.D. 2000. Lichenology in Indian subcontinent: A supplement to "A hand book of lichens". Publisher: M/s Bishen Singh Mahendra Pal Singh, Dehra Dun.
3) Awasthi D. D. 2013). A hand book of lichens , Publisher: M/s Bishen Singh Mahendra Pal Singh, Dehra Dun.
4) Sally E. Smith and David J. Read (2008). Mycorrhizal Symbiosis. 3rd edn. Academic Press, New York.
5) Larry Peterson R., Hugues B. Massicotte, Lewis H. Melville, 2004. Mycorrhizas: Anatomy and Cell Biology, CAB International, UK.

BOTANY: I- SEMESTER - SOFT CORE 1.4
PHYTOPATHOLOGY

Theory-32 Hrs

Unit-1: Concept of plant disease, Economic aspects of plant diseases; Types of plant diseases- Infectious diseases and non-infectious diseases; Causative agents of plant diseases; Angiospermic parasites; Development of plant pathology; Plant pathology in practice- Plant Clinic and Plant Doctor Concept; Parasitism and pathogenicity; Disease triangle; Infections and colonization; Weapons of plant pathogens; Effect of pathogen on physiology of host plant (photosynthesis, translocation and transpiration, respiration, permeability, transcription and translation).

Unit-2: Defence mechanisms in Plants- Pre-existing structural and chemical defences, induced structural and biochemical defences; Plant disease epidemiology- Elements of an epidemic and development of epidemics; Plant Disease forecasting; Genes and Diseases, Gene for gene concept, non-host resistance; Types of plant resistance to pathogens (Horizontal and Vertical Resistance); 'R' Genes and 'avr' genes; Genetics of virulence in pathogens and resistance in host plants; Breeding for disease resistance.

.

Unit-3: Management of Plant Diseases: Exclusion, eradication, cross protection, direct protection, integrated disease management, chemical methods of plant disease control; Biotechnological approaches to plant disease management; Gene silencing and disease control; Mechanism of gene silencing and control of viral diseases; Engineered resistance to viral, bacterial, fungal and insect diseases of crop plants.

Unit-4:Study of diseases of crop plants: Potato Spindle Tuber Disease, Tobacco Mosaic Disease, Sandal Spike Disease, Bacterial blight of Paddy, Citrus Canker, Late Blight of Potato, Downy Mildew of Maize, Blight of Paddy, Angular leaf spot of Cotton, Tikka disease of ground nut, Rust of coffee, Grain and Head smut of Sorghum. Leaf blight of Paddy, Blast of Paddy, Powdery mildew of cucurbits, Wilt of Tomato, Phloem Necrosis of Coffee, Root Knot of Disease of Mulberry and Vegetables; Non-parasitic diseases of plants; Seed-borne diseases.

Practicals-32 Hrs

1) Isolation of bacterial, fungal, and nematode plant pathogens of crop plants.
2) Study of mineral deficiency diseases of Tomato and French bean.
3) Estimation of foliar infection by Stover's method.
4) Study of spore germination.
5) Estimation of total phenols in diseased and healthy plant tissues.
6) Mycoflora analysis by Standard Blotter Method SBM/agar plating method.
7)-9) Study of Tobacco mosaic, Bacterial blight; Downy mildew of Maize; Powdery mildew of cucurbits; Grain smut of sorghum; Leaf rust of Coffee; Root Knot of Mulberry. Bunchy top of banana, Grassy shoot of sugar cane, Little leaf of Brinjal; Potao Spindle Tuber Disease (PSTVd)
10) Study of effect of pathogens on seed germination and vigour index.
11) Study of effect of fungicide on seed-borne pathogens.
12) Study of Fungal bio-control agents.

References:

1) Agrios, G. N. 2005. Plant Pathology 5th edn. Academic Press, San Diego.
2) Dickinson, M. 2003. Molecular Plant Pathology, Garland Publishing Inc, CT.
3) Ingram,D.S. and Robertson, N.F. 1999. Plant Diseases, Collins Publishers, London.

4) Johnston, A and Both, C. 1983. Plant Pathologists Pocket-book. 2nd edn.
Commonwealth Mycological Institute, Oxford and IBH Pub. Co. Calcutta.
5) Lane, C.R., Beales P.A. and Hughes, K.J.D. 2012. Fungal Plant Pathogens, CABI Publishing, Wallingford.
6) Mehrotra, R. S., 2003. Plant Pathology, 2nd edn. Tata Mc. Graw Hill Pub. Co. Ltd., NewDelhi.
7) Rangaswamy, G. and Mahadevan, A. 2002. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd. New Delhi.
8) Schumann, G. L. and D'Arcy, C. J. 2012. Hungry Planet: Stories of Plant Diseases, APS Press, USA.
9) Singh, R. S., 2009. Plant Diseases. 9th edn. Oxford and IBH Pub.Co. New Delhi.
10) Vidhyasekaran, P. 2004. Encylopedia of Plant Pathology.Viva Books Pvt. Ltd. New Delhi.

BOTANY: II- SEMESTER- HARDCORE 2.1

REPRODUCTIVE BIOLOGY OF ANGIOSPERMS AND PLANT MORPHOGENESIS

Theory-32 Hrs

Unit-1: Reproductive Biology of Angiosperms: Historical overview; Contributions of P. Maheshwari; BM Johri; BGL Swamy to the development of embryology in India; Microsporogenesis and Microgametogenesis- wall layers and functions; Tapetum- types, concept of male germ unit and its significance; Pollen morphological features; Unusual features-pollen development in Cyperaceae, pollen embryosac; Concept and scope of palynology.

Unit-2: Megasporogenesis and Megagametogenesis; Ovular structure and types; Development of monosporic, bisporic, tetrasporic and special types of embryo sacs; Ultra structure and nutrition of female gametophyte, concept of female germ unit and its significance; Fertilization- a general account, double fertilization, single fertilization, heterofertilization and polyspermy; Pollen recognition and rejection reactions - types, structures, methods to overcome incompatibility reactions; Endosperm- types, haustorial variations, ruminate and composite endosperm; Embryo- structure, development of monocot, dicot and grass embryo; Significance of embryonal suspensor; Experimental Embryology- scope and applications.

Unit-3: Plant Morphogenesis: Models of morphogenesis- comparison of plant v/s animal morphogenetic pathways: Embryo, *Arabidopsis thaliana*; Concepts- cell fate/ fate maps, gradients, stem cells in plants and their significance in development, polarity, symmetry, totipotency of cell types, pleuripotency, plasticity, differentiation, redifferentiation, dedifferentiation and regeneration in *Acetabularia* and *Arabidopsis thaliana.*

Unit-4: Plant Growth and Development: Types, shoot apical meristems, root meristems; control of cell division in meristems; Quiescent center and meresteme de attente; *Arabidopsis*- vascular patterning and leaf development, abnormal growth; Cellular basis of growth- maintenance of cell shape; Cytoskeletal elements; Photomorphogenesis- definition, history, Hartmann's technique; Photoreceptors and photo morphogenesis, localization and properties; Effect of blue light-mediated photomorphogenesis with suitable examples.

Practicals-32 Hrs

Reproductive Biology of Angiosperms:

1) Study of microsporangium- slides: wall layers, tapetal types, two-celled and three-celled pollen; pollen tetrads.

2) Study of pollen germination: *Balsam, Delonix, Hibiscus* and *Peltaphorum*

3) Study of megasporangium-slides: female gametophyte development in *Penstemon, Xyris pauciflora,* 2, 4, 8-nucleate stages, mature embryo sac.

4) Endosperm mounting- *Cucumis sativus, Grevellia robusta* and *Croton sparsiflorus*

5) Embryo: Slides-monocot, dicot and grass embryo.

6) Embryo mounting : *Crotalaria.*

Plant Morphogenesis:

7) Study of stem cells in plants: SAM, RM.

8) Regeneration abilities of shoot apical meristems of dicots on media with combinations of growth regulators.

9) Study of totipotency in cell types: stomata, epidermal cells, stem and leaf explants on a tissue culture media.

10) Polarity in stem cuttings: *Pothos* spp.

11) Study of regeneration in succulents *Kalanchoe*, *Byrophyllum.*

12) Study of leaf galls of plants: *Pongamia pinnata and Achyranthes aspera*: Morphological observations and histology.
13) Study of *Arabidopsis thaliana* as a model plant.

References:

1) Johri, B. M. 1984. The embryology of Angiosperms. Springer Verlag.
2) Johri, B. M. 1982. The experimental embryology of vascular plants. Springer Verlag, New York.
3) Swamy, B.G.L. & Krishnamurthy, K. V. 1982. From flower to fruit: The embryology of angiosperms. Tata McGraw Hill Co. New Delhi.
4) Eames, 1961. Morphology of Angiosperms. McGraw Hill book Co., Inc., New York.
5) Maheshwari, P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill book Co., Inc., New York.
6) Maheshwari, P. 1963. Recent advances in the embryology of angiosperms. ed. New Delhi
7) Bhojwani, S. S.and Bhatnagar, S. P. 1978. The embryology of Angiosperms. Vikas Publishing House, New Delhi.
8) Turing, A. M. 1952. The chemical basis of morphogenesis. Phil. Trans. R. Soc. Lond. B. 237: 37- 72.
9) Sinnot, E. W. 1960. Plant Morphogenesis. Mc Graw- Hill Book Co. Inc. New York, USA.
10) Steeves, T.A. and Sussex, I. M. 1989. Patterns in Plant development. 2nd edn. Cambridge University Press. UK.
Chasan, R. 1994. Tracing tracheary element development. The Plant Cell 6:917-919.
11) Lyndon, R. F. 1990. Plant Development : The Cellular basis. Unwin Hyman, London.
12) Aloni, R. 1987. Differentiation of vascular tissues. Annu. Rev. Plant Physiol. 38:179- 219.
13) Raman, A. 2007. Insect induced plant galls of India; unresolved questions. Curr. Sci. 92 (6): 748-757.
14) Smith, H. 1975. Phytochrome and Photomorphogenesis- an introduction to the photocontrol of plant development. Mc Graw- Hill Book Co. (UK), Ltd.
15) Mohr, H. 1972. Lectures in photomorphogenesis. Springler- Vohrleg, Berlin, Germany.

BOTANY: II- SEMESTER - HARD CORE 2.2
CELL BIOLOGY AND GENETICS

Theory-32 Hrs

Unit-1: Bio Molecules and Membranes: Structure, composition of bio-molecules and their stabilizing interactions (carbohydrates, lipids, proteins and nucleic acids); Unit membrane structure and functions; Membrane proteins, membrane transport and the electrical properties; Intra-cellular compartments and protein sorting; Intracellular membrane traffic; Cytoskeletons.

Unit-2: Functions of Organelles: Cell wall, membranes, nucleus, mitochondria, Golgi bodies, lysosomes, spherosomes, peroxisomes, ribosomes, endoplasmic reticulum, Plastids, chloroplast, vacuoles and cytoskeleton; Cell cycle and mechanism of cell cycle regulations; A brief account of cell signalling, receptors, second messengers; General mechanism of signal transduction pathway; Programmed cell death in life cycles of plants.

Unit-3: Extensions of Mendelian Principles co-dominance, incomplete dominance, gene interactions, multiple alleles, lethal alleles, pleiotropy, penetrance and expressivity, polygenic inheritance, linkage and crossing over, sex linked inheritance, sex limited and influenced traits, genome imprinting, extra nuclear inheritance; C**oncept of the gene**-classical-alleles, multiple alleles, pseudo-alleles, complementation test, experiments on rII locus and lozenge locus, modern- jumping genes, overlapping and genes within genes, split genes, nested genes, fusion genes; **Gene mapping methods-** linkage maps, tetrad analysis; Recombination in bacteria mapping genes in bacteria by interrupted mating technique, fine structure mapping, transduction and transformation mapping, mapping genes in Bacteriophages**,**

Unit-4: Sex Determination and Dosage Compensation: Chromosomal and genetic basis of sex determination; Mechanism of sex determination in *Melandrium*, *C. elegans*, Drosophila and humans, dosage compensation mechanisms in humans, Drosophila and *C. elegans*. **Transposable elements**- discovery in maize and bacteria, transposal elements in bacteria and bacteriophage, types and functions; Transposable elements in eukaryotes- Plants, *Drosophila* and Humans, mechanisms of transpositions;Transposable elements in research.

Practicals-32 Hrs

1) Determination of reducing sugars by Nelson-Somogyim's method.
2) Estimation of total soluble sugars by volumetric method.
3) Quantitative determination of free Amino acid content in germinating seeds.
4) Estimation of ascorbic acid in plant tissues.
5) Estimation of Phospholipids by TLC.
6) Slides/Charts/photos NP (Cytology Genetics and Embryology).
7) Study of mitosis in normal and induced root tips cells of Onion.
8) Study of meiosis in onion flower buds , translocation in Rhoeo.
9) Study of special chromosomes- B chromosomes, and sex chromosomes.
10) Determination of chiasma frequency in onion.
11) -12)To solve genetic problems on linkage, ordered and unordered tetrads.

References:

1) Atherly, A.G. Girton, J.R. Donald, J.R. 1999. The Science of Genetics. Saunders College Publishers. Fortworth .
2) Griffith, A.J.F. Gelbart, W.M. Muller, J.H. and Lewintin, R.C. 1999. Modern Genetic Analysis. W.H. Freeman and Co. New York.

3) Hartl. D. 1991. Basic Genetics. 2edn., Jones and Barlett Publishers Inc. Boston.
4) Fairbanks, D.J. and Anderson, W.R. 1999. Genetics the continuity of Life. Brooks's/Cole publishing Company, California.
5) Brooker. R.J. 1999. Genetics –analysis and principles. Addison Wesley Longman Inc.California.
6) Snustad, D.P., Simmons, M.J. and Jenkins, J.R. 1997. Principles of Genetics. Hohn Wiley & son's inc. New York.
7) Brown, T.A. 1989. Genetics a molecular approach. Van Nostrand Reinhold (intn) Co., Ltd. London.
8) Winchester, A.M. 1969. Genetics. 3rd edn. Oxford and IBH, New Delhi.
9) Strickberger, Monroe W. 2000. Evolution. 3rd Edn. Jones & Bartlett Publishers, Inc. 40 Tall PineDrive Sudbury, MA 01776, USA.
10) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Rafi, Keith Roberts, and Peter Walter. 2008. Molecular biology of the cell, 5th ed., Garland science, Taylor & Francis Group, LLC, 270 Madison Avenue, NewYork NY f 0016, USA.
11) Alberts, B., Bray, D., Lewis, J , Raff, M., Roberts, K and Watson, J.D. 1999 . Molecular biology of the cell. Garland Publishing, Inc., New York.
12) Kleinsmith, L.J. and Kish, V.M. 1995 .Principles of Cell and Molecular Biology 2nd edn. Harper Collins College Publishers, New York, USA.
13) Lodish, H. Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology, 4th edn.W.H. Freeman and Co. New York, USA.
14) Buchanan, B.B. W.Gruissem and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. ed. ASPP Press.USA.

BOTANY: II SEMESTER HARD CORE 2.3
PLANT BREEDING AND EVOLUTIONARY BIOLOGY

Theory-32 Hrs

Unit-1: Introduction: Objective and role of plant breeding; Evolution of plant breeding, scope of plant breeding, sciences related to plant breeding, Vavilov's concept of origin of centers of origin of crop plants; Recent trends in plant breeding; **Breeding Methods-**plant introduction and acclimatization, domestication and agriculture, pure line, clonal, mass and progeny selections, recurrent selection, pedigree, bulk and back cross methods; Heterosis breeding synthetic and composite varieties; **Breeding Techniques-**Mutation breeding, polyploidy, hybridization, tissue culture techniques in crop improvement, protoplast fusion, electrophoration, electro-fusion, biolistics, somatic hybridization, transgenic plants (GMO's); The role of Gene technology in plant breeding.

Unit-2: Breeding for Specific Purposes: Breeding for disease resistance, insect resistance, drought and salinity, quality trait, multiple cropping systems, ideotype breeding, breeding for Adaptation; **Crop breeding and seed production-** Breeding field crops, seed production techniques, release of new varieties, intellectual property rights, computer application in plant breeding, crop breeding Institutes/Centers; Genetic resources and germplasm conservation; Scientific Plant breeding; Green revolution; The elite crop (Golden rice); Contributions of **Dr.**
M.S. Swaminathan, Dr. Norman E. Borlaug and N.I. Vavilov.

Unit-3: Nature of Evolution : The origin, theories of evolution of life, earth and the universe,; Conditions of the early earth, emergence of the first living cell, origin of prokaryotic and eukaryotic cells, life in the Palaeozoic, Mesozoic and Coenozoic era. **Development of Evolutionary thoughts;** Ecological context, before Darwin, Darwinism, Darwin's evolutionary theory, Neo – Darwinism, modern synthesis: **Fossil evidence of Ancient life,** fossilization,; Interpreting geological time scale and fossil records; Evidences from comparative, morphology, patterns of development, comparative physiology and biochemistry, biogeography, palaeontology, taxonomy, anatomy and embryology, plant and animal breeding; Evidence from changing earth and sea; Extinctions; Evolutionary ecology.

Unit-4: Natural Selection : Types of natural selection, selective forces, selection models, sexual selection, selection and non adaptive characters, Adaptive radiation, artificial selection, **Variation- g**ene flow, genetic drift, gene mutation - Mendelian concept, chromosomal mutation, architectural changes in chromosomes; The Hardy – Weinberg law, polyploidy in plant evolution**;** Speciation and origin of higher categories **-**Types of speciation, models of speciation, pattern of speciation, isolating mechanism and species formation, signification of speciation; Molecular evolution.

Practicals-32 Hrs

(1) Study of floral biology of crops - typical examples of self and cross pollinated plants.
(2) Selfing and hybridization techniques - Bagging and emasculation.
(3) Pollen viability: germination test and TTC test.
(4) Studying of centre's of origin of cultivated crops - N.I. Vavilov Concept.
(5) Mode of pollination study in different crops.
(6) Identification of crop breeding institutes/ centers and logos.
(7) Studying and identification of contributors of plant breeding - M.S. Swaminathan, N.I. Vavilov, Norman . E. Borlaug .
(8) Study of contributions of scientists to evolutionary biology.
(9)-12) Study of models and photographs related to evolution.

References

1) Atherly, A.G. Girton, J.R. Donald, J.R. 1999. The Science of Genetics. Saunders College
2) Publishers. Fortworth.
3) Griffith, A.J.F., Gelbart, W.M. Muller, J.H. and Lewintin, R.C. 1999. Modern Genetic analysis. W.H. Freeman and co. New York.
4) Hartl. D. 1991. Basic Genetics. II edn. Jones and Barlett Publishers Inc. Boston.
5) Fairbanks, D.J. and W.R. Anderson. 1999. Genetics the continuity of life. Brooks's/Cole publishing company. California.
6) Brooker, R.J. 1999. Genetics –analysis and principles. Addison Wesley Longman Inc. California.
7) Snustad, D.P., Simmons, M.J. and Jenkins, J.R. 1997. Principles of Genetics. Hohn Wiley & son's inc. New York.
8) Brown, T.A.1989. Genetics a molecular approach. Van Nostrand Reinhold (intn) Co., Ltd. London.
10) Winchester, A.M. 1969. Genetics. III edn. Oxford and IBH, New Delhi.
11) Strickberger, Monroe W. 2000. Evolution. 3rd Ed., Jones & Bartlett Publishers, Inc. 40 Tall PineDrive Sudbury, MA 01776, United States of America
12) Futuyma, Douglas J. 2005. Evolution. Sinauer Associates, Inc., 23 Plumtree Road, Sunderland, MA 01375, United States of America
13) Dodson E. O. and Dodson P. 1976. Evolution: Process and Product. 2nd Ed., D. Van Nostrand Company, 450 West 33rd Street, New York, N.Y. 10001
14) Chopra, V.L. 2000. Plant Breeding- theory and practices. Oxford and IBH Publishing Co. Pvt. Ltd., Oxford.
15) Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of Plant Breeding. Narosa Publishing House, New Delhi.

BOTANY: II- SEMESTER - SOFT CORE 2.1
PLANT ANATOMY AND HISTO-CHEMISTRY

Theory-32 Hrs

Unit-1: Plant Anatomy: Primary vegetative body of the plant; Anatomical features of leaf, stem and root (dicot and monocot); leaf of fern and gymnosperm; Structure of modified leaves- Kranz anatomy and C4 photosynthesis; Ultra-structure and chemistry of the cell wall; formation of the cell wall and its uses.

Unit-2: Anatomy of Vascular Tissue: Ultra structure and differentiation of xylem and phloem tissues; Apical meristems- shoot apex in Pteridophytes, Gymnosperms and Angiosperms, theories, root apical meristems.

Unit -3: Secondary Growth: Vascular cambium, secondary xylem of gymnosperms and dicots and secondary phloem of Gymnosperms and dicots; Periderm and bark; Anomalous secondary growth in monocots and climbers; Leaf ontogeny - Dicot- simple, compound, Monocot; Floral anatomy-flower parts, floral meristem, vascular system.

Unit-4: Plant Histochemistry: Tests for minerals, carbohydrates, lignins, polyphenols, proteins, lipids and nucleic acids; Study of instruments: (a) Camera lucida (b) Micrometry (c) Microtome. Principles of histo-chemical stains; Killing, fixing and staining of plant tissues; Double staining- TBA method.

Practicals-32 Hrs

1) Staining of xylem and phloem elements.
2) Study of anatomy of roots in: *Ficus, Musa, Dieffenbachia*, *Vanda.*
3) Study of anamalous secondary growth in the following examples: Stem of *Aristolochia*, *Nyctanthes, Pyrostegia, Peperomia, Tinospora, Achyranthes*.
4) Study of Ecological anatomy.
5) Study of Vasculature in floral organs.
6) Studying double staining technique.
7-11) Embedding: TBA method, embedding for electron microscope, Sectioning**,** Microtomes, whole mounts maceration.
12) Histochemical- PAS Test**,** Sudan black- lipids**,** Feulgen reaction – Nucleic acids.

References:

1) Abraham, F. 1982. Plant Anatomy. 3rd edn. Pergaon Press. Oxford.
2) Cariquist, S. 1967. Comparative Plant Anatomy- Holt Reinert and Winston, New York.
3) Cutter, D. G. 1971. Plant Anatomy- Part 1, Cell and Tissues Edward Arnold London.
4) Cutter, D. G, 1971. Plant Anatomy- Part 1, Cell and Tissues Edward Arnold London. Part- II.
5) Eames and McDaniel, 1947. Plant Anatomy. 2nd edn., McGraw Hill, New York.
6) Esau, K. 1965, Plant Anatomy, Joh Wiley and Sons, New York.
7) James, D. Mauseth, 1998. Plant anatomy The Benzamin/ Cummins Publishing Co.Inc.
8) Esau, K. 1979, Anatomy of seed plants- first Wiley eastern reprint. New Delhi.
9) Krishnamurthy, K. V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers and Publishers) Pvt. Ltd. Madras.

BOTANY: II- SEMESTER - SOFT CORE 2.2
ETHNO-BOTANY AND INTELLECTUAL PROPERTY RIGHTS (IPR)

Theory - 32 Hrs

Unit-1: Ethno-botany: Introduction, concept, scope and objectives; Ethno-botany as an interdisciplinary science; The relevance of ethno-botany in the present context; Ethnic groups; Ethno-botany- Major and minor ethnic groups of India and their life styles; Forest Vs. ethnic groups; Plants in tribal life with reference to Magico-religious rituals and social customs; Sacred groves.

Unit-2: Methodology used in the study of Ethnobotany and Ethno pharmacology: Field work, Herbarium, Ancient Literature, Archaeological findings, temples and sacred places, protocols. Preliminary phyto-chemical analysis of ethno-botanical important medicinal plants.

Unit-3: Role of ethno-botany in modern Medicine with special examples; Medico-ethno-botanical Sources in India with special reference to Karnataka; Tribals Vs. Agriculture: Shifting, Podu and Jhum cultivation; Role of ethnic groups on surrounding environment; Crop genetic sources; Endangered taxa and forest management (participatory forest management); Ethno- botany as a tool to protect interests of ethnic groups; Sharing of wealth concept with few examples from India.

Unit-4: Study of Intellectual Property Rights – patents, trademark, geographical indication, copyright; IPR and Traditional Knowledge; Bio-piracy of traditional knowledge; Ethno botany and legal aspects; National and international organizations and treaty related to traditional knowledge – WIPO, TKDL, TRIPS, CBD, Nagoya protocol etc., Ethno botany as a source (recent) of already known drugs: a) *Withania* as an antioxidant and relaxant b) *Sarpagandha* in brain ailments c) *Becopa* and *Centella* in epilepsy and memory development in children d) *Phyllanthus fraternus* in diabetic and viral jaundice e) *Artemisia* as a powerful cerebral anti malarial agent and its possible use in tuberculosis.

Practicals-32 Hrs

1) Survey and collection important ethno botanical plants by using questionnaire and interview.
2) Preliminary phyto- chemical analysis of medicinal plants.
3) Study of biological functional properties of crude drugs – Anti microbial activity.
4) Study of methods of *in-situ* or *ex-situ* conservation of important medicinal plants.
5) Study of techniques used in Pharmacognosy – organoleptic, anatomy and chemical methods.
6) A visit to a Tribal area to conduct field work and collect ethno botanical information / data.
7) Listing of Crude drugs in Pansali shops (local crude drugs shops) and their identification (little known drugs only).
8) -12) Visit to nearby Western Ghats and Sacred Groves.

References:

1) Jain, S.K. 1995. Manual of Ethno-botany, Scientific Publishers, Jodhpur.
2) Jain, S.K. 1981. Glimpses of Indian. Ethno-botany, Oxford and I B H, New Delhi
3) S.K. Jain 1989. Methods and approaches in ethno-botany. (ed.) Society of ethno botanists, Lucknow, India.
4) Jain, S.K. 1990. Contributions of Indian ethno-botany. Scientific Publishers, Jodhpur.

5) Colton C.M. 1997. Ethno botany – Principles and applications. John Wiley and sons –
6) Rama Ro, N and A.N. Henry (1996). The Ethno-botany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
7) Rajiv K. Sinha – Ethno-botany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996
8) Faulks, P.J. 1958. An introduction to Ethno-botany, Moredale pub. Ltd. London

BOTANY: II- SEMESTER - SOFT CORE 2.3
ECONOMIC BOTANY

Theory -32 Hrs

Unit- 1: Economic Botany: The origin of cultivated plants and Agriculture; The future role of plants in relation to mankind; Introduction to Green revolution; Study of origin, distribution, cultivation and utility of the useful parts of the following- - rice, wheat, maize, barley, sorghum and millets; Red gram, green gram, black gram, horse gram, pea, cow pea, bengal gram; Oil Yielding plants- sunflower, safflower, groundnut, linseed, rape seed; A brief account of economically important horticultural and floricultural plants.

Unit- 2: Economic Botany: Study and utility of the useful parts of the following- Sugar yielding plants- sugar cane and sweet potato, sugar beet and *Stevia*; Spices and condiments - ginger, turmeric, cardamom, cinnamon, clove, saffron, all spice, black pepper, nutmeg, red pepper, coriander, cumin, fennel and *Vanilla.*

Unit -3: Economic Botany Study and utility of the useful parts of the following- fibre- cotton, jute, flax, hemp, Sunn hemp, China grass, coconut and Kapok; Timber yielding plants- *Tectona* and *Dalbergia*; Dyes- indigo, henna; Masticatories and fumitories-areca nut, betel leaf, tobacco; rubber- Para rubber and other substitutes; Gums- Gum Arabic, Karaya gum.

Unit-4: Medicinal Botany: Scope and importance of medicinal plants; Indigenous medicinal Sciences; Important medicinal plants and their uses; Major exporters and importers of traditional medicinal plants and plant products; Application of natural products to certain diseases- jaundice, cardiac, infertility, diabetics, blood pressure and skin diseases; Poisonous plants.

Practicals-32 Hrs

1) Utility, uses and economic importance of cereals and millets.
2) Utility, uses and economic importance of horticultural and floricultural plants
3) Utility, uses and economic importance of pulses and oil yielding crops.
4) Utility, uses and economic importance of sugar yielding crops.
5) Utility, uses and economic importance of spice and condiments.
6) Utility, uses and economic importance of fiber and timber yielding plants.
7) Utility, uses and economic importance of dye, rubber and gum yielding plants
8) Utility, uses and economic importance of masticatories and fumitories
9) -12) Study of medicinal and poisonous plants.

References:

1) Hill, A.F. 1952. Economic Botany, TataMcGraw Hill, New Delhi.
2) Kochhar, S.L. 1998. Economic Botany of Tropics, Macmillan India Publishers, New Delhi.
4) Pandey, B.P. 2000. Economic Botany. S. Chand & Company, New Delhi.
5) Pandey, S.N. and Chandha, A. 1999. Economic Botany. Vikas Publishing House Pvt. Ltd. New Delhi.

BOTANY: II SEMESTER- OPEN ELECTIVE 2.1
MEDICINAL PLANTS

Theory-32 Hrs

Unit-1: Medicinal Plants: History, scope and importance of medicinal plants; Indigenous medicinal sciences; History, origin, panchamahabhutas, saptadhatu and tridosha concept, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations.

Unit-2: Medicinal Plants Conservation: Conservation of endangered and endemic medicinal plants; Endemic and endangered medicinal plants; Red list criteria; *In-situ* conservation- biosphere reserves, sacred groves, national parks; *Ex situ* conservation- botanic gardens, ethno medicinal plant gardens; Propagation of medicinal plants - objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

Unit - 3: Funding for Cultivation of Medicinal Plants: Sources of financial aids for medicinal plant cultivation: Aims and objectives, Functions and activities of the board, Schemes and Projects for Financial assistance, Funding of projects; Procedure for processing project proposal for approval, Implementation and monitoring.

Unit- 4: Ethno botany and Folk medicines: Definition; Ethno botany in India: Methods to study ethno botany; Applications of Ethno botany: National interacts. Ethno medicine. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. Brief introduction to poisonous plants.

References:

1) Trivedi, P. C. 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2) Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn.
3) Agrobios, India.
4) Yoganarasimhan, S.N. Medicinal Plants of India- Vol 1- Karnataka, Interline Publishing Pvt. Ltd.

BOTANY: III- SEMESTER - HARD CORE 3.1
BIOCHEMISTRY AND PLANT PHYSIOLOGY

Theory -32 Hrs

Unit-1: Biochemistry- Brief account of plant structural and functional molecules-carbohydrates, proteins, lipids and nucleic acids**;** classification, structural and functional properties of bio molecules; Biochemistry of cell membranes; **Lipids-**building and storage molecules, classification and significance; **Proteins-** classification, structure- primary, secondary, tertiary and quaternary structure; properties of proteins; **Enzymes**-Nomenclature, nature and properties of enzymes, active sites, co-enzymes, kinetics of enzyme action, catalysis, specificity and inhibition, allosteric enzymes, ribozyme and abzyme.

Unit-2:Solute transport: Transport of solutes across the membranes Transmembrane proteins, Transport of ions, solutes and macro-molecules, Mechanism of translocations in phloem; Role played in signal transduction pathway stomatal physiology; **Phytosynthesis in higher plants** (i) Photophosphorylation - Calvin cycle; **Photorespiration** - C4 – Pathway, CAM in plants; Oxidative Phosphorylations; Glycolysis -TCA – Cycle and terminal oxidation.

Unit-3: Plant Hormones- plant hormones-discovery, biosynthesis, metabolism, transport and physiological effects of plant hormones and their applications; **Nitrogen metabolism** -(i) Molecular mechanism of N2 fixation (ii) Biosynthesis of amino acids (iii) Assimilation of nitrate and ammonium; **Lipid metabolism-** fats and oils biosynthesis and oxidation of lipids; Physiology of seed germination and flowering.

Unit -4: Stress Physiology: Water deficit and its physiological consequences; Drought tolerance mechanisms, Salinity stress and plant responses. Heat stress and heat shock proteins; Metal toxicity in plants. Biotic stress, HR and SAR mechanisms; **Mineral nutrition**-in plants and deficiency diseases; **Plant development-** physiology of flowering; **Phytochrome**- photochemical and biochemical properties of phytochrome; Concept of photoperiodism and vernalization and its influence on flowering;

Practicals-32 Hrs

1) Estimation of protein by Lowry's method
2) Determination of water potential of tissue by plasmolytic method
3) Determination of water potential by Gravimetric method
4) Quantitative estimation of chlorophyll a, chlorophyll b and total chlorophyll in plant tissue
5) Determination of diurnal fluctuation of acid content of CAM plants (TAN)
6) Determination of temperature quotient (Q10) of water uptake
7) Separation of chlorophyll pigments/Anthocyanin by TLC
8) Protein analysis by SDS PAGE method.
9) Estimation of Alpha-amylase activity in germinating seedling.
10) Silver staining of proteins.
11-12) Visit to Molecular Biology Laboratories.

References:

1) Barkla, B.J., and Pantajo, O. 1996. Physiology of ion transport across the tonoplast of higher plants. Ann. Rev. Plant Physiol. 47: 159-184.
2) Clayton, R.K. 1980. Photosynthesis: Physical mechanisms and chemical patterns. Cambridge Uni. Press, Cambridge.
3) Cohn, E.E., and Stumf, P.K. 1992. Outlines of Biochemistry. Wiley Eastern Pvt. Ltd.
4) Kozaki, A., and Takeba, G. 1996. Photorespiration protects C3 plants from

photooxidation. Nature 384: 557- 560.
5) Taiz, L., and Zeiger, E. 1998. Plant Physiology. Sinaur Associates Inc. Publishers, Sunderland Massachusetts.
6) Mukherji, S., and GHosh, A.K. 1996. Plant Physiology. New Central Book Agency Pvt. Ltd. Kolkatta, India.
7) Rabinowithc, E., and Jee, G. 1969. Photosynthesis. Willey Press, New York.
8) Rudier, W., and Thummlar, K. 1994. The Phytochrome, Chromophore I. Photomorphogenesis in Plants, II Edition, Netherlands, 51-69.
9) Spanswick, R.M. 1981. Electrogenic ion pumps. Ann. Rev. Plant Physiol. 32: 267-289.
10) Mc Elroy, W.D. 1995. Cell Physiology and Biochemistry. Prantice Hall of India.
11) Walsh, C.T. 1979. Enzymatic reaction mechanisms. Editors: W.H. Freeman, New York.
12) Webb, E. 1984. Enzyme nomenclature. Academic Press, Orlando Fla.
13) Zimmermann, M.H., and Milburn, J.A. Transport in Plants. 1. Phloem transport (Encyclopedia of Plant Physiology. New Series Vol. 1), Springer, New York.
14) Devline and Witham, 1986. Plant Physiology. CBS Publs. and Distributors, New Delhi.
15) Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons. Inc., NewYork, USA.
16) Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York, USA.
17) Singhal *et al*. 1999. Concepts in Photobiology, Photosynthesis and Phytomorphognesis, Narosa Pub. House, New Delhi.

BOTANY: III- SEMESTER - HARD CORE 3.2
MOLECULAR BIOLOGY

Theory-32 Hrs

Unit-1: Organization of chromosomes and genes in prokaryotes and eukaryotes - Operon, interrupted genes, gene families, unique and repetitive DNA, heterochromatin, euchromatin, transposons, mitochondrial and chloroplast genome organization, Transposable elements in prokaryotes and eukaryotes, genetic and evolutionary significance, **DNA replication**- patterns, Messelson and Stahl's and Taylor's experiment, enzymes of replication, mechanism of DNA replication in prokaryotes and Eukaryotes, proof reading and error correction mechanisms.

Unit-2: Molecular mechanism of mutation, repair and recombination:- Mutation-DNA damage by spontaneous mutations, physical and chemical mutagens and their molecular mechanisms, **Repair mechanisms**- direct reversal of damage, base and excision repair, recombinational repair, SOS repair, translation repair synthesis, transcription coupled repair, **Recombination**- homologous recombination, models of recombination, mechanisms, protein machinery of homologous recombination, genetic consequence of homologous recombination, gene conversion, site specific recombination, mechanism and biological significance, non homologous recombination- transposition, molecular mechanisms of transposition- conservative, replicative and retro-transposition.

Unit-3: RNA synthesis, processing and translation: transcription activators and repressors, promoters, RNA polymerases and transcription factors, mechanism of transcription in prokaryotes and eukaryotes, **RNA processing**- capping, polyadenylation, splicing, alternative splicing, RNA editing, exon shuffling and RNA transport, **Translation and processing**-ribosomes, tRNA aminoacylation, aminoacyl tRNA synthetase, genetic code, wobble hypothesis, deciphering of the code, translation mechanism , translation proof reading, translation inhibitors and post translational modifications.

Unit-4: Regulation of gene expression in Prokaryotes: Operon concept, regulation at transcription initiation- lac and trp operon control, regulation of lytic and lysogenic cycles in lambda phage, regulation beyond transcription initiation-premature termination- trp operon, ribosomal proteins as translational repressors, riboswitches, **Regulation of gene expression in eukaryotes**-transcription activators and repressors, regulation after transcription initiation- alternative splicing, translational control in ferretin and tranferrin mRNA, RNA interference, role of chromatin in regulation of gene expression and gene silencing.

Practicals-32 Hrs

1) Isolation of DNA from CTAB method.
2) Isolation of DNA from Onion.
3) Isolation of DNA from mulberry leaves.
4) Estimation of DNA by DPA method.
5) Extraction of RNA by trizol/ phenol-chloroform methods.
6) Estimation of proteins by Biuret method.
7) Estimation of protein by Bradford method.
8) Determination of Tm value of DNA.

9-12)Photo graphs/ charts related to molecular biology/Molecular Biologists.

References:

1) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Rafi, Keith Roberts, and Peter

Walter. 2008. Molecular biology of the cell, 5th edn., Garland science, Taylor & Francis Group, LLC, 270 Madison Avenue, NewYork ,USA.
2) Alberts, B., Bray, D., Lewis, J , Raff, M., Roberts, K and Watson, J.D. 1999 . Molecular biology of the cell. Garland Publishing, Inc., New York
3) Kleinsmith, L.J. and Kish, V.M. 1995 .Principles of Cell and Molecular Biology 2nd Edition Harper Collins College Publishers, New York, USA.
4) Lodish, H. Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology 4th Edition. W.H. Freeman and Co. New York, USA
5) Malaciniski, G.M. and Freidfelder, D. 1998. Essentials of Molecular Biology 3rd Edition. Jones and Bartlet Publishers, Inc., London.
6) Gunning.B.E.S. and Steer, M.W.1996. Plant Cell Biology; Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.
7) Harris,Nand Oparka, K.J. 1994. Plant Cell Biology A Practical Approach. IRL Press, Oxford University Press, U.K.
8) F.M. Ausubel, R.Brent, R.E. Kingston, D.D. Moore, J.G. Seidman, J.A. Smith, K. Struhl, (Current Edition) (2005). Current Protocols in Molecular Biology.
9) B.B. Buchanan, W.Gruissem and R.L. Jones . USA (2000) .Biochemistry and Molecular Biology of Plants. Ed. ASPP Press.
10) T.A. Brown, 2000. Essential of Molecular Biology, Vol-I & 2 Oxford University Press.
11) James D. Watson, Tania,. A. Baker, Stephen, P. Bell, Alexander ,Gannm, Michael Levine.2004. Molecular Biology of the gene. 5th Edition, Pearson Education.Philip M Gilmartin and Chris.
12) Bowle.2002. Molecular Biology of Plants. Vol 1 & 2 Oxford University Press.

BOTANY: III-SEMESTER - HARD CORE 3.3
PLANT BIOTECHNOLOGY

Theory-32 Hrs

Unit-1: Plant Tissue Culture: Scope and importance of plant tissue culture - Media composition and types, hormones and growth regulators, explants for organogenesis; Micro propagation, embryo and endosperm culture, somatic embryogenesis, variation and cell line selection, adrogenesis and microspore culture, significance of haploids, diploidization and bulbosum technique; Cryopreservation, germplasm collection; Somatic Hybrids**-** Isolation and protoplast culture and somatic hybridization and its significance, Synthetic seed production and somaclonal variations.

Unit-2: Genetic Engineering: Milestones in plant recombinant DNA technology; Importance of gene manipulation in future perspectives; **Tools in Genetic Engineering-** Enzymes in genetic engineering - restriction endonucleases, types and their actions, other DNA modifying enzymes; Cloning vectors- plasmids isolation and purification - Ti Plasmid, pBR322, pUC-series. Phage vectors-M13 phage vectors, Cosmids -types, phasmids or phagemids, shuttle vectors-types; YAC and BAC vectors, Lambda phage vectors, Lamda phage DNA as a vectors; Cloning vectors and expression vectors; Vectors for plant cells; Vectors for animal cells, baculovirus vectors- adenoviruses, retroviruses, transposons as vectors, Synthetic construction of vectors.

Unit 3: Applications of Genetic Engineering for pest, disease and stress tolerance: The genetic manipulation of herbicide resistance with suitable examples; The genetic manipulation of pest and disease resistance with suitable examples; Transgenic approaches to viral and bacterial disease resistance. Engineering for stress tolerance and Metabolic Engineering of Plants; Future prospects for GM crops.

Unit 4: Biofertilizers: Preparation and applications of biofertilizers such as Rhizobium, Azotobacter, Blue Green Algae and VAM. Single Cell proteins (SCP): Health benefits and advantages of single cell proteins- *Spirulina.* Biofuels: Ethanol and Biofuel production from plants. Mushroom cultivation and its advantages. Bioremediation: Phytoremediation; Biodegradation, Xenobiotics. Biotechnology of medicinal and aromatic plants for human welfare.

Practicals-32 Hrs

1) Preparation of plant tissue culture media and types.
2) Organ culture (Shoot tip, nodal and leaf culture) for callus Initiation and regeneration.
3) Anther culture for the production of haploids.
4) Suspension culture and production, separation and estimation of secondary metabolites.
5) Encapsulation of somatic embryos and production of Synthetic seed.
6) Extraction of secondary metabolites using Soxhlet extractor and Identification of In vitro secondary metabolites-alkaloids, steroids and flavonoids.
7) Restriction digestion of plasmid and genomic DNA and gel electrophoresis.

8) Isolation of genomic DNA from bacteria/plants and purification by agarose gel electrophoresis.
9) Restriction analysis of plasmids, gel purification of DNA, small and large scale purification of plasmids.
10) Preparation of competent *E. coli* cells. Bacterial transformation and recovery of plasmid clones.
11) Gene cloning in plasmids, analysis of recombinant plasmids.
12) DNA amplification by PCR, RT-PCR, Real Time PCR.
13) Analysis of DNA and RNA and Protein by Southern, Northern and Western blotting.
14) Primer design for PCR.

References:

1) Slater, N. Scott and M. Fowler. Plant Biotechnology 2003: The genetic manipulation of plants. Oxford University Press, Oxford.
2) Plant Biotechnology. 2000. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds). Springer Verlag, Heidelberg.
3) Text Book of Biotechnology. 2004. H.K. Das (ed). Wiley India Pvt. Ltd., New Delhi.
4) Plant Biotechnology -The Genetic Manipulation of Plants, Adrian Slater, Nigel Scott and Mark Flower, Oxford University Press, (2000).
5) Plant Genetic Transformation and Gene Expression by (eds) J.Draper *et.al*. Blackwell Scientific Publications, Oxford (1988).
6)Reinert, J. 1982. Plant Cell and Tissue Culture: A Laboratory Manual. Narosa Publishing House, New Delhi.
7)Chawla H.S., 2009, Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
8)Bhojwani, S.S. and Razdan, M.K. 2004. Plant Tissue Culture: Theory and practice. Elsevier Science Publishers, New York, USA.
9)PUROHIT S. D., 2012. Introduction To Plant Cell Tissue And Organ Culture PHI Learning Pvt. Ltd., New Delhi
10)Roberta, H. Smith, 2012. Plant Tissue Culture: Techniques and Experiments 3 edition. Academic Press; US.

BOTANY: III- SEMESTER- SOFT CORE 3.1
MOLECULAR GENETICS OF PLANTS

Theory-32 Hrs

Unit-1: Plants as genetic tools in Biology: *Arabidopsis, Rice, Maize, Saccharomyces;* Genome organization in plants; *Arabidopsis thaliana*- an experimental model for understanding plant development and functions; Plant genes and regulation; nucleus and chromatin organization; Histones and histone modifications; DNA packaging, organization and types of DNA sequences; functional and non- functional sequences, organization of plant nuclear genes, plastid genes and mitochondrial genes.

Unit-2: Genes responding to hormones, phytochrome, responses to abiotic stresses; Genes induced by water stress and freezing stress; Genes involved in photosynthesis and nitrogen fixation and their regulation; Molecular development of leaf and flower - ABC and revised model of flower development; Genes involved in fertilization, seed development, embryo development.

Unit-3: Genetics of *Agrobacterium:* Biology and genetics of *Agrobacterium tumefaciens;* The Ti- plasmid, *Vir* genes and expression, Mechanism of T-DNA transfer and integration; Basic features of vectors for plant transformation; Proteomics, genomics and bioinformatics; Structural and functional genomics, comparative genomics - biochemical, evolutionary, physiological and phylogenomics; Tools to study functional genomics.

Unit-4: Proteomics- functional and comparative proteomics; Protein distribution, characterization and identification, differential display proteomics, detection of functional linkages; Pharmacogenomics; Bioinformatics- tools of bioinformatics, data bases and data base management, bioinformatics in taxonomy, biodiversity, agriculture; Bioinformatics in drug design and drug discovery.

Practicals-32 Hrs

1) *Arabidopsis thaliana*- study of plant system and its biology.
2) *Arabidopsis* RNA extraction (total and polysomal) for Northern blotting.
3) Expression of foreign genes in plant cells through *Agrobacterium tumefaciens* (Chart)
4) Production of tobacco transgenic plants and assay for the introduced transgenic (Chart)
5) Co-cultivation of tobacco *Agrobacterium tumefaciens*
6) -12) Learning gene bank formats- EMBL format, FASTA format, Swiss- PROT, Ex PASy

References:

1) Buchmann, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. ASPP Press, USA.
2) Ausubel, F.M., Brent, R., Kingston, R.E., Moore, D.D., Seidman, J.G., Smith, J.A., and Struhl, K. 2005. Current protocols in molecular biology. Current Edition.
3) Brown, T.A. 2000. Essentials of Molecular Biology. Vol. I & II, Oxford University Press.
4) Potrykus, I., and Spangenberg, G. 1995. Gene transfer to plants. Springer, Berlin, Heidelberg.
5) Watson, J.D., and Baker, T.A., Bell, S.P. Gannm, A. and Levine, M. 2004. Molecular Biology of Genes. 5th edn., Pearson Education.
6) Gilmartin, P.M., and Bowler, C. 2002. Molecular Biology of Plants. Vol. I & II, Oxford University Press.
7) Karchar, S.J. 1995. Molecular Biology- A Project Approach, Academic Press, New York.
8) Sambrock, J., Fritch, E.F., and Maniatis, T. 1989. Molecular cloning- a laboratory manual.
9) Slater, A., Scott, N., and Flower, M. 2000. Plant Biotechnology- the Genetic Manipulation of Plants, Oxford University Press, Oxford.

10) Lea, P.J., and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology. John Willey and Sons Press, New York.
11) Draper, J. 1988. Plant Genetic Transformation and Gene Expression. Blackwell Scientific Publications, Oxford.
12) Old, R.W., and Primrose, S.B. 2004. Principles of Gene Manipulation. An introduction to Genetic Engineering. 5th Edition, Blackwell Science Publications.

BOTANY: IV- SEMESTER- SOFT CORE 3.2
MOLECULAR PLANT PATHOLOGY

Theory-32 Hrs

Unit-1: Concepts and scope of physiological and molecular plant pathology; Molecular approaches to plant disease diagnosis; Nucleic acid based probes for detection of plant pathogens including non-culturable organisms; **Pathogenicity and Disease Development**- factors; induced resistance, virulence and pathogenecity factors; Plant-pathogen interactions with emphasis on incompatible interactions and induced resistance.

Unit -2: Pathogenesis: Necrogenic plant pathogenic bacteria with emphasis on hrp and avr genes and virulence factors; Fungal plant pathogens with emphasis on virulence and pathogenicity factors; Plant viruses with emphasis on virus replication, virus transport in plants and control of plant viruses with transgenic plants; **Signal Transuduction-** recognition of the pathogen by the host, transmission of the alarm signal to the host defense providers; Necrotic defense reaction, defense through hypersensitive response; Molecular basis of induced biochemical reaction; Local and systemic acquired resistance (SAR).

Unit-3:Genetics of Plant Diseases and Resistance: Genes and diseases; physiological specialization among plant pathogens; Variability in viruses, bacteria and fungi; Levels of variability in pathogens and loss of virulence in plant pathogens; Genetics of virulence in pathogens and of resistance in host plants; Molecular plant breeding for disease resistance.

Unit-4: Genetics and molecular basis of host-pathogen interaction: Evolution of parasitism; genetics oh host-pathogen interaction; Gene for gene relationship; Criteria for gene for gene type relationship; Molecular basis of host pathogen interaction; Host-parasite-interaction. **Biotechnological methods of plant disease management;** Genetic engineering and crop protection; Cross protection; Gene silencing and disease control- mechanism of gene silencing and control of viral diseases; Engineered resistance to viral, bacterial, fungal and insect diseases of crop plants.

Practicals-32 Hrs

1-2) Testing hypersensitivity reaction on *Nicotiana and Bajra.*
3) Estimation of lypoxygenease in diseased and healthy plants.
4) Estimation of polyphenols in diseased and healthy
plants. 5-7) Studying systemic acquired resistance in
crop plants.
8) Genetic testing of disease resistance in plants.
9-11) Molecular detection of viruses, Mycoplasma, fungi and bacteria from infected plants.
12) In-vitro testing of pathogen virulence.
Visit to agricultural research station to study diseases on different crop plants.

References:

1) Singh, R. S. (1973). Plant Disease. Oxford and IBH Pub.Co. New Delhi.
2) Agrios, G. N. (1994). Plant Pathology 2nd Edn. Academic Press NY.
3) Johnston A and Both, C. 1983-Plant Pathologists Pocket-book. 2nd Edn. Commonwealth Mycological Institute, Oxford and IBH Pub. Co. Calcutta.
5) Rangaswamy G and Mahadevan A 2002. Diseases of crop plants in India, Prentice Hall of India Pvt. Ltd. New Delhi.
6) Mehrotra, R. S.1983-Plant Pathology Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.
7) Vidhyasekaran, P. 2004. Encylopedia of Plant Pathology.Viva Books Pvt.Ltd. New Delhi.

BOTANY: III SEMESTER- SOFT CORE 3.3
PLANT PROPAGATION AND PLANT BREEDING

Theory-32 Hrs

Unit-1: **Plant Propagation:** History, scope and importance of plant propagation; Propagation structures with reference to green house equipment and media; Seed propagation and vegetative propagation; Propagation by cuttings; Biology and techniques of grafting; Techniques of budding; Layering and its natural modifications; Propagation by specialized stems and roots; Micro propagation **–** techniques and applications in forestry and horticulture; Limitations and applications of vegetative propagation; Propagation methods of some selected plants – Citrus, Grape, Mango, Mulberry, Hibiscus, Rose, Croton, Eucalyptus.

Unit-2: Plant Breeding: History of plant breeding, objectives of plant breeding, salient achievements of plant breeding; Centres of origin of crop plants, Exploration and collection of plant genetic resources, evaluation of germplasm collection, documentation, conservation of plant genetic resources, utilization of genetic resources; The theory of pure line selection – Genetic basis, sources of genetic variation in pure lines, the land variety (races); Mendelian experiments of plant hybridization; Quantitative Inheritance; Applications of biometrical genetics in plant breeding.

Unit-3: Plant Breeding: Types of plant breeding; Fertility regulating mechanisms - manual or mechanical control, genetic control, incompatibility, male sterility, genetic engineering for male sterility, chemical control, genetic basis of heterosis; Synthetic and composite varieties **-**genetic basis, procedure for developing synthetic and composite varieties - genetic basis, procedure for developing synthetic varieties; Breeding for resistance to disease and insect pests.

Unit - 4 :Mutation Breeding: Significance of induced mutations in plant breeding; Polyploidy in plant breeding**- t**ypes of polyploids, induction of polyploidy, phenotypic effects of polyploidy, significance of polyploids; Tissue culture in crop improvement; Molecular approaches to crop improvement- probes, gel electrophoration, electrofusion, biolistics, gene cloning, transgenic plants (GMO's), molecular markers, construction of genetic maps, application of DNA makers in plant breeding, the role of gene technology in plant breeding; Crop breeding Institutes/Centers, Molecular biology in relation to intellectual property rights.

Practicals-32 Hrs

1) Study of types of vegetative propagation: Cutting, Grafting, budding, layering.
2) Study of propagation by modified stems and modified roots.
3) Preparation of media, explants, culture, initiation of shoot multiplication.
4) Pot and green house implants (demonstration) (5) Studying of floral biology.
6) Hybridization techniques - bagging and emasculation.
7) Pollen viability test : Seed germination test, TTC test.
8) Mode of pollination study in different crops.
9) Visit to crop breeding stations/institutes / centres.
10) Estimation of protein quality, Amino acid Analysis and determination of oil and fatty acids.
11) Observation of colour and conditions of mature anthers in different crops.
12) Identification of and studying of important plant breeders.

References:

1) Abbottt, A.J. and Atkin, R.K. eds. 1987. Improving vegetatively propagated crops.

Academic press, New York.
2) Bose, T.K., Sadhu, M.K., & Das, P., 1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
4) Hartmann, H.T., Kester E.D., Davis, F.T., and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.
5) Krishnamurthy. H.M. 1981. Plant Growth substances including application in Agriculture.
6) Pierik, L.M. 1987. In vitro culture of Higher plants Murtinus Nijhoff pub. Dordrecht.
7) Razdan, M.K. 1994. An Introduction to Plant tissue culture, Oxford and IBH Pub. Co., PVT. Ltd., Bombay and Calcutta.
8. Mac Donald, B. 1987. Practical woody plant propagation for nursery growers. Portland, OR: Timber press.
9. Sadhu, M.K. 1989. Plant propagation Wiley eastern Ltd. N. Delhi.

BOTANY: III SEMESTER SOFT CORE 3.4
PHYTOCHEMISTRY AND HERBAL TECHNOLOGY

Theory-32 Hrs

Unit-1: **Phytochemisrty:** Scope of phytochemistry, plants as source of chemical compounds, primary and secondary metabolites and its applications; Definition, source of herbal raw materials, identification, authentication, standardization of medicinal plants as per WHO guidelines and different herbal pharmacopoeias; Natural pigments, natural products as markers for new drug discovery.

Unit-2: Extraction, isolation and purification of phytochemicals: Selection of plant samples, processing and storage of samples for extraction; Factors influencing the choice of extraction, principles of extraction methods, infusion, decoction, digestion, maceration, percolation, solvent extraction, fluid extraction, ultrasound, microwave assisted extraction, advantage and disadvantage involved in each method; Isolation of selected primary and secondary metabolites – amino acids, proteins and carbohydrate; Phenolics, flavonoids, alkaloids, lipids, oils, terpenes and saponins; Purification techniques for primary and secondary metabolites – solvent-solvent fractionation and chromatography techniques.

Unit-3: Characterisation of Phytochemicals: Preliminary, qualitative and quantitative techniques – paper chromatography, thin layer chromatography, column chromatography-HPLC, GC (qualitative and quantitative), colour reactions for amino acids, sugars, phenolics, flavonoids, alkaloids, terpenes, saponins, oils, lipids; Spectroscopic estimations/gravimetric determination of total sugars, amino acids, proteins, phenolics, flavonoids, alkaloids, terpenes, saponins, oils, lipids; Characterisation using spectroscopic techniques - UV/VIS, FTIR, DSC (differential scanning calorimeter), NMR, MS, MALDI. XRD – single crystal and powder.

Unit-4: Standardisation and Validation of Photochemical: Quality determination of herbal drugs; Role of processing methods and storage conditions on quality of drugs; Standardisation parameters- impurity limit, ash content, extractable matter, moisture content, other phytochemicals, microbial contaminants, pesticides; Validation of drug – guidelines, limit of detection and quantification of impurities, organoleptic properties, physical, chemical, biological characteristics, stability testing, storage conditions and packing system/unit.

Practicals-32 Hrs

1) Survey and collection of medicinal plants for analysis.
2) Selection of plant part, processing and storage of samples for further analysis.
3) Extraction methods - aqueous and sequential solvent extraction of compounds.
4) Preliminary phytochemical analysis of active principles from the extracts.
5) Antibacterial/antifungal activity of crude /active principles
6) Identification of secondary metabolites using TLC- phenolics, flavonoids, alkaloids, terpenes, saponins etc.
7) Column chromatographic separation of active principles.
8) Characterisation of active principle using spectroscopy, HPLC, GCMS, LCMS, FTIR, and MALDI TOF.
9) -12) Submission of report on TEN important curative principles of Indian medicinal plants.

References:

1) Braithwaite, A. and Smith, F.J. 1996. Chromatographic Methods. 5th edn., Blackie Academic & Professional, London.
2) Bourne, U.K. Kokate, Purohit, C.K. and Gokhale S.B. 1983. Pharmacognosy. Nivali Prakashan Publication.
3) Braithwaite, A. and Smith, F. J. 1996. Chromatographic Methods. 5th edn. Blackie Academic & Professional, London.
4) Sadasivam. S. and A. Manickam, 0000. Bio Chemical methods 2ndedn. New Age International Pvt Ltd. New Delhi.
5) Harborne, J.B. 1984. Phytochemical Methods, 2ndedn. Chapman and Hall, London. Harborne J.B., 1973. Phytochemical methods a guide to modern techniques of plants analysis. Chapman and Hall Ltd. London.

BOTANY: III SEMESTER- OPEN ELECTIVE 3.1
PLANT PROPAGATION TECHNIQUES

Theory-32 Hrs

Unit-1: History, scope and importance of plant propagation; Propagation structures with reference to green house equipment and media; Seed propagation – the development of seeds, techniques of seed production and handling principles and media.

Unit-2: Vegetative propagation: Techniques of propagation by cuttings; stem cuttings – hard wood, semi hard wood, soft wood and herbaceous, leaf cuttings, leaf bud cuttings, root cuttings; Biology and techniques of grafting: Whip and tongue, wedge and cleft, bark, side grafting, approach.

Unit-3: Techniques of budding: T- budding patch budding, chip budding, ring budding; Layering and its natural modifications- simple layering, tip layering, mound or stool layering, air layering, compound or serpentine layering and trench layering; Propagation by specialized stems and roots.

Unit- 4: Micro propagation – techniques and applications in forestry and horticulture; Advantage, limitations and applications of vegetative propagation, Somaclonal variations; Propagation methods of some selected plants – Citrus, gape, mango, mulberry, hibiscus, rose, Croton, Eucalyptus.

References:

1) Abbott, A.J. and Atkin, R.K. (eds.) 1987. Improving vegetatively propagated crops. Academic press, New York.
2) Bose, T.K., Sadhu, M.K., and Das, P., 1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
3) Hartmann and Kester, 1983. Plant propagation
4) Hartmann, H.T., Kester E.D., Davis, F.T. and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.
5) Krishnamurthy. H.M. 1981. Plant Growth substances including application in Agriculture.
6) L.M. Pierik 1987. In vitro culture of Higher plants Murtinus Nijhoff pub. Dordrecht.
7) M.K. Razdan 1994. An Introduction to Plant tissue culture, Oxford and IBH Pub. Co., PVT. Ltd., Bombay and Calcutta.
8) Mac Donald, B. 1987. Practical woody plant propagation for nursery growers. Portland, OR: Timber press.
9) Sadhu, M.K. 1989. Plant propagation Wiley eastern Ltd. N. Delhi.

BOTANY: IV- SEMESTER- HARD CORE 4.1

ECOLOGY, CONSERVATION BIOLOGY AND PHYTOGEOGRAPHY

Theory-32 Hrs

Unit-1: Introduction and scope of Ecology: Plants and the environment- plant adaptation, ecotypes, habitat ecology- fresh water and marine water ecology (ecosystems), wetlands and their characteristics; Ecosystem function; The distribution of biomes; Major Terrestrial Biomes; Forests-Tropical Forests-Temperate Forests, Taiga, Grasslands, Savanna, Temperate Grasslands/Prairies, Tundra, Deser and Chaparral.

Unit-2: Environmental Biology: Global warming: Greenhouse gases - causes and consequences; Ozone depletion- causes and consequences; Air, water and soil pollution - major pollutants, their source, permissible limits - and control methods; Radioactive pollution- Ionising radiation, disposal of radioactive waste, nuclear accidents; Environmental Education Programmes - WWF, UNEP, MAB; Role of plants in solving energy crisis and ameliorating global warming.

Unit-3: Biodiversity and Conservation Biology: Science in the service of Biodiversity, biodiversity and its value, biodiversity issues, concerns, management; Biodiversity hot spots; Biodiversity- threats and current status of biodiversity; IUCN categories, Red Data book and Red lists, invasive alien species as threat to biodiversity; Conservation strategies- past, present, and future; Attitudes about conservation; conservation movements; CITES (Convention on international trade in endangered species), WCU (World Conservation Union); Endangered species Act. 2002 (GOI); Protected areas, Network of India- history, size, scale and management; Heritage trees.

Unit-4: Phytogeography: Biogeography of the world, India and Karnataka; Climatic zones, tectonics, continental movements; Types of plant distribution – discontinuous distribution - land bridge theory, continental drift; continuous distribution-cosmopolitan, circumpolar, circumboreal, circumaustral, pantropical; Distribution of plants - islands; Phytochorea of the world, India; Plant dispersal, migrations and isolation; Eendemic plants of Western Ghats and Eastern Himalayas; Origin, distribution and acclimatization of coffee, cardamom, sugarcane, cashew, ragi, maize, wheat, rice and cotton; Remote sensing and GPS, study of vegetation by GIS (Geographical Information system).

Practicals-32 Hrs

1) Study of local vegetation by quadrate method.
2) Water analysis for pollution studies.(Bio-monitoring: TDS, Hardness, Chlorides, CO_2 COD, DO, BOD)
3) Rapid detection of bacteriological quality of water with special reference to feacal coliforms.
4) Morphology and anatomy of plants in relation to habitats - Xerophytes, Mesophytes, Hydrophytes.
5) *In situ* and *Ex situ* method of conservation.
6) Eminent phytogeographers of the world (photos).
7) Continental drift (charts).
8) Application of Remote Sensing, GIS and GPS in Forestry and Wild life management.
9) Biogeography of the world – Oceans, deserts, islands, mountains.

10) Biogeography of India –rivers, mountains, islands.
11) Floristic regions of world – India and Karnataka.
12) Study of endemic plants of India.
13) Origin, acclimatization and distribution of Coffee, Cardamom, Sugarcane, Cashew, Ragi, Maize, Wheat, Rice and Cotton.

References:

1) Polunin, N. 1961. Introduction to plant geography.
2) Good R.D. 1974. Geography of the flowering plants.
3) James H. B. 1998. Biogeography.
4) Cain, S.A. 1944. Foundations of plant Geography.
5) Croiat, 1952. Manual of Phytogeography.
6) Edgar A. 1972. Plants, Man and Life.
7) Valentine, D. H. 1972. Taxonomy, Phytogeography & Evolution.
8) Phil Gibson J. and Gibson Terri, R. 2006. Plant ecology.
9) Primack, R. B. 2006. Essentials of conservation biology.

10) Ricklefs, R. E. 2001. The Economy of Nature.
11)Narasaiah M. L., 2005. Biodiversity and Sustainable Development.
12)Tondon P, Abrol Y. P, Kumaria S., 2007. Biodiversity and its significance.
14) Krishnamurthy K. V. 2007. An Advanced Textbook on Biodiversity: Principles and Practice.
15) Christian Leveque and Jean-Claude Mounolou (2003). Biodiversity.
16) Jeffries Michael J. 2006. Biodiversity and conservation.

BOTANY: IV- SEMESTER- SOFT CORE 4.2
PROJECT WORK

BOTANY: IV- SEMESTER- SOFT CORE 4.1
SEED TECHNOLOGY

Theory-32 Hrs

Unit-1: Seed Technology: Introduction to seed science and technology and its goals; Development of seed technology industry in India; Seed as basic input in agriculture; Seed Biology - Seed development, morphology and anatomy of dicot and monocot seeds; Seed structure and functions; Seed programmes and organizations; Seed village concept, seed production agencies, seed industry and custom seed production in India; International Seed Science and Technology Organizations.

Unit-2:Seed Production: General principles of seed production in self and cross pollinated and vegetatively propagated crops; Hybrid seed production; Maintenance of inbred lines and breeders seeds; Synthetic and composite seeds; Improved seed and their identification; Germplasm banks; **Seed Processing**-Harvesting, seed drying, seed cleaning and grading; Equipments; Seed Storage- types of storage structure; seed factors affecting storage life, effect of storage on relative humidity, temperature and moisture; Seed deterioration; Seed treatment.

Unit-3: Seed Quality Testing: Devices and tools used in seed testing; ISTA and its role in seed testing; Seed sampling- physical purity and heterogeneity test; Seed moisture content- importance and determination and methods; Viability and vigour testing; Genetic purity testing -objective and criteria for genetic purity testing, seed health testing, field and seed standards, designated diseases, objectionable weeds; Significance of seed borne diseases, seed health testing and detection methods for seed borne fungi, bacteria, viruses and nematodes; Preparation and dispatch of seed testing reports, storage of guard samples, application and use of seed standards and tolerances.

Unit- 4: Seed Certification: Principles and philosophy of seed certification, purpose and procedures, national seed programme; National Seed Corporation (NSC) - agencies responsible for achieving self-reliance in seed production and supply of quality of seeds (State Seeds Corporation; National Seed Development Council (NSDC); Central Seed Committee(CSC) ; Seed market surveys, seed industry in relation to global market; Concept of WTO, GATT, IPR, Plant Variety Protection and its significance seed technology; UPOV and its role.

Practicals-32 Hrs

1) Determination of physical purity of seed samples.
2) Determination of density or weight per thousand seeds.
3) Determination of seed Heterogeneity.
4) Visual examination of dry seeds for disease symptoms.
5) Determination of moisture content by hot air oven method.
6) Seed viability test- TTC method.
7) Determination of seed germination by TP/BP/Sand method.
8) Evaluation of seedlings vigour by BP/Sand methods.
9) Seed vigour evaluation by (a) conductivity test (b) Hiltner's test (c) Performance test(d) Accelerated ageing test (e) Cold test.
10) Examination of suspensions obtained from washings of seed.
11) Infection sites studied by planting seed components.
12) Detection of seed-borne fungi and their characters of five seed borne pathogens. Vist: Visit to seed industries/seed companies/ seed research stations.

References:

1) ACAR.2009. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.

2) ACAR.2013. Handbook of Horticulture. Indian Council of Agricultural Research, New Delhi.

3) Agarawal, P. K. 2005. Principles of Seed Technology.2nd edn. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

4) Basra, A. S. 2006. Handbook of Seed Science and Technology, The Haworth Press, USA.

5) Copeland, L. O. and McDonald, M. B. 2001. Principles of Seed Science and Technology. 4th edn. Chapman & Hall.

6) Copeland, L.A. 1995. Principles of Seed Science and Technology- Kluwer Academic Publishers, The Netherlands.

7) Michael, B. and Bewley, D. 2000. Seed technology and its biological basis. Wiley- Blackwell.

8) Neergaard, P. 2005. Seed Pathology, Palgrave, Macmillan, Denmark. Science, Technology and Uses. CABI, UK.

9) Vanangamudi, K., Natarajan, K., Saravanan, T., Natarajan, N., Umarani, R., Bharathi, A. and Srimathi, P. 2006. Advances in Seed Science and Technology: Vol: III: Forest Tree Seed Technology and Management, Agrobios, New Delhi.

BOTANY: IV- SEMESTER- SOFT CORE 4.2
SEED PATHOLOGY

Theory - 32 Hrs

Unit-1: Seed Pathology: Introduction, historical development, development of seed health testing; Reduction in crop yields loss in due to seed-borne diseases; Seed-borne pathogens **(**Fungi, Bacteria, Mycoplasma-like Organisms, fastidious Vascular Bacteria, Spiroplasmas, Viruses, Viroids, Nematodes); Location of seed-borne inoculums, histopathology of some seed-borne pathogens; Seed infection, mechanism of seed infection, seed infestation or contamination; Factors affecting seed infection; Longevity of seed-borne pathogens.

Unit-2: Seed transmission and inoculation, factors affecting seed transmission; Cultural practices, epidemiology and inoculum thresholds of seed-borne pathogens; Classification of seed-borne; Role of Seed-borne inoculum in disease development; Economic loss due to seed borne pathogens; Certification program; Seed health tests, Nonparasitic seed disorders; Deterioration of grains; Storage fungi, field and storage fungi; Invasion by storage fungi; effects of seed deterioration.

Unit-3: Detection of Seed-borne Diseases: Examination of dry seeds; Isolation of fungi, Bright-field microscopic examination, observation under UV light, measurement of gases, Determination of FAV, Moldy smell, collection of seed exudates; Immunoassays, ergosterol estimation; Avoiding damage to seeds during harvesting; Processing, threshing, storage conditions, reducing seed moisture to safe limits, seed treatment, resistance.

Unit-4: Mycotoxins - Fungi known to produce mycotoxins, Factors affecting mycotoxin production the effects and control of mycotoxins, storage conditions, sorting of grains, cultural operations, chemical treatment, biological control, detoxification, regulatory measures, use of resistant cultivars; Control of seed-borne pathogens; Selection of seed production areas; Crop management, crop rotation, isolation distances, rouging, biological control, chemical method, mechanical method, physical methods; Certification- certification standards, plant quarantine, national and international regulations.

Practicals-32 Hrs

1-5) Detection of seed-borne fungi and their identification.
6) Detection of Seed-borne bacteria.
6) Detection of seed-borne viruses.
7) Detection of seed-borne insects by egg-plug staining.
8) Detection seed-borne nematodes.
9) Effect of deterioration of grains by Storage Fungi.
10) Detection of seed-borne fungi by PCR.
11) Estimation of ergosterol by UV-visible Spectrophotometer.
12) Detection of mycotoxins by thin Layer chromatography.

References

1) Agarwal, V. K. and Sinclair, J. B. 1996. Principles of Seed Pathology, 2nd edn. CRC Press, Tayler and Francis, USA.
2) Neergaard, P. 1977. Seed Pathology. Vol. I..Macmillan Press, Cornell University, USA.
3) Agrios, G. N. 1994 -Plant Pathology 2nd edn. Academic Press, New York.
4) Mehrotra, R. S. 1983-Plant Pathology Tata Mc. Graw Hill Pub. Co. Ltd., New Delhi.

5) Rangaswamy, G. and Mahadevan, K. 2002. Diseases of Crop plants in India. Prentice Hall of India Private Limited New Delhi.
6) Agarawal, P. K. 2005. Principles of Seed Technology.2nd edn. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
7) Basra, A. S. 2006. Handbook of Seed Science and Technology, The Haworth Press, USA.
8) Copeland, L.A. 1995. Principles of Seed Science and Technology- Kluwer Academic Publishers, The Netherlands.
9) Vanangamudi, K., Natarajan, K., Saravanan, T., Natarajan, N., Umarani, R., Bharathi, A. and Srimathi, P. 2006. Advances in Seed Science and Technology: Vol: III: Forest Tree Seed Technology and Management, Agrobios, New Delhi.

BOTANY: IV- SEMESTER- SOFT CORE 4.3
BIO- ANALYTICAL TECHNIQUES

Theory-32 Hrs

Unit- 1: Spectroscopy: Principles of UV-Visible spectroscopy, chromophores and their interaction with UV-visible radiation and their utilization in structural, qualitative and quantitative analysis of drug molecules; Infrared Spectroscopy, Infrared radiation and its interaction with organic molecules, vibrational mode of bonds, instrumentation and applications, interpretation of IR spectra; FTIR and ATR, X-ray diffraction methods.

Unit-2: Nuclear Magnetic Resonance Spectroscopy: Magnetic properties of nuclei, field and precession, instrumentation and applications of NMR; Chromatographic techniques- Principles and applications- types- column, paper, thin layer and gas chromatography, HPLC, HPTLC, size exclusion chromatography, Affinity chromatography, Mass spectrometry, MALDI-TOF.

Unit-3: Electrophoresis: Principle and application of PAGE, SDS PAGE, immunostaining, immuno-electrophoresis, Iso-electric focusing, 2D electrophoresis Centrifugation- Principles, techniques of preparative and analytical centrifugation. Ultracentrifuges, molecular weight determination, sedimentation analysis, RCF. Microscopy- principles and applications of electron microscope (SEM and TEM), CryoEM, Preparations of specimen for electron microscopy- freeze drying, freeze etching, fixing, staining; confocal, fluorescent, flow cytometry - principles and applications.

Unit-4: Molecular Biology Techniques: Primer designing; Principles and applications of PCR; Blotting techniques; Hybridization techniques; Micro-array; Next Generation Sequencing- Nucleic acid sequencing.

Practicals-32 Hrs

1) Calibration of bio-analytical instruments.
2) Principles and instrumentation and applications of imaging techniques:
3) Separation of fatty acids/lipids by TLC/HPTLC.
4) Separation of proteins by PAGE, SDS- PAGE.
5) Agarose gel electrophoresis of DNA/RNA.
6) Immunoelectrophoresis
7) Agar gel diffusion, counter immuno electrophoresis.
8) Verification of Beer Lambert law with the U.V. spectrophotometer.
9) Demonstration of blotting techniques.
10) Performing PCR for amplification of ITS regions of fungi/ bacteria.

References

1) Braithwaite, A. and Smith, F.J. 1996. Chromatographic Methods. 5th edn. Blackie Academic & Professional London.
2) Budzikiewicz, H., Djerassi, C. and Williams, D.H. 1968. Mass Spectrometry of Organic Compounds. Holden-Day, San Francisco, CA
3) Harborne, J.B. 1984. Phytochemical Methods. 2nd edn. Chapman and Hall, London.
4) Harborne J.B. (1973) Phytochemical methods a guide to modern techniques of plants analysis. Chapman and Hall, London Ltd.

BOTANY: II SEMESTER - OPEN ELECTIVE 4.1
PLANT DIVERSITY AND HUMAN WELFARE

Theory-32 Hrs

Unit -1: Plant Diversity and Significance: Role of plant diversity in ameliorating energy crisis and global warming; Types of biodiversity-genetic diversity, species diversity, plant diversity at the ecosystem level; Agro-biodiversity and cultivated plant taxa, wild taxa; **Values and uses of Biodiversity-** Ethical and aesthetic values, precautionary principle, methodologies for valuation, uses of plants and microbes.

Unit -2: Loss of Biodiversity: Major causes of for biodiversity loss; Loss of genetic diversity, Loss of species diversity; Loss of ecosystem diversity; Loss of agro-biodiversity; Projected scenario for biodiversity loss; Management of Plant Biodiversity- Organizations associated with biodiversity management; Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations; Biodiversity information management and communication.

Unit -3: Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Conservation of Heritage Trees.

Unit-4: Role of plants in relation to Human Welfare: Importance of forestry their utilization and commercial aspects, Avenue trees, Ornamental plants of India, Alcoholic beverages through ages, Fruits and nuts- Fruit crops of Karnataka and their commercial importance; Wood and its uses.

References:

1) Krishnamurthy K. V. 2007. An Advanced Textbook on Biodiversity: Principles and Practice. Oxford & IHB Publishing Co. Pvt. Ltd. New Delhi.
2) Christian Leveque and Jean-Claude Mounolou, 2003. Biodiversity. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England.
3) Jeffries Michael J. 2006. Biodiversity and conservation, 2nd edn. Taylor and Francis Group, New York.

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE

(AUTONOMOUS)

OOTY ROAD, MYSORE-570 025

Postgraduate Department of Commerce

2019-20

MCD230 Corporate Tax Law and Planning

Course Objective:

CO1: Deliberate in detail with examples different types of companies under corporate income tax
CO2: Understand the detail of different sources of income for corporate assesses
CO3: Specify in depth impudence of tax planning
CO4: Understand in depth procedure for assessment

Module 1: **Definition of company**-Indian company, Domestic Company, Foreign Company, Widely Held Company, Closely held company, Residential Status of a company and incidence of Tax.

Module 2: **Computation of Taxable income of companies**- Computation of table income under different heads of income-House property, Profit and gain from business or profession, Capital gain and income other sources, carry forward and set off of losses in case of companies. Deduction from Gross Total income. Minimum Alternative Tax.

Module 3: **Tax Planning**- Tax avoidance and tax evasion. Tax planning with corporate dividend, Dividend policy- bonus shares. Tax planning with reference to specific managerial decisions- Make or Buy, Own or Lease, Purchase by installment or by Hire, Repair, Replace, Renewal or Renovation, shut down or continue.

Module 4: **Procedure for assessment**- Deduction of Tax at Source, Advance payment of Tax, Tax returns, refunds appeals and revision.

MCB050 ENTREPRENEURIAL DEVELOPMENT

Course Objective:

CO1: Write down in detail with examples skills of an young entrepreneurs	
CO2: Write down in detail with examples techniques of project planning, implementation and execution	
CO3:Identify in detail with examples institutional support to entrepreneurs	
CO4: Learn the characteristics of MIS in project	

Module – 1: Entrepreneurship: Need, Scope, Entrepreneurial Competencies and Traits, Factors affecting Entrepreneurial Development, Entrepreneurial Motivation, Conceptual Model of Entrepreneurship, Entrepreneur Vs Intrapreneur, and Classification of Entrepreneurs. Micro, Small and Medium Enterprises (MSMEs): Meaning and Definitions of MSMEs, Features, Scope, Objectives, Relationship between Small and Large Units; Indian MSME Sector - Nature, Contribution to Economy, Problems and Government Schemes; and MSMEs Act, 2006.

Module – 2: Entrepreneurial Development Programs and Small Business: Relevance and Achievements of EDPs, Role of Government in Organizing such Programs, Women and Rural Entrepreneurs - Present Status in India. Small Business: Concept and Definition, Role of Small Business in Modern Indian Economy, Small Entrepreneur in International Business, Steps for starting a Small Industry, Registration as SSI, Role of SIDBI, Advantages and Problems of SSIs, Institutional Support Mechanism in India, EDI, Incubation Centers, Incentives and Facilities, and Government Policies for SSIs.

Module – 3: Project: Definition, Characteristics, Types, Steps in identification of Projects, Project Life Cycle. Project Management - Meaning, Scope and Importance, Role of Project Manager. Project Appraisal - Preparation of a Real Time Project, Feasibility Report containing Technical Appraisal, Environment Appraisal, Market Appraisal and Managerial Appraisal. Project Identification - Environment for Business Opportunities, Idea Generation, Short Listing and Selection of Product/Service, Stages in Venture Appraisal, Factory Design and Layout, and Feasibility Report Preparation.

Module – 4: Project Planning: Functions, Project Objectives and Policies, Identifying Strategic Project Variables; Statement of Work; Mild Stone Schedules Tools for Planning Hierarchy of Plans. Project Financing: Project Cost Estimation and Working Capital Requirement, Sources of Fund, Preparation of Projected Income Statement, etc; Implementation of Projects - Graphic representation of Project

MCC210 Indirect Tax Law and Practice

Course Objective:

CO1: To comprehend the principles of taxations, objectives of taxes and its impact, shifting and incidence process of indirect taxes in market orientated economy
CO2: To understand the implications of indirect taxes on the taxable capacity consumers, dealers and of the society at large and its changes
CO3: To make them to be a tax consultant in preparing the tax planning, tax management. Payment of tax and filling of tax returns
CO4:To understand the impact of tax on Domestic, National and International Trade and educating the students as a tax audit, consultant and mangers

Modul-1: **Excise Duty**: Nature of Excise Duty-Definitions-Basis of Duty Payable-Basis of Assessable Value-Transaction Value as Assessable Value-Inclusions in and Exclusions from Transaction Value-Valuation Rules to Determine Assessable Value-Sale to a Related Person. Excise Duty on Small Scale Industries.

Module-2: **Value Added Tax:** Concept of value added. Cascading Effect of Taxes CENVAT, Cascading Effect of Taxes: CENVAT on Inputs-CENVAT on Capital Goods- Dealers' Invoice for CENVAT. Exemptions from Excise Duty- Payment of Duty-Returns-Assessment-Recovery and Refunds Administrative Set Up of Central Excise,

Modul-3: **Customs Duty:** Customs Act, 1962 and the related Rules, Circulars and Notifications; Customs Tariff Act, 1975 and the related Rules. Principles governing levy of customs duty, types of duty including protective duty, safeguard duty, countervailing duty and anti-dumping duty and exemption from customs duties. Basic principles of classification of goods and valuation of goods. Customs authorities, appointment of customs ports, warehousing stations. Provisions governing conveyance, importation and exportation of goods, special provisions regarding baggage, goods imported or exported by post, and stores.

Modul-4: **Service Tax** :Scope of Service Tax-Taxable Service- Administration of the Act-Exemptions from Service Tax-Rate of Service Tax- Computation of Service Tax in Case of Advertising Agency Services: Banking and Financial Services-General Insurance Services-Telephone and Pager Services-Tour Operating Services.

MCC250 Marginal costing and Decision making

Course Objective:

CO1:Identify the detail of wide range of managerial decisions	
CO2: Deliberate the detail of techniques of controlling cost through standard costing	
CO3: Understand the detail of managerial cost control decisions	
CO4: Learn the detail of direct costing	

Module 1: Introduction: Meaning- terminology- Scope & Concepts- Cost Behavior Analysis- Break Even Analysis- Approaches of Break Even Analysis in relation to cost & revenue. Factors- Multi-product Break Even Analysis- Assumptions Underlying Break Even Analysis- Limitations of Break Even Analysis- Case Studies.

Module 2: Contribution Concepts & Sort term Profitability Analysis: Profitability Analysis Under Constrained Conditions- Profit- Volume Ratio & its Uses- Profit Volume Graphs – Case Studies.

Module 3: Marginal Costing & Managerial Decisions: Profit Planning- Pricing Decision – Production Decision – Make and Buy Decision Joint & By-product Decision – Distribution Cost Analysis- Case Studies.

Module 4: Direct Costing: Meaning- Importance & Preparation of income statements- Comparison with Absorption Costing- Arguments in Favour of Direct Costing- Criticisms of Direct Costing. Value Analysis & Value Engineering: Basic Concept of Value- Constitution of a Value Analysis Team-Procedures Underlying Value Analysis Study- Benefits From & Resistance to Value Analysis Study- Reporting to Management- Objectives of Reporting- Reporting Needs of Different Management Levels- Types of Reports- General Principles of Reporting- Modes of Reporting- Reports to the Board of Directors- Reports to Top Management- Reporting to top Divisional Management- Reports to Junior Management Level- Preparation of Reports- use of Reports by Management- Case Studies.

MCC030 - Management of Non-profit organization

Course Objective:

CO1: Understand the Non-profit Sectors
CO2: Specify the Characteristics of Financial Reporting
CO3: Learn in depth training and development
CO4: Write down the details Governance and professionalism

Module 1: The world of non-profit enterprises – third sector, nonprofits sector, social enterprises; Economic, Sociological and Structural theories of nonprofits; Contemporary role of nonprofits; Nonprofits vis-à-vis State and Business

Module 2: Accounting & Finance – Financial reporting in nonprofits; Distinct needs of nonprofit accounting; Sources of funds and their implications; Basic tenets of fund management in nonprofits

Module 3: Human Resource Management – Volunteers & Staff, Critical issues of compensation, quality and retention, Training and development, Incentives and Motivation

Module 4: Governance and Professionalism – Governance process and Board role; Credibility and legitimacy issues; Professionalism, Productivity and measurement of quality

MCB 260: RETAIL MANAGEMENT

Module 1: Retailing Introduction to Retail: What is Retail?- Functions of a retailer-The Marketing-Retail equation The Rise of the Retailer – Proximity to customer – Rise of consumerism-Global retail market Challenges and opportunities-Empowered consumer-Technology enabled effectiveness Evolution of Retail in India-Drivers of Retail change in India-Emergence of young earning India Size of Retail in India: Clothing ,Textiles and Fashion accessories-Food And Food services Books & Music, Communication accessories –Emerging Sectors-FDI in retail-Retail Realities : Beyond Urban Boundaries –Challenges to Retail Development in India – Threat of new entrants –Substitutes, Bargaining Power of suppliers and buyers, Intensity of rivalry

Module 2: Retail Models And Theories Of Retail Development The Evolution of Retail formats – Theories of retail development-Environmental, Cyclical and Conflict Theory-The Concept of life cycle in Retail-Innovation, accelerative growth- Maturity Decline-Phrase of growth in retail markets-Business models in retail-Classification based on ownership /Merchandise offered/Franchising /Non Store Retailing/Direct selling/Direct response marketing/Telemarketing/Fairs and Road Shows/Event Management/Automated Vending/kiosks/ The Cash & Carry/credit Marketing/Brand Management.

Module 3: Customer Relationship Management (Crm) CRM : What is CRM-Common Misconceptions-Definition-Components off CRM-Defining CRM Concepts – Customer Life Cycle- B to B CRM- Understanding Goal of CRM-Using Customer touch points – Deciding who should lead the CRM Functions : Marketing/Sales/Customer Services/ Product Support-Channel and other partners-CRM Planning – Developing Strategy- Building CRM Component-Analyzing and Segmenting Customers Taking it to Customers – Get Ready : Avoiding Common Barriers, GETSET: Organising for success and go: Developing your CRM strategy-CRM Building : Infrastructure, Information, Process, Technology, People – Managing quality information, Quality systems, Customer privacy.

Module 4: Services Management: Distinctive characteristics service operations-Service Bench marking-Service strategy - Designing the service enterprise – Service quality-Service facility location-Managing service operations-Service-Supply relationships vehicle routing.

MCD250 Tools and Techniques of control

Course Objective

CO1: Deliberate the detail of cost control and management tools
CO2: Learn in detail with examples costing system for job and process oriented manufacturing environments
CO3: Identify the classification and characteristics of uniform costing and inter-firm comparison
CO4: Learn in depth objectives and criticism of management audit

Module 1: Budgetary Control: Objectives of Budgetary Control-Preparation of the Budget-Functional Budgets-Sales Budgets-Production Budget-Cost Budget-Plant Utilization Budget Capital Expenditure Budget-Selling & Distribution Cost Budget-Purchasing Budget & Cost Budget-The Master Budget-Operation of Budgetary Control-Flexible Budgetary Control-Zero-Base Budgeting-Case Studies.

Module 2: Standard Costing: Objectives-Principles-Determination of Standards for Material-Labor-Direct Expenses & Overhead Costs-Variable and Fixed Costs-Case Studies.

Module 3: Variance analyses: Material, Labor, and Overhead Variances-sales & Profit Variances-Disposition of Variances-Assessing the Significance of Standard Cost Variance-Standard Cost Accounting-Case Studies.

Module 4: Uniform costing & Interfirm Comparisons: Objectives and Purposes Underlying Uniform Costing-Development of Uniform Costing-Cost Audit-Meaning & Definition-Inclusion of Clause B to Sec.208 to Sub Sec. (d) to Sec. 209-Indian Companies Act 1956-Appointment of Cost-Cost Audit Programme-Records Relating to Materials-Labor Overhead-Depreciation-Stores & Spare Parts-Work-in-progress and Incomplete Contracts-Cost Auditor's Report-Application of Cost Audit Report Rules, 1963-Sachar Committee's Report. Management Audit: Meaning & Definition-objectives & Criticisms-Types of Audits-Argurments for & Against Management Audit-Social Audit-Steps Underlying Social Audit Programme-Social Audit Report-Limitations of Social Audits-Case Studies.

MCB240 **Human Resource Management**

Course Objective:

CO1: Specify in depth human resource planning
CO2: Understand in detail with examples human resource development
CO3: Specify the characteristics of reward system
CO4: Deliberate in detail with examples 360 degree appraisal

Module 1: Environmental context: New economic policy and changing business-technological –socio-economic and political and legal environment, structural reforms and their implications for HRM in India-Response of the management-worker and unions to structural reforms and their implications for HRM in India-Response of the management –Worker and unions to structural adjustment. Concepts of human resource management-Meaning-Objectives-Scope and functions-Perspective of HRM: linking corporate strategies and policies with HRM Organisation of HRM department.

Module 2: Human Resources planning and Procurement; Job analysis and evaluation-job description-job specification -job rotation and job enrichment. Human resource planning- importance-objectives and problems. Recruitment-meaning-recruitment policy, sources –factors affecting selection decision-selection procedure. Human resource information system.

Module 3: Human resource development: Meaning-concepts of HRD-objectives of training-organisation of training programmers-methods-advantages and limitations of training. Evaluation of training programme HRD for total quality management. Transfer policy Promotion policy-Demotion and Discipline- consequences of indiscipline –disciplinary procedure.

Module 4: Compensation/Rewards system: Significance of reward system in business organisation. Compensation system in practice-systems of promoting -factors determining employee compensation and rewards-dearness allowance, employee benefits-bonus-laws on wages, bonus and social security-managerial compensation. Performance Appraisal: concepts, objectives philosophy and process of performance appraisal system- counseling.-career planning and management.

MCD210 Supply Chain Management

Course Objective

CO1: Deliberate the detail of foundational role of logistics management	
CO2: Understand in detail with examples evaluation of marketing channels	
CO3: Learn in depth channel management	
CO4: Identify the detail of staffing the sales team	

Module 1 **Introduction to Sales Management:** Sales Management: Its Nature, Rewards, and Responsibilities, Social, Ethical, and Legal Responsibilities of Sales Personnel. Building Relationships through Strategic Planning, The Market-Driven Sales Organization, Forecasting Market Demand and Sales Budgets Design and Size of Sales Territories, Sales Objectives and Quotas, staffing the Sales Team **-** Planning for and Recruiting Successful Salespeople, Selection, Placement, and Socialization of Successful Salespeople, Training the Sales Team **-** The Management of Sales Training and Development, Contents of the Sales Training Program: Sales Knowledge and the Selling Process, Directing The Sales Team - Motivating Salespeople toward High Performance, Compensation for High Performance, Leading the Sales Team

Module 2 **Marketing Logistics :** Logistics and its importance, Functions of Logistics management - Procurement /Purchasing, Inward Transport, Receiving, Warehousing, Stock Control, Order Picking, Materials Handling, Outward Transport, Physical Distribution Management, Recycling, Returns, and Waste Disposal, Importance of Communication in Logistics, Technology in Logistics- Electronic Data interchange (EDI), Artificial Intelligence, Expert Systems, Communication Technology, Bar Coding and Scanning, Streamlining the Logistics Process, Strategic Issues in Logistics Management

Module 3 **Marketing Channels:** Evolution of Marketing Channels- The Production Era, The Sales Era, The Marketing Era, Relationship Marketing Era, Channel member and their roles, Roles of Channel Members, Channel Functions, Designing marketing channels - Channel Structure, Channel Intensity, Types of Channel Intermediaries at Each Level, Channel Flows and Cost.Importance of Channel Integration, Vertical Marketing Systems, Types of vertical marketing systems - Corporate VMS, Administered VMS, Contractual VMS, Horizontal Marketing Systems, Hybrid channel system, Designing and Managing Hybrid Channel Systems

Module 4 **Channel Management:** Recruiting Channel, Members - Recruiting as a Continuous Process, Recruiting Manufacturers, Screening, Criteria for Selecting Channel Members - Sales Factors, Product Factors, Experience Factors, Administrative Factors, Risk Factors, Motivating Channel Members, Distributor Advisory Councils, Modifying Channel Arrangements - PLC Changes, Customer-Driven Refinement of Existing Channels, Growth of Multi-Channel Marketing Systems, Managing Channel Relationships - Cooperation and coordination, Conflict, Power

JSS MAHA VIDYAPEETHA

JSS College of Arts, Commerce and Science

Ooty Road, Mysuru - 570 025

Department of Master of Computer Applications

OVERALL COURSE GRID OF

Master of Computer Applications

2021-2022

Master of Computer Applications

2 Years / 4 Semesters

1. Introduction:

MCA is Masters of Computer Application is a PG course of two years and has it is a master Course in Computer Application the MCA subjects are related to computer languages computer software and the MCA syllabus is divided into 4 semesters has the MCA subjects consists 5 number but their brief knowledge is given in two years so the MCA syllabus is made in such a way that the students learn MCA subjects in two years in such a pattern that the gain all the knowledge

The MCA course includes classroom teaching, practical assignments, and project work which is a mandate in the MCA course syllabus. MCA course syllabus emphasis the latest programming languages and tools to develop better and faster applications. Some colleges encourage students to spend a full semester working in the industry to explore and understand how IT works.

To train MCA course subjects offered by the universities are Data Structures and files using C, Project Visual C++, Computer Networks and Java programming etc. MCA syllabus varies from university to university and some of them are- Internet & JAVA Programming, Modeling and Simulation, Computer and 'C' Programming, Management Information System, and many others.

The MCA course list also emphasis certain specialization topics like Troubleshooting, System Engineering, Software Development, Hardware Technology, etc.

2. Lecture-Practical/Project-Tutorial (L-P-T)

A course shall have either or all the three components, i.e. a course may have only lecture component, or only practical/project component or a combination of any two/three components

Lecture (L): Classroom sessions delivered by faculty in an interactive mode. It should be conducted as per the scheme of lectures indicated in respective course.

Practical/Project(P): Practical / Project Work consisting of Hands-on experience /Field Studies / Case studies that equip students to acquire the much required skill component. Besides separate Practical/Project course, three course in each semester include few practical assignment and it will be evaluated under internal evaluation

Tutorial (T): Session consisting of participatory discussion/ self-study/ desk work/ brief seminarpresentations by students and such other novel methods that make a student to absorb and assimilatemore effectively the contents delivered in the Lecture sessions

A Mini project is an assignment that the student needs to complete at the end of every semester in order to strengthen the understanding of fundamentals through effective application of thecourses learnt. The details guidelines have been given in the course structure.

The Project Work to be conducted in the FINAL Semester and evaluated at the end of the semester. The detail guidelines have been in the respective course structure.

The teaching / learning as well as evaluation are to be interpreted in a broader perspective asfollows:

i) Teaching – Learning Processes: Classroom sessions, Group Exercises, Seminars, Small Group Projects, Self-study, etc.

ii) Evaluation: Tutorials, Class Tests, Presentations, Field work, Assignments, competency based Activity, etc.

The MCA Programme is a combination of:

a. Four-Credit Courses (100 Marks each): 4 Credits each

b. One-Credit Courses (50 Marks each):

Following are the session details per credit for each of L-P-T model

1) Every ONE-hour session per week of L amounts to 1 credit per Semester,

2) Minimum of TWO hours per week of P amounts to 1 credit per Semester

3) Minimum of ONE hours per week of T amounts to 1 credit per Semester

Scheme and Syllabus

Semester I					
Course Title	**Course Code**	**Credits**	**Contact hours**	**EXT**	**INT**
Java Programming	IT11	4:0:0	4	70	30
Data Structure and Algorithms	IT12	4:0:0	4	70	30
Computer Organisation and Architecture	IT13	4:0:0	4	70	30
Operating System Concepts	IT14	4:0:0	4	70	30
Computer Networks	IT15	4:0:0	4	70	30
Management Information System	BT11	4:0:0	4	70	30
Mathematical foundations	MT11	4:0:0	4	70	30
Java Programming Lab	IT11L	0:0:1	2	30	20
Data Structure and Algorithms Lab	ITC11	0:0:1	2	30	20
	TOTAL	30	32	550	250

Semester II						
Sl. No.	**Course Title**	**Course Code**	**Credits**	**Contact Hours**	**EXT**	**INT**
1	Python Programming	IT21	4:0:0	4	70	30
2	Software Architecture	IT22	4:0:0	4	70	30
3	Optimization Techniques	MT21	4:0:0	4	70	30
4	Advanced Internet Technologies	IT23	4:0:0	4	70	30
5	Analysis and Design of Algorithms	IT24	4:0:0	4	70	30
6	DBMS	IT 25	4:0:0	4	70	30
7	Elective	ET2X	4:0:0	4	70	30
8	Python Programming Lab	IT21L	0:0:1	2	30	20
9	Advanced Internet Technologies Lab	IT23L	0:0:1	2	30	20
			30	32	550	250

ELECTIVES:

Machine Intelligence Stream		Data Sciences Stream		Applications Stream	
ET21	Artificial Intelligence and Robotics	ET22	NOSQL	ET23	Enterprise Resource Planning

Semester III						
Sl. No.	**Course Title**	**Course Code**	**Credits**	**Contact Hours**	**EXT**	**INT**
1	Mobile Application Development	IT31	4:0:0	4	70	30
2	Data Warehousing and Data Mining	IT32	4:0:0	4	70	30
3	Software Testing and Quality Assurance	IT33	4:0:0	4	70	30
4	.NET Technologies	IT34	4:0:0	4	70	30
5	Cloud Computing	IT35	4:0:0	4	70	30
6	Cryptography and Network Security	IT36	4:0:0	4	70	30
7	Elective	OC32	4:0:0	4	70	30
8	Mobile Application Development Lab	IT31L	0:0:1	2	30	20
9	Data Warehousing and Data Mining Lab	IT32L	0:0:1	2	30	20
			30	32	550	250

ELECTIVES:

Machine Intelligence Stream		Data Sciences Stream		Applications Stream	
ET31	Soft Computing	ET32	Big Data Analytics	ET33	Software Project Management and Practices

Semester IV					
Sl. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Business Intelligence	BM41	4:0:0	70	30
2	Project	ITC41	0:0:12	150	100
			16	220	130

Semester	Credit	IE	UE
Semester I	30	260	540
Semester II	30	260	540
Semester III	30	260	540
Semester IV	16	130	220
Total	106	910	1840
			2750

IT : Information Technology

BT: Business Technology

MT: Mathematics Technology

Semester I

Course Code: IT-11
Course Name: Java Programming

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30	-	-	70	100

Course Description:

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: CO1: Demonstrate and implement programs using components and constructs of a Java language CO2: Identify classes, objects, members of a class and use packages and interfaces appropriately. CO3: Demonstrate for Java program for multithread, synchronization and exception handling concepts. CO4: Use the concept of string, event handling, simple data structures like arrays and members of classes of Java API in application development CO5: Design and develop Java based UI and Networking applications using applets, swing components and networking concepts.
TOPICS COVERED:

UNIT 1 – Java Basics 10 Hours

History of Java, Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and casting, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, nested and inner classes, exploring string class

UNIT 2 – OOP Concepts in Java, Packages and Interfaces 10 Hours

Hierarchical abstractions, Base class object, subclass, subtype, substitutability, forms of inheritance- specialization, specification, construction, extension, limitation, combination, benefits of inheritance, costs of inheritance. Member access rules, super uses, using final with inheritance, polymorphism- method overriding, abstract classes, the Object class.

Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces. Exploring java.io.

UNIT 3 - Exception Handling and Multi Threading 10 Hours

Concepts of exception handling, benefits of exception handling, Termination or presumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes. String handling, Exploring java.util.

Differences between multi threading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads; inter thread communication, thread groups, daemon threads. Enumerations, auto boxing, annotations, generics.

UNIT 4 - String and Event Handling 10 Hours

String fundamentals, String Constructors, Three string related language features, The Length() method, Obtaining the characters within the string, String comparison, using index Of() and lastindexOf(), changing the case of the characters within the string, String buffer and String builder.

Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics, layout manager – layout manager types – border, grid, flow, card and grid bag.

UNIT 5 – Applets, Swings and Networking with Java.Net 12 Hours

Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Swings- Introduction, limitations of AWT, MVC architecture, components, containers, exploring swing- JApplet, JFrame and JComponent, Icons and Labels, text fields, buttons – The JButton class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

Networking fundamentals, Networking Classes & Interfaces, The InetAddress class, The Socket class, URL class, URL connection class, Http URL connection class, Exploring collection frame work, Collection overview, Collection classes and interfaces, Array class.

TEXT BOOKS / REFERENCES:

1. Herbert Schildt. Java - The Complete Reference, Ninth Edition. Oracle Press, McGraw Hill Education (India) Edition- 2014.

Reference books:

1. Cay S. Horstmann, Gary Cornell. Core Java, Core Java Volume-1 – Fundamentals, 9th edition, Pearson Education, 2014.
2. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.

ADDITIONAL LEARNING SOURCES:

1. http://www.oracle.com/technetwork/java/index-jsp-135888.html
2. http://www.javaworld.com/article/2074929/core-java
3. http://www.javaworld.com/
4. http://www.learnjavaonline.org/
5. https://www.codecademy.com/learn/learn-java
6. http://www.tutorialspoint.com/java/
7. http://www.java-examples.com/
8. http://www.homeandlearn.co.uk/java/java.html

Course Code: IT-12

Course Name: Data Structure and Algorithms

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30	-	-	70	100

COURSE OUTCOMES:

Upon successful completion of this course, the student will be able to:

CO1: Design and analyze programming problem statements.
CO2: Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.
CO3: Apply mathematical abstraction to solve problems.
CO4: Demonstrate various methods of organizing large amounts of data.
CO5: Analyze algorithms and to determine algorithm correctness and time efficiency class.
CO6: demonstrate linear data structures linked list, stack and queue (apply)
CO7: implement tree, graph, hash table and heap data structures (apply)
CO8: apply brute force and backtracking techniques (apply)
CO9: demonstrate greedy and divide-conquer approaches (apply)
CO10: implement dynamic programming technique (apply)

UNIT 1 - Introduction and overview of C Programming 12 Hours

Introduction to C programming, Variables, Data types, Constants, Declarations, Operators, Precedence, Associativity, Order of evaluation. Input and output statements; Control Statements, Arrays – Single dimension, Two dimensional, Multi dimensional Arrays, Strings. Functions, Categories of functions. Examples Pointers, Pointer arithmetic, Call by value, Pointer Expression, Pointer as function arguments, recursion, passing strings to functions, Call by reference, Functions returning pointers, Pointers to functions, Programming Examples. Structures and Unions.

UNIT 2 - Introduction to Data Structures 8 Hours

Information and its meaning: Abstract Data Types, Sequences as Value Definitions, ADT for Varying length character Strings, pointers and review of Pointers, Dynamic Memory Allocation - definition, malloc, calloc, and realloc, free. Data Structures: Array as an ADT, Arrays as Parameters, String as an ADT.

UNIT 3 - The Stack 12 Hours

Definition and examples, Primitive operations, Example, The stack as an ADT, Representing stacks, Implementing the pop, push operations using function overloading, Examples for infix, postfix, and prefix expressions, Basic definition and Examples. Applications of Stacks: Expression Evaluations, Expression conversion, Recursion as application of stack, Properties of recursive definition or algorithm. Binary search, Towers of Hanoi problem.

UNIT 4 - Queues and Linked List 12 Hours

The queue and its sequential representation, the queue as ADT, Basic operations using polymorphism and inheritance, Priority queue, Array implementation of a priority queue. Linked lists, inserting and removing nodes from a list, Linked implementations of stacks, Linked implementation of queues, linked list as a data Structure. Example of list operations.

UNIT 5 - Linked Lists and Trees 8 Hours

Other list structures: Circular lists, Stack as circular lists, doubly linked lists. Application of linked lists: Stacks, Queues, double-ended queues, priority queues. Sorting and Searching: Applications and implementation with function overloading. Tree: Definition and representation, Types of trees, Basic operations on Tree.

TEXT BOOKS/ REFERENCES :

Text Books :

1. Programming in ANSI C, Third Edition, E. Balaguruswamy. 6th Edition (2013).
2. Data Structures Using C and C++ by Aaron.M. Tenenbaum, Yedidyah Langsam and Moshe J. Augustine, PHI, Edition, 2011.

Reference Books :

1. Data structures, Algorithms and Applications in C++, S. Sahani, University Press (India) Pvt Ltd, 2nd Edition.
2. The complete reference C, Herbert Schildt, Fifth Edition, Tata McGraw Hill.

ADDITIONAL LEARNING SOURCES:

1. http://www.tutorialspoint.com/Data-Structures-in-C-Online-Training/classid=13
2. http://nptel.ac.in/datastructures_c
3. www.javatpoint.com
4. www.oracle.com
5. www.geeksforgeeks.org/java

Course Code: IT-13
Course Name: Computer Organisation and Architecture

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30	-	-	70	100

Upon Successful Completion of this Course, Student will know
CO1: Computer Architecture-Hardware, software
CO2: Design of Interfaces
CO3: Addressing Modes

UNIT-1 **12 Hours**
Principles of Computer design - Software, hardware interaction layers in computer architecture. Central processing unit. Machine language instructions, Addressing modes, instruction types, Instruction set selection, Instruction cycle and execution cycle.

UNIT-2 **12 Hours**
Control unit, Data path and control path design, Microprogramming V s hardwired control, RISC Vs CISC, Pipelining in CPU design: Superscalar processors.

UNIT-3 **12 Hours**
Memory system, Storage technologies, Memory array organization, Memory hierarchy, interleaving, cache and virtual memories and architectural aids to implement these.

UNIT-4 **8 Hours**
Input-output devices and characteristics. Input-output processing, bus interface, data transfer techniques, I/O interrupts, channels.

UNIT-5 **8 Hours**
Performance evaluation - SPEC marks, Transaction Processing benchmarks.

TEXT BOOKS/ REFERENCES :

1. Pal Chauduri, P., "Computer Organisation and Design", Prentice Hall of India, New Delhi, 1994.
2. Rajaraman,V., and Radhakrishnan, T., "Introduction to Digital Computer Design" (4thedition). Prentice Hall of India, New Delhi, 1997.
3. Stallings. W, "Computer Organization and Architecture, (2nd edition) Prentice Hall of India, New Delhi

Course Code: IT-14
Course Name: Operating System and Linux

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30	-	-	70	100

COURSE OUTCOMES:

Upon successful completion of this course, the student will be able to:

CO1: Recognize the structure of operating system, interaction of an operating system and application programs.
CO2: Analyze the various programming paradigms viz., multi-process and multi-threaded programming.
CO3: Examine the various resource and memory management techniques.
CO4: Distinguish the different features of real time and mobile operating systems.
CO5: Identify current issues in system security; demonstrate various factors can influence the overall performance of an operating system.

TOPICS COVERED:

UNIT 1- Computer and Operating Systems Structure 11 Hours

Basic Elements, Processor Registers, Instruction Execution, The Memory Hierarchy, Cache Memory, I/O Communication Techniques, Introduction to Operating System, Mainframe Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real - Time Systems, Handheld Systems, Feature Migration, Computing Environments.
System Structures: System Components, Operating – System Services, System Calls, System Programs, System Structure, Virtual Machines, System Design and Implementation, System Generation

UNIT 2 - Process Management and Mutual Execution 10 Hours

Process, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues, Processes and Threads, Symmetric Multiprocessing(SMP), Micro kernels, CPU Scheduler and Scheduling. Principles of Concurrency, Mutual Exclusion: Hardware Support, Semaphores, Monitors, Message Passing, Readers/Writes Problem.

UNIT 3 - Deadlock and Memory Management 11 Hours

Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategy, Dining Philosophers Problem Memory Management: Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Process Creation, Page Replacement, Allocation of Frames, Thrashing

UNIT 4 - File System and Secondary Storage 10 Hours

File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection, File – System Structure, File – System Implementation, Directory Implementation, Allocation Methods, Free–Space Management**,** Disk Structure, Disk Scheduling, Disk Management.

UNIT 5 - Computer Security and Case study of Linux Operating system 10 Hours

The Security Problem, User Authentication, Program Threats, System Threats. Linux System Linux history, Design Principles, Kernel modules, Process, management, scheduling, Memory management, File systems, Input and output, Inter-process communications.

TEXT BOOKS/REFERENCES:
TEXT BOOKS : 1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8th edition, Wiley India, 2009. 2. William Stallings, "Operating System Internals and Design Principles" Pearson, 6thedition, 2012 REFERENCES: 1. Dhananjay M. Dhamdhere, "Operating Systems – A Concept – Based Approach", TataMcGraw – Hill, 3rd Edition, 2012. 2. Harvey M Deital: Operating systems, 3rd Edition, Pearson Education, 1990. 3. Chakraborty , "Operating Systems" Jaico Publishing House, 2011
ADDITIONAL RESOURCES:
1. https://www.tutorialspoint.com/operating_system/os_linux 2. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems.

Course Code: IT-15
Course Name: Computer Networks

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30	-	-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: **CO1:** Analyze and distinguish the basic concepts, principles and techniques of data communication along with the layers of OSI and TCP/IP model. CO2: Independently understand and distinguish the concept of links, nodes and data transmission issues in the network. **CO3:** Capability to categorize wired LANs: Ethernet, IPv4 addresses and performance of The network-layer. **CO4:** Design and demonstrate the services of TCP and UDP. **CO5:** Ability to summarize and interpret the basic concepts of Application-Layer paradigms and standard client-server protocols.

TOPICS COVERED:

UNIT 1 - Basics of Data Communications and Physical Layer 10 Hours

Data Communications: Components, Data Representation, Data Flow, Networks; Network Criteria, Physical Structures, Network Types: LAN, WAN, Switching, Network Models: Protocol Layering: Principles of Protocol Layering, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in the TCP/IP Protocol Suite, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model; OSI versus TCP/IP, Lack of OSI Model's Success, Introduction to Physical Layer, Data and Signals, Periodic Analog Signals, Digital Signals, Transmission Impairment, Data Rate Limits, Performance, Switching: Circuit-Switched Networks, Packet Switching, Datagram Networks, Virtual Circuit Networks.

UNIT 2 - Data Link Layer 10 Hours

Introduction to Data-Link Layer, Link-Layer Addressing: Address Resolution Protocol (ARP), Error Detection and Correction: Introduction, Types of Errors, Redundancy, Detection versus Correction, Coding, Block coding: Error Detection, Cyclic Code: Cyclic Redundancy Check, Polynomials, Cyclic Code Analysis and its Advantages, Checksum, Forward Error Correction: Using Hamming Distance, Using XOR, Chunk Interleaving.

UNIT 3 - LANs and Network Layer 10 Hours

Ethernet Protocol, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency of Standard Ethernet, Implementation, Changes in the Standard, Fast Ethernet (100 MBPS): Access Method, Physical Layer, 10 Gigabit Ethernet, Introduction to Network Layer, Network- Layer Services: Packetizing, Routing and Forwarding, Packet Switching: Datagram Approach, Virtual-Circuit Approach, Network Layer Performance: delay Throughput, Packet loss, Congestion Control, IPv4 addresses.

UNIT 4 - Transport Layer 10 Hours

Introduction to Transport-Layer: Transport-Layer Services; Transport-Layer Protocols: Port Numbers, User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control, TCP Timers.

UNIT 5 - Application Layer and Standard Client-Server Protocols 12 Hours

Introduction to Application Layer, Services, Application-Layer Paradigms, Client-Server Programming: Application Programming Interface, Using Services of the Transport Layer, Iterative Communication using UDP, Iterative Communication using TCP, Concurrent Communication, World Wide Web and HTTP: FTP: Two Connections, Control Connection, Data Connection, Security for FTP, E-Mail: Architecture, Web-Based Mail, TELNET: Local versus Remote Logging, Secure Shell (SSH): Components, Applications, Domain Name System (DNS): Name Space, DNS in the Internet, Resolution, Caching, Resource Records, DNS Messages, Registrars, DDNS, Security of DNS.

TEXT BOOKS / REFERENCES:

Text books:

B. A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Education (India) Private Limited, 2013.

Reference books:

1. William Stallings, Data and Computer Communications, 10th Edition, Pearson, 2013.
2. Larry L. Peterson and Bruce S. David: Computer Networks – A Systems Approach, 5th Edition, Elsevier, 2011.
3. Andrew S. Tanenbaum, Computer Networks, Fourth Edition, PHI, 2008.

4. Fred Halsall, Data Communications, Computer Networks and Open Systems, 4th Edition, Pearson Education, 2005.

1. www.nptel.ac.in/courses
2. http://freevideolectures.com/Course/2276/Computer-Networks

Course Code: BT-11
Course Name: Management Information System

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30			70	100

Course Description:

COURSE OUTCOMES:
Upon successful completion of this course, the student will be able to: CO1: Apply the different strategies for the management of business to formulate business process. CO2: Analyze the need for business process re-engineering, and the process of making. CO3: Analyze and examine business information needs to facilitate evaluation of strategic alternatives. CO4: Apply Management Information Systems knowledge and skills learned to facilitate the acquisition, development, deployment, and management of information systems. CO5: Effectively communicate strategic alternatives to facilitate decision-making.
TOPICS COVERED:

UNIT 1- Systems Engineering, Information and Knowledge 12 Hours

System concepts, system control, types of systems, handling system complexity, Classes of systems, General model of MIS, Need for system analysis, System analysis for existing system & new requirement, system development model, MIS & system analysis. Information concepts, classification of information, methods of data and information collection, value of information, information: A quality product, General model of a human as information processor, Knowledge, Introduction of MIS: MIS: Concept, Definition, Role of the MIS, Impact of MIS, MIS and the user, Management as a control system, MIS support to the management, Management effectiveness and MIS, Organization as system. MIS: organization effectiveness.

UNIT 2- Decision Making and DSS 10 Hours

Decision making concepts; decision making process, decision-making by analytical modeling, and Behavioral concepts in decision making, organizational decision-making, Decision structure, DSS components, and Management reporting alternatives
Technology of Information System : Introduction, Data processing, Transaction processing, Application processing, information system processing, TQM of information systems, Human factors & user interface, Strategic nature of IT decision, MIS choice of information technology.

UNIT 3- Electronic Business systems 10 Hours

Enterprise business system – Introduction, cross-functional enterprise applications, real world case, Functional business system, - Introduction, marketing systems, sales force automation, CIM, HRM, online accounting system, Customer relationship management, ERP, Supply chain management (real world cases for the above)

E-business Technology: Introduction to E-business, model of E-business, internet and World Wide Web, Intranet/Extranet, Electronic, Impact of Web on Strategic management, Web enabled business management, MIS in Web environment.

UNIT 4- Strategic Management of Business & Developing Business/IT Strategies /IT Solutions 10 Hours

Concept of corporate planning, Essentiality of strategic planning, Development of the business strategies, Type of strategies, short-range planning, tools of planning, MIS: strategic business planning. Planning fundamentals (real world cases), Organizational planning, planning for competitive advantage, (SWOT Analysis), Business models and planning. Business/IT planning, identifying business/IT strategies, Implementation Challenges, Change management., Developing business systems, (real world case), SDLC, prototyping, System development process, implementing business system .

UNIT 5: E-Commerce Introduction 10 Hours

Introduction to e-commerce, E-commerce Business Models and Concepts, Ecommerce Infrastructure: The Internet and World Wide Web, Web design, JavaScript Internet Information Server (IIS); Personal Web Server (PWS).

E-Commerce techniques and Issues: Introduction to Active Server Pages (ASP), Building an E-Commerce Web Site, E-Commerce Payment Systems, E-Commerce Marketing Techniques, Building product catalogue, Search product catalogue, Web Spider and search agent, Ethical, Social and Political Issues in E-Commerce.

TEXT BOOKS /REFERENCES:

Text Books :

1. Waman S Jhawadekar: Management Information System, 3rd Edition, Tata McGraw Hill.
2. James A O’Brien and George M Marakas: Management Information System, 7th Edition, Tata McGraw Hill, 2006
3. Turban, Rainer, and Potter, Introduction to E-Commerce, second edition, 2003
4. H. M. Deitel, P. J. Deitel and T. R. Nieto, E-Business and E-Commerce: How to Program, Prentice hall, 2001

Reference Books:

1. Ralph M Stair and George W Reynolds: Principles of Information Systems, 7th Edition, Thomson, 2010.
2. Steven Alter: Information Systems - The Foundation of E-Business, 4th Edition, Pearson Education, 2001
3. Elizabth Chang: E-Commerce Fundamentals and Applications, Wile India Edition.

ADDITIONAL LEARNING RESOURCES:

1. http://mbaexamnotes.com/management-information-system-notes
2. https://www.tutorialspoint.com/management_information_system

Course Code: MT-11
Course Name: Mathematical Foundations

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30			70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: **CO1:** Implement statistical measures and explore its applications **CO2:** Analysis of computational errors and design of algorithms to solve a set of linear equations. **CO3:** Applying the concepts of vector and linear functions in real time applications. **CO4:** Apply the notion of relations on finite structures, like strings and analyze algorithms using the concept of functions. **CO5:** Explore the properties of Graph theory and its applications in computer science.
TOPICS COVERED:

UNIT 1- Statistics 10 hours

Univariate data – different measures of location, dispersion, relative dispersion, skewness and kurtosis, Moments, Measures based on them – comparison with moment measures, Correlation and Regression Analysis.

UNIT 2 – Number Systems and Vector & Matrix Algebra 10 hours

Errors in Numerical Computations, Types of Errors, Analysis and Estimation of Errors, Vector Algebra: Vector spaces with real field, Basis and dimension of a vector space, Orthogonal vectors, Properties of Matrices and Determinants: Matrix Operations, Elementary Matrices, Inverse Matrix, Diagonal Matrix, Symmetric Matrix, and Determinant Matrix.

UNIT 3 - Linear Algebraic Systems 11 hours

Numerical methods for Linear Systems, Direct Methods for Linear Systems: Cramer's Rule, Gauss Elimination Method, Gauss Jordan Elimination Method, Pivoting Strategies, Gauss- Jordon Method, LU Decomposition Method, Tridiagonal Systems of Linear Equations, Iterative Methods for Solving Linear Systems, Jacobis Iteration Method, Gauss-Seidel Iterative Method, Convergence Criteria, Eigen Values and Eigen Vectors.

UNIT 4 – Relations and Functions   10 hours

Cartesian products and Relations, Properties of Relations, Functions: Plain and One-to-One, Onto Functions: Stirling Numbers and the Second Kind, Special functions, The Pigeon-hole principle, Function composition and inverse functions.

UNIT 5 - Graph Theory   11 Hours

Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree: Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles, Graph Coloring and Chromatic Polynomials.

TEXT BOOKS / REFERENCES:

TEXT BOOKS :

1. Sant Sharan Mishra, "Computer Oriented Numerical and Statistical Methods", PHI Learning Private Limited, 2013.
2. Rizwan Butt, "Introduction to Numerical Analysis Using Matlab", Infinity Science Press LLC, 2008
3. Ralph P Grimaldi, B.V.Ramana, "Discrete & Combinatorial Mathematics, An Applied Introduction" 5th Edition, Pearson Education, 2009.

REFERENCES:

1. D.S. Chandrasekharaiah, Discrete Mathematical Structures, 4th Edition, PRISM Pvt. Ltd. 2012.
2. Bondy and U.S.R.Murty: Graph Theory and Applications (Freely downloadable from Bondy's website; Google-Bondy)
3. S. Kumarsean, "Linear Algebra A geometric approach", Prentice Hall of India Private Limited, 2001
4. Kenneth H Rosen, "Discrete Mathematics & its Applications" 7th edition, McGraw- Hill, 2010.

ADDITIONAL LEARNING SOURCES:

1. http://www.personal.kent.edu/~rmuhamma/GraphTheory/graphTheory.htm
2. http://www.tutorialspoint.com/discrete_mathematics/
3. http://nptel.iitm.ac.in/
4. http://www.maths.lu.se/english/library/e-resources/
5. http://sunzi.lib.hku.hk/ER/detail/hkul/3743848
6. https://www.**math**.ucdavis.edu/~**linear/linear-**guest.pd

Course Code: IT11L
Course Name: Java Programming Practicals

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
--	3 Hrs./Week	1		50		50	100

Upon successful completion of this course, students will be able to:

CO1: Demonstrate and implement programs using components and constructs of a Java language
CO2: Identify classes, objects, members of a class and exhibit use packages and interfaces appropriately.
CO3: Demonstrate for Java program for multithread, synchronization and exception handling concepts.
CO4: Use the concept of string, event handling, simple data structures like arrays and members of classes of Java API in application development
CO5: Design and develop Java based UI and Networking applications using applets, swing components and networking concepts.

LIST OF PROGRAMS TO BE COVERED:

1. Display Hello world
2. Check entered number is ODD or EVEN
3. Find factorial of number
4. Find the sum of the digits of a given number
5. Swap two numbers without using a temporary variable
6. Accept a name and display the name with greeting message using Class.
7. Generate a salary for an employee using class, object, constructors, methods and access control. Different parameters to be considered are Emp_No, Emp_Name, Age, Basic, DA, HRA, CA, PT, IT.
8. Generate a sales report for a sales executive using class, object, constructors, methods and access control. Different parameters to be considered are Emp_No, Emp_Name, Sales_Q1, Sales_Q2, Sales_Q3, Sales_Q4.
9. Demonstrate Constructor Overloading and Method Overloading.
10. Implement Inner class and demonstrate its Access protection.
11. Write a program in Java for String handling which performs the following:
    a. Checks the capacity of String Buffer objects.
    b. Reverses the contents of a string given on console and converts the resultant string in upper case.
    c. Reads a string from console and appends it to the resultant string of ii.
12. Demonstrate Inheritance.

13. Simple Program on Java for the implementation of Multiple inheritance using
    a. interfaces to calculate the area of a rectangle and triangle.
14. Write a JAVA program which has
    a. A Class called Account that creates account with 500Rs minimum balance, a deposit() method to deposit amount, a withdraw() method to withdraw amount and also throws Less Balance Exception if an account holder tries to withdraw money which makes the balance become less than 500Rs.
    b. A Class called Less Balance Exception which returns the statement that says withdraw amount (Rs) is not valid.
    c. A Class which creates 2 accounts, both account deposit money and one account tries to withdraw more money which generates a Less Balance Exception take appropriate action for the same.
15. Write a JAVA program using Synchronized Threads, which demonstrates Producer Consumer concept.
16. Write a JAVA program to implement a Queue using user defined Exception Handling (also make use of throw, throws.).
17. Complete the following:
    a. Create a package named shape.
    b. Create some classes in the package representing some common shapes like Square,
    c. Triangle and Circle. Import and compile these classes in other program.
18. Write a JAVA Program
    a. Create an enumeration Day of Week with seven values SUNDAY through SATURDAY. Add a method is Workday( ) to the Day of Week class that returns true if the value on which it is called is MONDAY through FRIDAY. For example, the call Day Of Week SUNDAY is Workday ( ) returns false.
19. Write a JAVA program which has
    a. A Interface class for Stack Operations
    b. A Class that implements the Stack Interface and creates a fixed length Stack.
    c. A Class that implements the Stack Interface and creates a Dynamic length Stack.
    d. A Class that uses both the above Stacks through Interface reference and does the Stack operations that demonstrates the runtime binding.
20. Print a chessboard pattern.
21. Write a JAVA Program which uses File Input Stream / File Output Stream Classes.
22. Demonstrate utilities of Linked List Class.
23. Write a JAVA applet program, which handles keyboard event.
24. Write a JAVA Swing program, to design a form.
25. Create a simple Student Registration application using Swings, JDBC and MySQL.
26. Write a JAVA program which uses Datagram Socket for Client Server Communication.

TEXT BOOKS / REFERENCES:

Text books:

1. Herbert Schildt. Java - The Complete Reference, Ninth Edition. Oracle Press, McGraw Hill Education (India) Edition- 2014.

Reference books:

1. Cay S. Horstmann, Gary Cornell. Core Java, Core Java Volume-1 – Fundamentals, 9th edition, Pearson Education, 2014.
2. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.

ADDITIONAL LEARNING SOURCES:

1. http://www.oracle.com/technetwork/java/index-jsp-135888.html
2. http://www.javaworld.com/article/2074929/core-java
3. http://www.javaworld.com/
4. http://www.learnjavaonline.org/
6. https://www.codecademy.com/learn/learn-java
7. http://www.tutorialspoint.com/java/
8. http://www.java-examples.com/
5. http://www.homeandlearn.co.uk/java/java.html

Course Code: IT12L

Course Name: Data Structure and Algorithms Practicals

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
--	3 Hrs./Week	1		50		50	100

COURSE OUTCOMES:
Upon successful completion of this course, the student will be able to: CO1: Design and analyze programming problem statements. CO2: Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem. CO3: Apply mathematical abstraction to solve problems. CO4: Demonstrate various methods of organizing large amounts of data. CO5: Analyze algorithms and to determine algorithm correctness and time efficiency class.
LIST OF EXPERIMENTS COVERED:

PROGRAMS ON C.

1. Programs to learn and explore C data types, looping and decision making structures. {mean, median, lcm, gcd, min max}
2. Calculate the salary of an employee given his basic pay, HRA = 10% of basic pay, TA=5% of his basic pay and deductions IT = 2.5% of his basic pay.
3. Solve quadratic equations to find the roots of the equation.
4. Programs to implement arrays and structures.{Ex: Students marks calculation, matrix operations}
5. Calculate the average marks of the student test marks and display the result using structure.
6. Programs to implement dynamic memory allocation: malloc, calloc, realloc and free.

STACK

7. Write a C program to evaluate the validity of an expression
8. Write a C program to evaluate a postfix expression.
9. Write a C program to convert an expression from infix to postfix.
10. Write a C program to implement multiple stack of integers.

QUEUES

11. Write a C program to perform basic operations on queue of integers, the program should provide the appropriate message to handle all concerned conditions
12. Write a C program to perform basic operations on list of students information stored in circular queue.

Let student information include regno, course title, year of study

13. Write a C program to implement dual queue.

LINKED LIST

14. Write a C program to implement stack operations using linked list.
15. Write a C program to implement queue operations using linked list.
16. Write a C program to create the students mark list based on the rank. Let the student record contain student-id, name, total marks.

17. Write a C program to perform operations.

a. Creation of list.
b. Insertion of new element [At Front, from rear, based on the position]
c. Deletion of a node [At Front, from rear, based on the position]
d. Display the list.
e. Replace the content of one element by another element.
f. Swap two nodes

18. Write a C program to perform the following operations on doubly linked list.

a. Creation of list by :

Insertion [At beginning, At end, In between] Deletion [At beginning, At end, In between]

b. Display all the nodes.
c. Swap two nodes based on specific criteria.

TREES

19. Write a C program to perform / implement the binary tree using array and hence perform the following

a. To print the left and right child of specified node
b. To print all the ancestors of a specified node
c. To print all the node in a specific level
d. To print only the leaf node

20. Write a C program to perform / implement the binary tree using linked list and hence perform the following

a. To print the left and right child of specified node
b. To print all the ancestors of a specified node
c. To print all the node in a specific level
d. To print only the leaf node

21. Write a C program with recursive routines to traverse the binary tree in all possible orders

a. Create a tree
b. Pre-Order traversal
c. In-Order traversal
d. Post-Order traversal

22. Write a C program to construct a heap of n integers and hence sort them using heap sort Algorithm

23. Implement the search techniques
    a. Linear Search
    b. Binary Search

Text Books :

1. Programming in ANSI C, Third Edition, E. Balaguruswamy. 6th Edition (2013).
2. Data Structures Using C and C++ by Aaron.M. Tenenbaum, Yedidyah Langsam and Moshe J. Augustine , PHI, Edition, 2011.

Reference Books :

1. Data structures, Algorithms and Applications in C++, S. Sahani, University Press (India) Pvt Ltd, 2nd Edition.
2. The complete reference C, Herbert Schildt, Fifth Edition, Tata McGraw Hill.

1. http://www.tutorialspoint.com/Data-Structures-in-C -Online-Training/classid=13
2.http://nptel.ac.in/datastructures_c

Semester II

Course Code: IT-21
Course Name: Python Programming

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30			70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: CO1: Design and apply a solution clearly, accurately in a program using python. CO2: Comprehend and Apply knowledge in real time situational problems and think creatively about solutions. CO3: Apply the best features of mathematics, engineering and natural sciences to program using python. CO4: Apply object-oriented programming concepts to develop dynamic interactive Python applications. CO5: Demonstrate how to build and package python modules for reusability.
TOPICS COVERED:

UNIT 1 - Introduction to Python 10 Hours

Python Basics: Data Types, Operators, Input/Output Statements, Creating Python Programs, Python Flow Control statements: Decision making statements, Indentation, Conditionals, loops, break, continue, and pass statements. Strings, lists, Tuples, Dictionaries

UNIT 2 - Python Functions 10 Hours

Defining functions, DOC strings, Function parameters: default, keyword required and variable length arguments, key-word only parameters, local and global variables, pass by reference versus value, Anonymous functions, Recursion. Functional Programming:
Mapping, Filtering and Reduction, Lambda Functions, List Comprehensions.

UNIT 3 - Object Oriented Programming 10 Hours

Definition and defining a class, Constructor, Destructor, self and del keywords, Access to Attributes and Methods, geattr and hasattr attributes, Data Attributes and Class Attributes, Data Hiding, Inheritance, Static Members. Regular Expressions: Defining Regular Expressions and String Processing.

UNIT 4 - File Handling and Python GUI Programming 10 Hours

File object attributes, Read and Write into the file, Rename and Delete a File, Exceptions Handling: Built-in Exceptions and User defined Exceptions GUI Programming, Introduction to Python GUI Programming, Tkinter Programming, Tkinter widgets, Events and Bindings

UNIT 5 - Working with Django 12 Hours

Rendering Templates into HTML and Other Formats, Understanding Models, Views, and Templates, Separating the Layers (MVC) - Models, Views, Templates, Overall Django Architecture, Defining and Using Models, Using Models, Templates and Form Processing, Setting up the Database, Using a Database Server, Using SQLite, Creating the Tables

TEXT BOOKS / REFERENCES:

Text books:

1. Timothy A. Budd: Exploring Python, Tata McGraw-Hill, 2011.

2. Jeff Forcier, Paul Bissex, Wesley Chun: Python Web Development with Django, Addison-Wesley, 2008.

Reference books:

1. Ascher, Lutz: Learning Python, 4th Edition, O'Reilly, 2009.
2. Wesley J Chun: Core Python Applications Programming, Pearson Education, 3rd Edition, 2013.
3. Paul Gries, Jennifer Campbell, Jason Montojo , Practical Programming: An introduction to Computer Science Using Python, second edition, Pragmatic Bookshelf.
4. Allen Downey , Jeffrey Elkner , Learning with Python: How to Think Like a Computer Scientist Paperback –, 2015

ADDITIONAL LEARNING SOURCES:

http://www.network-theory.co.uk/docs/pytut/ http://docs.python.org/tutorial/
http://zetcode.com/tutorials/pythontutorial/ http://www.sthurlow.com/python/
http://www.tutorialspoint.com/python/ http://www.djangoproject.com/
http://www.djangobook.com/

Course Code: IT-22
Course Name: Software Architecture

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30			70	100

COURSE OUTCOMES:
Upon successful completion of this course, the student will be able to: CO1: Comprehend the need and importance of software architectures. CO2: Differentiate various architectural styles based on requirement. CO3: Implement system qualities during architecture development for the application. CO4: Apply pattern oriented architecture by understanding patterns and their descriptions. CO5: Design and document the software architecture.
TOPICS COVERED:

UNIT 1 - Introduction, Architectural Styles 12 Hours

The Architecture Business Cycle: Where do architectures come from? Software processes and the architecture business cycle; What makes a "good" architecture? What software architecture is and what it is not; Other points of view; Architectural patterns, reference models and reference architectures; Importance of software architecture; Architectural structures and views.
Architectural styles; Pipes and filters; Data abstraction and object-oriented organization; Event-based, implicit invocation; Layered systems; Repositories; Interpreters; Process control; Other familiar architectures; Heterogeneous architectures.

UNIT 2 - Understanding and Achieving Quality Attributes 10 Hours

Functionality and architecture; Architecture and quality attributes; System quality attributes; Quality attribute scenarios in practice; Other system quality attributes; Business qualities; Architecture qualities.
Achieving Quality: Introducing tactics; Availability tactics; Modifiability tactics; Performance tactics; Security tactics; Testability tactics; Usability tactics; Relationship of tactics to architectural patterns; Architectural patterns and styles.

UNIT 3 - Architectural Patterns – From Mud to Structures, Distributed Systems 12 Hours
Introduction: From mud to structure: Layers, Pipes and Filters, Blackboard. Distributed Systems: Broker; Interactive Systems: MVC, Presentation-Abstraction-Control.

UNIT 4 - Adaptable Systems & Other systems 08 Hours

Adaptable Systems: Microkernel; Reflection. Structural decomposition: Whole – Part; Organization of work: Master – Slave; Access Control: Proxy.

UNIT 5 - Designing and Documenting Software Architecture 10 Hours

Architecture in the life cycle; Designing the architecture; Forming the team structure; Creating a skeletal system. Uses of architectural documentation; Views; Choosing the relevant views; Documenting a view; Documentation across views.

TEXT BOOKS / REFERENCES:

1. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, 3d Edition, Pearson Education, 2013.
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: Pattern-Oriented Software Architecture, A System of Patterns, Volume 1, John Wiley and Sons, 2012.
3. Mary Shaw and David Garlan: Software Architecture -Perspectives on an Emerging Discipline, Prentice Hall of India, 2010.

Reference books:

1. Richard N. Taylor, Nenad Medvidovic and Eric M. Dashofy: Software Architecture: Foundations, Theory, and Practice, Wiley- India 2012.

ADDITIONAL LEARNING SOURCES:

1. http://www.sei.cmu.edu/architecture/
2. http://handbookofsoftwarearchitecture.com/
3. https://leanpub.com/software-architecture-for-developers/read
4. http://www.hillside.net/patterns/

Course Code: MT-21
Course Name: Optimization Techniques

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30			70	100

Prerequisite: Basic mathematical knowledge is essentials.

Course Objectives:

1. To understand the role and principles of optimization techniques in business world.
2. To understand the process of problem statement formulation of the business scenario.
3. To understand the implementation of various decision-making techniques in the process of decision making.
4. To gain the techniques and skills on how to use optimization techniques to support the decision making in business world.

Course Outcomes:
Student will be able to
CO1: Understand the role and principles of optimization techniques in business world (Understand)
CO2: Demonstrate specific optimization technique for effective decision making (Apply)
CO3: Apply the optimization techniques in business environments (Apply)
CO4: Illustrate and infer for the business scenario (Analyze)
CO5: Analyze the optimization techniques in strategic planning for optimal gain. (Analyze)

UNIT 1 Linear Programming 10 Hours

Various definitions, statements of basic theorems and properties, Advantages and Limitations application areas of Linear programming ,Linear Programming – Concept
Formulation of Linear programming, Solution of LPP using Graphical method
Simplex Method and Problems, Two Phase Simplex Method and problems

UNIT 2 Markov Chains & Simulation Techniques: 12 Hours

Markov chains: Applications related to technical functional areas,
Steady state Probabilities and its implications, Decision making based on the inferences Monte Carlo Simulation. Application of Markov chain in Queuing theory, Simulation techniques used in Machine learning and bioinformatics.

UNIT 3 Sequential model and related Problems 10 Hours

Processing n jobs through 2 machines ,Processing n jobs through 3 machines Processing n jobs through m machine. PERT and CPM: Basic differences between PERT and CPM. Network diagram:Time estimates (Forward Pass Computation, Backward Pass Computation ,Critical Path,Probability of meeting scheduled date of completion, Calculation on CPM network. Various floats for activities, Event Slack: calculation on PERT network. Application of schedule based on cost analysis and crashing Case study-based problems

UNIT 4 Game Theory 12 Hours

Introduction,n X m zero sum game with dominance ,Solution using Algebraic, Arithmetic and Matrix strategy

Decision Analysis

Introduction to Decision Analysis, Types of Decision-making environment Decision making under uncertainty and under risk, Concept of Decision Tree.

Text Books:

1. Operations Research by Pannerselvam
2. Operations Research Theory and Application by J. K. Sharma –Mac-Millan Publication
3. Statistical and Quantitative Methods – Mr. Ranjit Chitale

Reference Books:

1. Statistical Methods – S.P.Gupta, Sultan Chand, New Delhi
2. Operation Research by V. k. Kapoor
3. Operations Research by Kanti Swaroop, P. K. Gupta and Man Mohan
4. Introduction to Operations Research by Hiller & Lieberman, Tata Mc Graw Hill
5. Operations Research by H. A. Taha
6. Operation Research by Hira & Gupta
7. What is Game Theory?, David K. Levine, Economics, UCLA

Practicals to be conducted on the following topics. It is expected that, Applications to be covered using Python and /or R

1. Linear Programming
2. Markov Chain and Simulation Techniques
3. Sequential models and related problems
4. CPM and PERT
5. Game Theory
6. Decision Analysis

Course Code: IT-23
Course Name: Advanced Internet Technologies

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30	-	-	70	100

Course Description:

Course Outcomes:

Student will be able to
CO1: Outline the basic concepts of Advance Internet Technologies (Understand)
CO2: Design appropriate user interfaces and implements webpage based on given problem Statement (Apply)
CO3: Implement concepts and methods of NodeJS (Apply)
CO4: Implement concepts and methods of Angular (Apply)
CO5: Build Dynamic web pages using server-side PHP programming with Database Connectivity (Apply)

Course Structure:

UNIT 1 Introduction to HTML5
Basics of HTML5 – Introduction, features, form new elements, attributes and semantics in HTML5, <canvas>, <video>, <audio>.
Introduction to Scalable Vector Graphics (SVG), Introduction to Version compatibility
Installation of Apache Tomcat (Xampp/Lampp/MySQL)

UNIT 2 Introduction to CSS3
Architecture of CSS, CSS Modules, CSS Framework, Selectors and Pseudo Classes, Fonts and Text Effects, Colors, Background Images, and Masks, Transitions, Transforms and Animations Embedding Media, Gradients, Bootstrap

UNIT 3 Node JS
introduction and how it works, installation of node js, REPL, NPM, How modules work, Webserver Creation, Events
Extra Reading: Node.js with MySQL

UNIT 4 Angular (Latest Stable Version)

Introduction (Features and Advantage), Type Script , Modules, Components, Directives, Expression, Filters, Dependency Injection, Services, Routing, SPA (Single Page Application)

UNIT 5 PHP

Installing and Configuring PHP

Introduction, PHP and the Web Server Architecture, PHP Capabilities, PHP and HTTP, Environment Variables, Variables, Constants, Data Types, Operators

Working with Arrays, Decision Making, Flow Control and Loops, Introduction to Laravel, Creating a Dynamic HTML Form with PHP, Database Connectivity with MySQL, Performing basic database operations (CRUD), Using GET, POST, REQUEST, SESSION, and COOKIE Variables

Extra Reading: Sending Emails, PHP with AJAX and XML, Payment Gateway Integration

Text Books:

1. Complete reference HTML, TMH
2. HTML5 & CSS3, Castro Elizabeth 7th Edition
3. Beginning Node.js by Basarat Ali Syed
4. Angular: Up and Running- Learning Angular, Step by Step by Shyam Seshadri
5. Beginning PHP, Apache, MySQL web development Reference Books
6. Introducing HTML5 - Bruce Lawson, Remy Sharp
7. Node.js in Action, 2ed by Alex Young, Bradley Meck
8. Mastering Node.js by Pasquali Sandro
9. Angular Essentials by Kumar Dhananjay Complete Ref. PHP

Course Code: IT-24
Course Name: Advanced DBMS

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Course Description:

1. Introduction DBMS – Concepts & Architectures

Database and Need for DBMS, Characteristics of DBMS
Database 3-tier schema (ANSI/SPARC) and system architecture of DBMS
Views of data- Schemas and instances, Data Independence
Centralized, Client-Server system, Transaction servers, Data servers, Cloud based servers
Indexing and Hashing - Basic concepts of indexing, ordered index, B+ tree index, B+ tree extensions, Multiple key access, Hashing concepts, types of hashing, Bitmap indices.

2. Data Modelling and Relational Database Design

Data Modelling using ER Diagram: Representation of Entities, Attributes, Relationships and their Type, Cardinality, Generalization, Specialization, Aggregation.
Relational data model: Structure of Relational Database Model, Types of keys, Referential Integrity Constraints, Codd's rules, Database Design using E-R, E-R to Relational
Normalization – Normal forms based on primary (1 NF, 2 NF, 3NF, BCNF)
Note: Case studies based on E-R diagram & Normalization

Extra Reading: Database languages - Relational Algebra, Relational database languages, Data definition in SQL, Views and Queries in SQL, Joins, specifying constraints and Indexes in SQL, Specifying constraints management systems Postgres/ SQL/MySQL.

3. Transaction and Concurrency control

Concept of transaction, ACID properties, States of transaction
Concurrency control, Problems in concurrency controls
Scheduling of transactions, Serializability and testing of serilaizibity
Lock-based Protocol and Time stamp-based ordering protocols, Deadlock Handling

4. Parallel Databases

Introduction to Parallel Databases, Parallel Database Architectures
I/O parallelism, Inter-query and Intra-query parallelism
Inter-operational and Intra-operational parallelism
Key elements of parallel database processing: Speed-up, Scale-up Synchronization and Locking

5. Distributed Databases

Introduction to Distributed Database System, Homogeneous and Heterogeneous Databases, Distributed data storage (Fragmentation and Replication), Distributed transactions, Concurrency control schemes in DDBMS
Commit protocols 2 phase and 3 Phase Commit Protocol

6. Object Oriented Databases & Applications

Overview of Object- Oriented Database concepts & characteristics
Database design for OODBMS – Objects, OIDs and reference type
Spatial data and Spatial indexing (Any two techniques)
Mobile Database: Need, Structure, Features, Limitations and Applications
Temporal databases, temporal aspects valid time, transaction time or decision time
Multimedia Database: Architecture, Type and Characteristics.

7. Crash Recovery and Backup, Failure classifications, Recovery & Atomicity, Log based recovery, Checkpoint and Shadow Paging in Data recovery, Database backup and types of backups

8. Security and Privacy

Database security issues,Discretionary access control based on grant & revoking privilege,Mandatory access control and role-based access control for multilevel security, Encryption & public key infrastructures

9. NO-SQL Database
Introduction, Types of NOSQL, Need of NoSQL databases, Use Cases

Recommended Books:

1. Introduction to database systems C.J. Date, Pearson.
2. Fundamentals of Database Systems by Elmasri Navathe
3. Principles of Database Management James Martin, PHI
4. Database System Concepts by Abraham Silberschatz, H. Korth, Sudarshan

Reference Books:

Database Management System by Raghu Ramakrishnan / Johannes Gherke
Database Management System (DBMS)A Practical Approach. By Rajiv Chopra
Database system practical approach to design, implementation & management by Connoly & Begg,
NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence Martin Fowler

List of Practicals (if any)
To install and configure database software (ORACLE/MYSQL)
To design a database (logical & physical database)
To Perform all SQL operations and queries on designed physical database
To install and configure NO-SQL database and practice for core operations
To perform experiments on database crash and recovery
To perform experiments on database Backup – restoring operations on database server
To perform some operations on Object oriented databases

Course Code: IT-25
Course Name: Analysis and Design of Algorithms

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: **CO 1:** Apply object oriented techniques to solve bigger computing problems **CO 2:** Explore the knowledge of computational complexity, approximation and randomized algorithms **CO 3:** Analyze the range of the algorithm and the notion of tractable and intractable problems **CO 4:** Design and analyze a wide range of searching and sorting algorithms **CO 5:** Implementation of graph and matching algorithms
TOPICS COVERED:

UNIT 1 - Introduction and overview of C++ Programming 12 Hours

C++ Class Overview- Class Definition, OOPs concepts ,Objects, Class Members, Access Control, Class Scope, Inheritance and Polymorphism ,Constructors and destructors, parameter passing methods, Inline functions, static class members, this pointer, friend functions, dynamic memory allocation and deallocation (new and delete), Exception handling.

UNIT 2 - Introduction and the fundamentals of the Analysis of Algorithm Efficiency 12 Hours

Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental data Structures. Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms, Examples

UNIT 3 - Brute Force and Divide and Conquer 10 Hours

Selection Sort and Bubble Sort, Sequential Search and String Matching, Exhaustive Search, Merge- sort, Quick-sort, Binary Search, Binary tree Traversals and related properties.

UNIT 4 - Decrease-and-Conquer, Transform-and-Conquer 10 Hours

Insertion Sort, Depth First search and Breadth First Search, Topological sorting, Algorithms for Generating Combinatorial Objects. Presorting, Balanced Search Trees, Heaps and Heap sort, Problem Reduction.

UNIT 5 - Space and Time Tradeoffs and Dynamic Programming 10 Hours

Sorting by Counting, Input Enhancement in String Matching, Computing a binomial coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem and Memory Functions.

Text Book:

1. Anany Levitin: Introduction to the Design and Analysis of Algorithms, Pearson Education, 2003.
2. Herbert Scheldt: The Complete Reference C++, 6th Edition, Tata McGraw Hill 2013.

References:

1. Coremen T.H., Leiserson C.E., and Rivest R.L.: Introduction to Algorithms, PHI, 1998.
2. Horowitz E., Sahani S., Rajasekharan S.: Computer Algorithms, Galgotia Publications, 2001.

ADDITIONAL LEARNING SOURCES:

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. http://nptel.ac.in/courses/106101060/

Course Code: IT-21L
Course Name: Practicals

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
-	10 Hrs./Week	5	-	75	-	50	125

Course Description:

This Practical course contains 2 sections. –
1. List of Practicals – Python Programming
2. List of Practicals – Advanced Internet Technologies

Course Outcomes:
Student will be able to
CO1: implement python programming concepts for solving real life problems. (Apply)
CO2: Implement Advanced Internet Technologies (Apply)

Course Structure:
List of Practicals – Python Programming
Note:

- Recommended IDE for python – IDLE
- Exception handling concepts should be used with file handling programs.
  1. Python installation and configuration with windows and Linux
  2. Programs for understanding the data types, control flow statements, blocks and loops
  3. Programs for understanding functions, use of built in functions, user defined functions
  4. Programs to use existing modules, packages and creating modules, packages
  5. Programs for implementations of all object-oriented concepts like class, method, inheritance, polymorphism etc. (Real life examples must be covered for the implementation of object- oriented concepts)
  6. Programs for parsing of data, validations like Password, email, URL, etc.
  7. Programs for Pattern finding should be covered.
  8. Programs covering all the aspects of Exception handling, user defined exception, Multithreading should be covered.
  9. Programs demonstrating the IO operations like reading from file, writing into file from different file types like data file, binary file, etc.
  10. Programs to perform searching, adding, updating the content from the file.
  11. Program for performing CRUD operation with MongoDB and Python

12. Basic programs with NumPy as Array, Searching and Sorting, date & time and String handling
13. Programs for series and data frames should be covered.
14. Programs to demonstrate data pre-processing and data handling with data frame
15. Program for data visualization should be covered.

List of Practicals – Advanced Internet Technologies

1. Program to implement Audio and Video features for your web page.
2. Program to design form using HTML5 elements, attributes and Semantics.
3. Programs using Canvas and SVG.
4. Programs to demonstrate external and internal styles in the web page using font, text, background, borders, opacity and other CSS 3 properties.
5. Implement Transformation using Translation, Rotation and Scaling in your web page.
6. Program to show current date and time using user defined module
7. Program using built-in modules to split the query string into readable parts.
8. Program using NPM which will convert entered string into either case
9. Write a program to create a calculator using Node JS. (Install and configure Node JS and Server)
10. Write Program for Form validation in Angular.
11. Program to demonstrate the ngif, ngfor, ngswitch statements.
12. Create angular project which will demonstrate the usage of component directive, structural directive and attribute directives
13. Create angular project which has HTML template and handle the click event on click of the button (Installation of Angular and Bootstrap 4 CSS Framework)
14. Program for basic operations, array and user interface handling.
15. Program to demonstrate session management using various techniques.
16. Program to perform the CRUD Operations using PHP Script.

Course Code: ET-21
Course Name: Artificial Intelligence and Robotics

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Upon successful completion of this course, students will be able to:

CO1: Find appropriate idealizations for converting real world problems into AI problems formulated using the appropriate search algorithm.
CO2: Formulate and implement the appropriate search algorithms to find the solutions for real time and heuristics problems.
CO3: Represent and debug knowledge in an appropriate first order logic representation with the understanding of the fundamentals of knowledge representation.
CO4: Choose and Implement the appropriate algorithms for a real world supervised learning problem.
CO5: Inculcate the basic knowledge of Robotics along with the Artificial Intelligence

TOPICS COVERED:

UNIT: 1 – Introduction to AI, Informed Search and Exploration 10 Hours

Intelligent Agents: Agents and environment; Rationality; the nature of environment; the structure of agents. Problem-solving: Problem solving agents; Example problems; Searching for solution; uninformed search strategies.
Informed search strategies; Heuristic functions; On-line search agents and unknown environment.

UNIT: 2 - Constraint Satisfaction, Adversial Search, Logical Agent 10 Hours

Constraint satisfaction problems; Backtracking search for CSPs. Adversial search: Games; Optimal decisions in games; Alpha-Beta pruning.Knowledge-based agents; The wumpus world as an example world; Logic; propositional logic Reasoning patterns in propositional logic; Effective propositional inference; Agents based on propositional logic.

UNIT: 3 - First-Order Logic, Inference in First-Order Logic: 12 Hours

Representation revisited; Syntax and semantics of first-order logic; Using first-order logic; Knowledge engineering in first-order logic. Propositional versus first-order inference; Unification and lifting; Forward chaining; Backward chaining; Resolution.

UNIT: 4 - Knowledge Representation and Learning, AI: Present and Future 10 Hours

Ontological engineering; Categories and objects; Actions, situations, and events; Mental events and mental objects; The Internet shopping world; Reasoning systems for categories; Reasoning with default information; Truth maintenance systems.
Learning: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory. AI: Present and Future: Agent components; Agent architectures; Are we going in the right direction? What if AI does succeed? Game theory.

UNIT: 5 – Introduction to Robotics : 10 Hours

Introduction; Robot Hardware: sensors and Effectors; Robotic Perception: localization, mapping, other types of perception; Planning to Move: configuration space, cell decomposition methods and skeletonization methods; Planning uncertain movements: robust methods; Moving: dynamics and control, potential field control and reactive control; Robotic Software: architectures, subsumption architecture , three-layer architecture and robotic programming languages ; Application domains.

TUTORIALS:

1. Program to design tic-tac-toe game.
2. Program for breadth first and depth first search.
3. Program to N-Queeens Problem.
4. To implement max-min problem.
5. To implement simulated Annealing Algorithm.
6. Write a program to implement A* program.
7. To implement Hill-Climbing Algorithm.

Text Book / References:

Text Book:

1. Stuart Russel, Petr Norvig: Artificial Intelligence A Modern Approach, 2nd Edition, Pearson Education, 2003.

References:

1. Elaine Rich, Kevin Knight: Artificial Intelligence, 2nd Edition, Tata McGraw Hill, 1991.
2. Nils J. Nilsson: Principles of Artificial Intelligence, Elsevier, 1980.

Course Code: ET-22
Course Name: NOSQL

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Upon successful completion of this course, students will be able to :

CO1: Demonstrate competency in describing how NoSQL databases differ from relational databases from a theoretical perspective.
CO2: Demonstrate competency in designing NoSQL database management systems
CO3: Use of a number of NoSQL databases to store and retrieve data and perform aggregation functions
CO4: Demonstrate competency in selecting a particular NoSQL database for different applications.
CO5: Execute various CRUD operations with MongoDB.

TOPICS COVERED:

UNIT 1 – An Overview and Characteristics of NoSQL 10 Hours
Introduction to NoSQL : An Overview of NoSQL , Defining NoSQL, History, What NoSQL is and what it is not, Why NoSQL?, List of NoSQL Databases. Characteristics of NoSQL: Application, RDBMS approach, Challenges, NoSQL approach.

UNIT 2 – NoSQL Storage Types 12 Hours
Modifying and managing NOSQL, Data stores, Indexing and ordering datasets (MongoDB/ CouchDB / Cassandra) NoSQL Storage Types : Storage types, Column-oriented databases, Document store, key-value store, graph store, multi-storage type databases, comparing the models.

UNIT 3 – Advantages and Drawbacks 10 Hours
Advantages and Drawbacks : Transactional application, Computational application, Web-scale application. Performing CURD operations : Creating records, accessing data, updating and deleting data.

UNIT 4 - Querying SQL 10 Hours

Querying NoSQL stores : similarities between NoSQL and MongoDB query features. Managing data stores and managing evolutions.

UNIT 5 – Indexing and Ordering 10 Hours

Indexing and ordering data sets: Essential concepts behind database index, indexing and ordering in MongoDB, indexing and ordering in CouchDB, Comparative Study of NoSQL Products Comparison: Technical comparison, Implementation language, Engine types, Speed, Features, Limits, Bulk operations, Bulk read, Bulk insert, Bulk update, Bulk delete, Query options.

TUTORIAL
Case Study

1. Application definition, Requirement analysis, Implementation using MongoDB, Features and constraints.
2. Database design, Database queries, Database modeling, Schema definition, Writing queries.
3. Queries for a single entity, simple result, Queries for a single entity, Aggregate, Queries for a one to one relationship.
4. Queries for a one to many relationship, Queries for a many to many relationship, Miscellaneous queries.
5. Pagination, Limiting items in an array in result set.
6. Plug-in and dynamic data support, Model refinements.
7. Reference using non-ID property, Demoralizations and document embedding.
8. Complete document embedding and Partial document embedding.
9. Bucketing, Cache document approach, Miscellaneous changes.

TEXT BOOKS / REFERENCES:

TEXT BOOKS :

1. Shanshank Tiwari "Professional NOSQL", WROX Press, 2011

Pramod.J.Sadalage and Martin Fowler, "NoSQL Distilled : A Brief guide to the emerging world of polygot persistence", Pearson Education corporation, I Edition, 2014.

Reference Books :

1. 1. The definitive guide to MONGODB, The NOSQL Database for cloud and desktop computing, Apress 2010.

ADDITIONAL LEARNING SOURCES:

1. https://www.mongodb.com/nosql-explained
2. http://www.dbta.com/Editorial/Trends-and-Applications/NoSQL-for-the-Enterprise-80198.aspx
3. http://www.oracle.com/technetwork/database/databasetechnologies/nosqldb/overview/in dex.html

Course Code: ET-23
Course Name: Enterprise Resource Planning

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to, CO1: Comprehend the basics and concepts of ERP CO2: Apply different ERP related technologies CO3: Implement ERP system by utilizing various concepts of ERP CO4: Analyze different business models of ERP CO5: Analyze the present and future trends of ERP.
TOPICS COVERED:

UNIT 1 - Introduction 10 Hours

Enterprise—An Overview, Business Processes, Introduction to ERP, Basics ERP Concepts, Justifying ERP Investments, Risks of ERP, Benefits of ERP.

UNIT 2 - ERP and Technology 10 Hours

ERP and Related Technologies, Business Intelligence (BI) and Business Analytics (BA), E-Commerce and E-Business, Business Process Reengineering (BPR), Data Warehousing and Data Mining, On-line Analytical Processing (OLAP).

UNIT 3 - ERP and Technology 10 Hours

Product Life Cycle Management (PLM), Supply Chain Management (SCM), Customer Relationship Management (CRM), Geographic Information System (GIS), Advanced Technology and ERP Security.

UNIT 4 - ERP Implementation 10 Hours

To be or not to be…, Implementation Challenges, ERP Implementation (Transition) Strategies, ERP Implementation Life Cycle, Pre Implementation Tasks: Getting Ready, Requirements Definition, Implementation Methodologies, ERP Development Methods, Process Definition, Contracts with Vendors, Consultants and Employees, Training and

Education, Data Migration, Project Management and Monitoring, Post-Implementation Activities, Success and Failure Factors of an ERP Implementation

UNIT 5 - The Business Modules 12 Hours

Business Modules of an ERP Packages, Financials, Manufacturing (Production), Human Resource Management, Plant Maintenance, Materials Management, Quality Management, Marketing, Sales, Distribution and Services.

TEXT BOOKS / REFERENCES:

Text books:

1. Alexis Leon, "ERP Demystified", Tata McGraw Hill, 14 Aug 2014.

Reference books:

1. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, "Concepts in Enterprise Resource Planning", Thomson Learning, 2001.
2. Vinod Kumar Garg and N.K .Venkata Krishnan, "Enterprise Resource Planning – concepts and Planning", Prentice Hall, 1998.
3. Jose Antonio Fernandz, "The SAP R /3 Hand book", Tata McGraw Hill, 2006.

TUTORIALS:

Developing Following Applications. Using any Database Systems.

1. Financial System.
2. Manufacturing System.
3. Human Resource Planning.
4. Plant Maintenance.
5. Materials Management System.
6. Quality Management System.
7. Marketing, Sales, & Distributing System etc..

ADDITIONAL LEARNING SOURCES:

1. http://www.netsuite.com/portal/resource/articles/erp/what-is-erp.shtml
2. https://www.managementstudyguide.com/enterprise-resource-planning-1-articles.htm

Semester III

Course Code: IT-31
Course Name: Mobile Applications

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Upon successful completion of this course, students will be to: **CO1:** Gain broad understanding of the discipline of Mobile Application Development using J2ME Technology. **CO2:** Develop User Interface for a J2ME application **CO3:** Manage data on both service-side components and client-side applications and Address Portability and Compatibility issues between PDA'S and Cell phones. **CO4:** Implement the design using Android SDK. **CO5:** Implement the design using Objective C and Ios
TOPICS COVERED:

Unit 1 - J2ME Overview, Architecture and Development Environment 12 Hours

Java 2 micro edition and the world of java, inside J2ME, J2ME and wireless devices. small computing technology: wireless technology , radio data networks, microwave technology, mobile radio Networks, messaging, personal digital assistants.
J2ME architecture, small computing device requirements, run time environment, midlet programming, java language for J2ME, J2ME software development kits, hello world J2ME style, multiple midlets in a midlet suite, J2ME wireless toolkit.

Unit 2 - J2ME Best Practices and Patterns 10 Hours

The reality of working in a J2ME world, best practices commands, items, and event processing: J2ME user interfaces , display class, the palm OS emulator, C command class, item class, exception handling. high level display screens: screen class, alert class, form class, item class, list class, text box class, ticker class. low-level display canvas:
The Canvas, User Interactions, Graphics, Clipping Regions, Animation.

Unit 3 - Record Management System 10 Hours

Record storage, writing and reading records, record enumeration, sorting records, searching records, record listener. JDBC objects: The concept of JDBC, JDBC driver types, JDBC packages, overview of the JDBC process, database connection, statement objects, result set, transaction processing, metadata, data types, and exception.

Unit 4 - Technology-I Android-12 10 Hours

Introduction – establishing the development environment – android architecture – activities and views
– interacting with UI – persisting data using SQLite – packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

Unit 5 - Technology-II IOS-12 10 Hours

Introduction to objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TEXT BOOKS / REFERENCES:

Text Books:

1. James Keogh , J2ME The Complete Reference , Tata McGrawHill.
2. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
3. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS.

Reference Books:

1. Michael Juntao Yuan, Enterprise J2ME, Developing Mobile Java Applications Pearson Education , 2011.
2. Sing Li, Jonathan B. Knudsen, Beginning J2ME: From Novice to Professional, Third Edition, Apress, 2015.
3. Development: Exploring the iOS SDK”, Apress, 2013.

ADDITIONAL LEARNING SOURCES:

1. http://developer.android.com/develop/index.html.

Course Code: IT-32
Course Name: Software Testing and Practices

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Course Description:

Upon successful completion of this course, students will be able to: CO1: Gain knowledge on basics of Software Testing, Test case selection and creation . CO2: Illustrate various perspectives of testing with examples. CO3: Use by differentiating boundary value testing, Equivalence class testing, Decision table based testing. CO4: Implement Path testing and Data flow testing based on the requirements CO5: Comprehend different levels of testing, Integration testing and Fault based testing.
TOPICS COVERED:

UNIT 1- Basics of Software Testing 12 Hours
Humans, Errors and Testing, Software Quality; Requirements, Behavior and Correctness, Correctness Vs Reliability; Testing and Debugging; Test Metrics; Software and Hardware Testing; Testing and Verification; Defect Management; Execution History;Test Generation Strategies; Static Testing; Test Generation from Predicates.
Basic Principles, Test case selection and Adequacy
Sensitivity, Redundancy, Restriction, Partition, Visibility and Feedback, Test Specification and cases, Adequacy Criteria, Comparing Criteria

UNIT 2- A perspective on Testing, Examples 8 Hours
Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Level of testing, Examples: Generalized pseudocode, The triangle problem, theNextDate function, The commission problem, The SATM (Simple Automation Teller Machine) problem, The currency converter, Saturn windshield wiper.

UNIT 3 - Boundary value, Equivalence class and Decision table based testing 8 Hours
Boundary value analysis, Robustness testing, Worst-case testing, special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for triangle problem, Next Date function and commission problem, Guidelines and observations, Decision tables, Test cases for triangle problem.

UNIT 4 - Path Testing, Data flow testing, Levels and Integration Testing 12 Hours
DD Paths, Test coverage metrics, Basis path testing, guidelines and observations, Definition Use testing, Slice based testing, Guidelines and observations. Traditional view of testing

levels, Alternative life cycle models, the SATM systems, separating integration and system testing, Guidelines and observations.

UNIT 5 - Fault Based Testing 12 Hours

Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis; From Test case specification to Test Cases, Scaffolding, Generic vs specific Scaffolding, Test Oracles, Self checks as oracles, Capture and Replay.

Agile Testing

Definition and description, how is it different from traditional testing, ten principals for testers, business-facing the test that support the testing.

TEXT BOOKS / REFERENCES:

TEXT BOOKS :

1. Adithya P. Mathur " Foundations of Software Testing – Fundamental Algorithms and Techniques", Pearson Education India, 2011
2. Mauro Pezze, Michael Young, Software testing and Analysis- Process, Principles and Techniques", Wiley India, 2012
3. Paul C Jourgensen, "Software Testing A Craftmans Approach", Aueredach publications, 3rd edition, 2011
4. Lisa Crisping, Janet Gregory, "Agile Testing : A Practical Guide for Testers and Agile Team", The Addison Wesley Signature Series, 2009.

REFERENCE BOOKS:

1. KshirasagaraNaik, PriyadarshiTripathy: Software Testing and Quality Assurance, Wiley India 2012
2. M.G.Limaye: Software Testing-Principels, Techniques and Tools – McGrawHill, 2009
3. Brain Marick: The Craft of Software Testing, Pearson Education India, 2008
4. Ron Patton: Software Testing, 2nd Edition, Pearson Education, India, 2013

ADDITIONAL LEARNING SOURCES:

1. http://www.softwaretestinghelp.com/agile-scrum-methodology-for-development-and-testing/
2. http://crbtech.in/Testing/agile-model-software-testing/
3. https://www.getzephyr.com/**test**-management/**agile-model**-in-**software-testing**
4. http://www.mountaingoatsoftware.com/
5. http://www.testingexperience.com/
6. http://www.infoq.com/ http://www.qasymphony.com/

Course Code: IT-33
Course Name: Cloud Computing

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, the student will be able to: CO1: Interpret the basic concepts, principles and techniques of data mining. CO2: Apply knowledge discovery techniques while mining the data; recognize & fixing the issues in data mining. CO3: To apply the techniques of clustering, classification, association finding, feature selection and visualization of real world data. CO4: Demonstrate the real world problem has a data mining solution. CO5: Apply evaluation metrics to select data mining techniques.
Topics Covered:

UNIT 1- Introduction to Cloud Computing 11 Hours

Defining Cloud Computing, Cloud types, The NIST model, The Cloud Cube Model, Deployment models, Service models, Examining the Characteristics of Cloud Computing, paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing, Assessing the role of open standards. Assessing the Value Proposition: Measuring the Cloud's Value, Early adopters and new application, The laws of cloudonomics, Cloud computing obstacles, Behavioral factors relating to cloud adoption, Measuring cloud computing costs, Avoiding Capital Expenditures, Right-sizing, Computing the total cost of ownership, Specifying service level agreements, Defining licensing models. Understanding Cloud Architecture: Exploring the cloud computing stack, Composability, Infrastructure, Platforms. Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud, The Jolicloud Netbook OS, Chromium OS: The browser as an Operating System.

UNIT 2- Understanding Service and Application by Type 10 Hours

Defining Infrastructure as a service (IaaS), Defining Platform as a Service (PaaS), Defining Software as a Service (SaaS), Defining Identity as a Service (IDaaS), and Defining Compliance as a Service (CaaS). Understanding Abstraction and Virtualization: Using Virtualization technologies, Load Balancing and Virtualization, Understanding Hypervisors, Understanding Machine Imaging, Porting Applications. Capacity Planning: Capacity Planning, Defining Baseline and Metrics, Network Capacity, Scaling.

UNIT 3 - Exploring Platform as a Service 10 Hours

Defining Services, Using PaaS Application Frameworks Using Google Web Services: Exploring Google Applications, Surveying the Google Application Portfolio, Exploring the Google Toolkit, Working with the Google App Engine. Managing the Cloud: Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards.

UNIT 4 - Understanding Cloud Security 10 Hours

Securing the cloud, Securing data, Establishing identity and Presence. Moving Application to the Cloud: Application in the Cloud, Applications and cloud APIs. Working with cloud-based storage: Measuring the digital universe, Provisioning Cloud Storage, Exploring Cloud Backup Solutions, Cloud Storage Interoperability.

UNIT 5: Using Webmail Services 10 Hours

Using Webmail Services: Exploring the cloud Mail Services, Working with syndication services. Communicating with the cloud: Exploring instant messaging, Exploring collaboration technologies, Using social networks. Working with Mobile Devices: Defining the Mobile Market, Using Smart phones with the Cloud.

Text Books/ References:

Text Books:

1. Barrie Sosinsky "Cloud Computing Bible" 2011 by Wiley Publishing, Inc.

Reference Books:

1. Cloud Computing Principles and Paradigms by Rajkumar Buyya 2011, Published by John Wiley & Sons
2. Cloud Computing Theory and Practice by Dan C.Marinescu, 2013, Published by Morgan Kaufmann.

Additional Resource :

1. https://cloudacademy.com/ebooks
2. www.freebookcentre.net › Networking Books

Course Code: IT-34
Course Name: Data Warehousing

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: **CO1:** Design a data warehouse or data mart to present information needed by management in a form that is usable for management client & Comprehend several data preprocessing methods. **CO2:** Ability to do Conceptual, Logical, and Physical design of Data Warehouse **CO3:** Able to produce and document dimensional models for a data warehouse based on an informal domain description. **CO4:** Utilize the concept of data warehouse and OLAP for data Warehousing and tools. **CO5:** xtrapolate knowledge and skills to design a data warehouse to support and provide business solutions
TOPICS COVERED:

Unit 1 - Introduction 12 Hours
Introduction to Data Warehouse. A Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data warehousing to Data Mining. The need for data warehousing, paradigm shift, business problem definition, operational and informational data stores, characteristics.Overview of client/server architecture, server specialization in client/server computing environments, server functions, server hardware architecture, system considerations, risc versus cisc, multiprocessor systems.

Unit 2 - Data Warehousing Components 10 Hours
Overall Architecture, data warehouse database, sourcing, acquisition, cleanup and transformation tools, metadata, access tools, data marts, data warehouse administration and management. Business Considerations, design considerations, technical considerations, implementation considerations, benefits of data warehousing.

Unit 3 - Mapping the data warehouse 10 Hours
Relational database technology for data warehouse, types, database architectures for parallel processing, parallel RDBMS features, alternative technologies, parallel dbms vendors, data layouts for best access, multidimensional data models, bitmapped indexing, complex data types.

Unit 4 - Data Extraction, Cleanup and Transformation Tools 12 Hours

Tool requirements, vendor approaches, access to legacy data, vendor solutions, transformation engines. Meta data: defined, meta data interchange initiative, metadata repository, metadata management, implementation examples, meta data trends. Need for OLAP, OLAP Guidelines, Categorization of OLAP Tools.

Unit 5 - Business Analysis 08 Hours

Tool Categories, Need for applications, cognos impromptu, applications, methodology, business intelligence market definition, situation overview, future outlook, essential guidance.

Tutorials:

Case Studies:

1. Data Warehousing Solution for One of Europe's Largest Financial Services Groups.
2. Data Warehousing for a Health Benefits Company
3. Data warehousing solution for banking system.
4. Data warehousing solutions for tax fraud with advanced analytics.
5. Data warehousing solutions for international satellite TV service provider**.**
6. Data warehousing solutions for Correlating data across the business.
7. Business Reporting & Customer Information Datamart Architecture Setup & Roll-out for a global technology company.
8. Global Planning Data Automation.
9. COTS-Anti Money Laundering.
10. Management Information System for Trade Finance.

TEXT BOOKS / REFERENCES:

Text books:

1. Alex Berson, Stephen J smith : Data Warehousing,Data Mining, & OLAP, Tata Mcgraw- Hill, 2012.

2. Gajendra Sharma: Data Mining, Data Warehousing and OLAP, Katson Books, 2010.

3. Jiawei Han and Micheline Kamber: Data Mining - Concepts and Techniques, 2nd Edition, Morgan Kaufmann Publisher, 2012.

Reference books:

1. Paulraj Ponnaiah : Data Warehousing fundamentals for IT professionals, wiley student publishers, second edition , 2014.
2. Ralph Kimball, Margy Ross : The data warehouse toolkit, third edition , wiley publishers, 2012.

ADDITIONAL LEARNING SOURCES:

1. https://www.coursera.org/specializations/data-warehousing.
2. www.knowledge-management-tools.net/data-warehousing.htm.
3. www.slideshare.net/2cdude/data-warehousing.
4. https://www.edx.org/course/delivering-relational-data-warehouse-microsoft-dat216x.

Course Code: IT-35
Course Name: NET Technologies

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, the student will be able to: CO1: Develop application using the concept of .NET framework and basics of C# .NET. CO2: Create server side applications using C#.NET. CO3: Develop web applications using the ASP.NET. CO4: Comprehend ASP.NET web form, state management and error handling mechanism. CO5: Access and manipulate data in a database by using Microsoft ADO.NET
TOPICS COVERED:

UNIT 1 –Introduction to .NET and Basics of C#.NET 12 Hours

The .NET Framework: The Evolution of Web Development-HTML and HTML Forms, Server-Side Programming, Client-Side Programming. The .NET Framework - C#, VB, and the .NET Languages, The Common Language Runtime, The .NET Class Library, Visual Studio. The .NET Languages, C# Language Basics, Case Sensitivity, Commenting, Statement Termination, Blocks, Variables and Data Types-Assignment and Initializes, Strings and Escaped Characters, Arrays, Enumerations, Variable Operations- Advanced Math, Type Conversions. Object-Based Manipulation- String, DateTime and TimeSpan Types, The Array Type. Conditional Logic-The if, switch Statement. Loops- The for, foreach, while loop, Methods-Parameters, Method Overloading, Optional and Named Parameters, Delegates.

UNIT 2 – C#.NET Types, Objects, and Namespaces10 Hours

The Basics About Classes-Static Members, A Simple Class, Building a Basic Class-Creating an Object, Adding Properties, Automatic Properties, Adding a Method, Adding a Constructor, Adding an Event, Testing the Product Class. Value Types and Reference Types-Assignment Operations, Equality Testing, Passing Parameters by Reference and by Value, Reviewing .NET Types. Understanding Namespaces and Assemblies- Using Namespaces, Importing Namespaces, Assemblies. Advanced Class Programming-Inheritance, Static Members, Casting Objects, Partial Classes, Generics.

UNIT 3 - Developing ASP.NET Applications 10 Hours

Visual Studio: Creating Websites-Creating an Empty Web Application, Websites and Web Projects, The Hidden Solution Files, The Solution Explorer, Adding Web Forms, Designing a Web Page-Adding Web Controls, The Properties Window, and The Anatomy of a Web Form-The Web Form Markup, The Page Directive, The Doctype, The Essentials of XHTML. Writing Code-The Code-Behind Class, Adding Event Handlers, Outlining, IntelliSense, Code Formatting and Coloring, Visual Studio Debugging-The Visual Studio Web Server, Single-Step Debugging, Variable Watches, The Anatomy of an ASP.NET Application-ASP.NET File Types, ASP.NET Application Directories. Introducing Server Controls-HTML Server Controls, Converting an HTML Page to an ASP.NET Page, View State, The HTML Control Classes, Adding the Currency Converter Code, Event Handling, Error Handling

UNIT 4 – ASP.NET Web Form Basics, State Management & Error Handling 10 Hours

ASP.NET Configuration- The web.config File, Nested Configuration, Storing Custom Settings in the web.config File, The Website Administration Tool (WAT), Web Controls-Basic Web Control Classes, The Web Control Tags, Web Control Classes, List Controls, Table Controls, Web Control Events and AutoPostBack, A Simple Web Page. The Problem of State-View State, Transferring Information Between Pages, Cookies, Session State, Session State Configuration, Application State, An Overview of State Management Choices. Error Handling, Logging, and Tracing-Common Errors, Exception Handling-The Exception Class, The Exception Chain, Handling Exceptions, Throwing Your Own Exceptions, Logging Exceptions, Page Tracing.

UNIT 5 – ADO.NET Fundamentals 10 Hours

Understanding Databases, Configuring Your Database-SQL Server Express, Browsing and Modifying Databases in Visual Studio, The *sqlcmd* Command-Line Tool. SQL Basics - Running Queries in Visual Studio, The Select, Update, Insert, Delete statement. The Data Provider Model: Direct Data Access-Creating a Connection, The Select Command, The DataReader, Putting It All Together, Updating Data. Disconnected Data Access-Selecting Disconnected Data, Selecting Multiple Tables, Defining Relationships. Introducing Data Binding-Types of ASP.NET Data Binding, How Data Binding Works, Single-Value Data Binding, Repeated-Value Data Binding, Data Source Controls.

TEXT BOOKS / REFERENCES:

Text books:

1. Matthew MacDonald. Beginning ASP.NET 4 in C# 2010, APRESS, 2010

Reference books:

1. Joseph Mayo. Visual studio 2010 - A beginners guide – BPB Publications 2010
2. Greg Buczek: ASP.Net Developer's Guide, Tata McGraw Hill Edition 4th Edition, 2005.
3. Pro ASP.NET 4 in C# 2010, MacDonald and Freeman

ADDITIONAL LEARNING SOURCES:

1. https://msdn.microsoft.com/en-us/library/4w3ex9c2.aspx
2. http://www.asp.net/
3. http://www.aspfree.com/
4. http://www.devx.com/dotnet
5. asp.net-tutorials.com/localization/local-and-global-resources/
6. https://www.tutorialspoint.com/asp.net/asp.net_ado_net.htm
7. www.w3schools.com/asp/ado_intro.asp
8. https://www.tutorialspoint.com/soa/index.htm

Course Code: IT-36
Course Name: Cryptography and Network Security

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Upon successful completion of this course, students will be able to: **CO 1:** Explore the need for computer security concepts. **CO 2:** Apply the principles and techniques of symmetric key encryption and public key encryption. **CO 3:** Demonstrate the specifics of message authentication codes and hash algorithms. **CO 4:** Analyze the facts of e-mail security and IP security evolution. **CO 5:** Comprehend Web Security, Secure Electronic Transaction, Intruder detection and Firewalls.
TOPICS COVERED:

UNIT 1 – Introduction and Classical Encryption Technique 9 Hours

Computer Security Concepts, OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, Model for Network Security. Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.

UNIT 2 - Block Ciphers, Public Key Cryptography and Key Management 11 Hours

Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The strength of DES, Block Cipher Design Principles, AES Structure, AES Transformation Functions, AES Key Expansion, An AES Example, Principles of Public Key Cryptosystem, The RSA Algorithm, Key Management, Diffie Hellman Key Exchange.

UNIT 3 - Cryptographic Hash Functions, Message Authentication Codes
12 Hours

Applications of Cryptographic Hash Functions, Message Authentication, Digital Signatures, Two Simple Hash Functions, Requirements and Security, Security Requirements for Cryptographic Hash Functions, Brute-Force Attacks, Cryptanalysis, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3, Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs.

UNIT 4 – Electronic Mail Security and IP Security 10 Hours

Pretty Good Privacy (PGP), S/MIME, IP Security Overview; IP Security Architecture; Authentication Header; Encapsulating Security Payload; Combining Security Associations.

UNIT 5 - User Authentication Protocols and Entity Authentication 10 Hours

Web Security Considerations; Secure Socket Layer (SSL) and Transport Layer Security (TLS); Secure Electronic Transaction (SET), Intruders, Intrusion Detection, Firewall Design Principles- Characteristics, Types of Firewall and Firewall Configuration.

Text books:

1. William Stallings, "Cryptography and Network Security – Principles and Practices", 6th Edition, Pearson Education, 2014.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay: "Cryptography and Network Security", 2nd Edition, Tata McGraw-Hill, 2014.

Reference books:

1. Atul Kahate, "Cryptography and Network Security" 2nd Edition, Tata McGraw-Hill Publishing Company, 2010.
2. Network Security Private Communication in a public world, Charlie Kaufman, Radia Perlman & Mike Speciner, Prentice Hall of India Private Ltd., New Delhi, 2011.
3. Network Security Essentials Applications and Standards, William Stallings, Pearson Education, New Delhi, 2010.
4. Network Security Complete Reference by Roberta Bragg, Mark Phodes-Ousley, Keith Strassberg Tata Mcgraw-Hill, 2009.

ADDITIONAL LEARNING SOURCES:

1. https://mrajacse.wordpress.com/2012/01/06/cryptography-network-security-ebooks/
2. www.williamstallings.com/Crypto/Crypto4e.html

Course Code: ET-31
Course Name: Soft Computing

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

Upon successful completion of this course, students will be able to, **CO1:** Identify and describe soft computing techniques and their roles in building intelligent machines. **CO2:** Recognize the feasibility of applying a soft computing methodology for a particular problem. **CO3:** Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems. **CO4:** Apply genetic algorithms to combinatorial optimization problems. **CO5:** Apply neural networks to pattern classification and regression problems .
TOPICS COVERED:

UNIT 1 - Introduction 10 Hours

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy logic: Introduction – crisp sets- fuzzy sets crisp relations and fuzzy relations: Cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.

UNIT 2 - Neural Networks 10 Hours

McCulloch-Pitts neuron – linear separability – hebb network – supervised learning network: perceptron networks adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto- associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative autoassociative memory network & iterative associative memory network – unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network.

UNIT 3 - Fuzzy Logic10 Hours
Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals –

fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning- fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT 4 – Genetic Algorithm 10 Hours
Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stopping condition – constraints – classification genetic programming – multilevel optimization – real life problem- advances in GA.

UNIT 5 – Hybrid Soft computing Techniques and Applications 12 Hours
Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.
TUTORIALS:
Solving simple programs using MATLAB in the following areas:

1. FUZZY Logic techniques.
2. Neural networks techniques.
3. Genetic Algorithm techniques.
4. Hybrid Soft Computing Techniques.

TEXT BOOKS / REFERENCES:
Text books:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education,2004.
2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

Reference books:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.

ADDITIONAL LEARNING SOURCES:

1. http://www.myreaders.info/html/soft_computing.html
2. http://www.soft-computing.de/

Course Code: ET-32
Course Name: Big data Analytics

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be **CO1:** Demonstrate the knowledge, significance structure and sources of Big Data. **CO2:** Ability to think critically in making decisions based on data analytics, specific to Big Data. **CO3:** Apply the technical skills in predicative and perspective modelling to support business decisions. **CO4:** Comprehend decision tools and techniques for data streaming using various algorithms. **CO5:** Demonstrate the Knowledge gained on mining social network data.
TOPICS COVERED:

UNIT 1 - Introduction to Big Data 12Hours

What is big data? Is the "big" part or the "data" art more important? How is big data different? How is big data more of the same? Risks of big data -why you need to tame big data -the structure of big data- exploring big data, most big data doesn't matter- filtering big data effectively -mixing big data with traditional data- the need for standards-today's big data is not tomorrow's big data. Web data: the original big data -web data overview -what web data reveals -web data in action? A cross-section of big data sources and the value they hold.

UNIT 2 : Data Analysis 08 Hours

Evolution of analytic scalability – convergence – parallel processing systems – cloud computing – grid computing – map reduce – enterprise analytic sand box – analytic data sets – analytic methods – analytic tools – cognos – microstrategy - pentaho. Analysis approaches – statistical significance – business approaches – analytic innovation – traditional approaches – iterative

UNIT 3 - Mining Data Streams 10 Hours

Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, realtime analytics platform(rtap) applications, case studies, real time sentiment analysis, stock market predictions.

UNIT 4 - Frequent Item sets and Clustering 10 Hours

Mining frequent itemsets - market based model – apriori algorithm – handling large data sets in main memory – limited pass algorithm – counting frequent itemsets in a stream – clustering techniques – hierarchical – k- means – clustering high dimensional data – clique and proclus – frequent pattern based clustering methods – clustering in non-euclidean space – clustering for streams and parallelism.

UNIT 5 : Frameworks and Visualization 10 Hours

Mapreduce – hadoop, hive, mapr – sharding – nosql databases - s3 - hadoop distributed file systems –visualizations - visual data analysis techniques, interaction techniques; systems and applications.

TUTORIALS
Case Studies:

1. Medicare and Medicaid Services : Integrity of health care data and secure payment processing.
2. Tesco PLC.
3. American Express Co.
4. Mobile Telecom Harnesses Big Data with Combined Actuate and Hadoop Solution.
5. Re-engineering a Telecom Market Share Analytical Application.
6. Telco Case Study: Vodafone and Argyle Data on using big data to combat fraud.
7. MTS India relies on HP Vertica in a highly competitive telecom market.
8. Mclaren's Formula One racing team : real time car sensor data during car races.

TEXT BOOKS / REFERENCES:

Text books:

1. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2013.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2014

Reference books:

1. Paul Zikopoulos, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill Professional, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, Pete Warden, Big Data Glossary, O‟Reilly.

3. Chuck Lam, “Hadoop in Action”, Dreamtech Press.

ADDITIONAL LEARNING SOURCES:

1. https://www.tutorialspoint.com/big_data_tutorials.html.
2. https://www.lynda.com/Big-Data-training-tutorials/2061-0.html.
3. https://www.tutorialspoint.com/hadoop/hadoop_big_data_overview.html.
4. https://bigdatauniversity.com.

Course Code: ET-33

Course Name: SOFTWARE PROJECT MANAGEMENT

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to: CO1: Comprehend software project management basics and approaches CO2: Analyze different project management initiation techniques CO3: Apply proper project planning and scheduling techniques CO4: Execute software projects with efficient control mechanisms CO5: Decide on closure of projects using standard and agile methodologies
TOPICS COVERED:

UNIT 1 -Software Project Basics 10 Hours

Introduction, Types of Software Projects, Classifications of Software Projects, Based on Software Development Life Cycle, Approach Driven, Maintenance, Web Application, Agile Development, Conclusion

Approaches to Software Project Management:Alignment of Software Engineering Methodology with Project Management Methodology, The Ad Hoc Methods-Based Approach, The Process-Driven Approach, So, What Is the Right Approach?, The Ad Hoc Approach, The Process-Driven Approach, But Is a Process-Driven Approach the Right Choice?, In a Process-Driven Approach: What Process and How Much?

Software Project Acquisition:From an External Client, The Request for Proposal, The Proposal, Negotiation, Contract Acceptance, From an Internal Client, The Feasibility Study, Preparing the Proposal, Finalizing the Proposal, Reference.

UNIT2 -Software Project Initiation 10 Hours

Introduction, Initiation Activities, Project Management Office-Level Activities, Identifying the Software Project Manager, Preparing/Handing Over the Project Dossier to the Software Project Manager, Coordinating Allocation of Project Resources, Assisting the Software Project Manager in Obtaining Necessary Service Level, Agreements from Departments in the Organization, Assisting the Software Project Manager with the Project Kickoff Meeting, Software Project Manager-Level Activities, Ensuring that Project Specifications Are

Complete,Reviewing Estimates and Revisions/Updates of Estimates, Identifying Necessary Resources and Raising Requests, Preparing Project Plans, Setting Up the Development Environment,Arranging for Project- Specific Skill Training, Organizing the Project Team, Training the Project Team on the Project Plans, Conducting a Project Kickoff Meeting, Arranging for a Phase-End Audit, Common Pitfalls in Project Initiation, Identifying the Wrong Software Project Mana, Identifying Inappropriate Resources, Incurring Delays in Software Project Initiation Activities.

UNIT3 -Software Project Planning 10 Hours

Introduction, Planning Defined, Plans Prepared in Software Project Management, The Project Management Plan, Resources, Skill Sets, Computer Systems, Project Management Method,The Configuration Management Plan, Naming Conventions, Change Management, The Quality Assurance Plan, The Schedule Plan, The Induction Training Plan, The Risk Management Plan, The Build Plan, The Deployment Plan, The User Training Plan,The Handover Plan, The Software Maintenance Plan, The Documentation Plan, Roles in Planning.
Scheduling: Introduction, The Initial Work Breakdown Structure, A Work Breakdown Structure with Predecessors Defined, A Work Breakdown Structure with Initial Dates, A Work Breakdown Structure with Resource Allocation, Scheduling in Practice, Graphic Representation of a Schedule

UNIT 4 -Software Project Execution 10 Hours

Introduction, Work Management, Work Registers, De-allocation, Configuration Management, Information Artifacts, Code Artifacts, Configuration Registers, Configuration Management Tools, Quality Management, Verification Techniques, Validation Techniques, Product Testing, Allocation of Quality Assurance Activities, Productivity Management, Stakeholder Expectations Management, Product Integration Management.
Software Project Execution Control: Introduction, Aspects of Control in Project Execution, Scope Control, Cost Control, Schedule/Progress Control, Quality Control, Effort Control, Productivity Monitoring, Control Mechanisms, Progress Assessment: Earned Value Analysis.

UNIT 5 - Software Project Closure 12 Hours

Introduction, Identifying Reusable Code Components, Documenting the Best Practices, Documenting the Lessons Learned, Collecting/Deriving and Depositing the Final Project Metrics in the Organizational, Knowledge Repository, Conducting Knowledge-Sharing Meetings with Peer Software Project Managers, Depositing Project Records with the Project Management Office, Depositing Code Artifacts in the Code Repository, Conducting the Project Postmortem, Releasing the Software Project Manager, Closing the Project, The Role of the Organization in Project Closure, The Project Management Office, The Configuration Control Board, The Systems Administration Department, Reference.

Agile Project Management: Introduction, Project Management Roles, Agile Project Management Characteristics, Metaphor, Teamwork and Collaboration, Guiding Principles, Open Information, Use a Light Touch, Monitoring and Adjustment, The Nuts and Bolts of Agile Project Management, Planning the Work, Controlling the Work, Process Improvement, Reference.

TUTORIALS:

Writing Cases for the following.

1. Writing requirement Proposal.
2. WritingNegotiationProposal.
3. Writing Feasibility Study Proposal.
4. Software Project Planning Proposal.
5. Software Project Execution Control Proposal.
6. WritingSchedules
7. Software Project Closure

TEXT BOOKS / REFERENCES:

Text books:

1. **“**Mastering Software Project Management: Best Practices, Tools and Techniques**”**, MuraliChemuturi, Thomas M. Cagley, J. Ross Publishing, 2010,

Reference books:

1. “IT Project MAnagement – On track from Start to Finish”, Book by Joseph Phillips, 2002.
2. “Managing the unmanageable” by Mantle and Lichty, 2012.
3. Making Things Happen: Mastering Project Managementby Scott Berkun, 2008.

ADDITIONAL LEARNING SOURCES:

1. https://www.tutorialspoint.com/software_engineering/software_project_management.htm
2. http://searchsoftwarequality.techtarget.com/tutorials/Software-Project-Management-Process

Course Code: BM-41
Course Name: BUSINESS INTELLIGENCE

Credit Scheme			Evaluation Scheme				
Lecture	Practical	Credit	Internal			External	Total
			Written	Practical	Tutorial		
4 Hrs./Week	-	4	30		-	70	100

COURSE OUTCOMES:
Upon successful completion of this course, students will be able to, CO1: Comprehend the basics and fundamentals of BI with its business and technical needs CO2: Use the requirements and architectural framework of BI CO3: Know and differentiate different components of the BI framework CO4: Design BI concepts by understanding the requirement needs CO5: Analyze and implement advanced BI techniques and analytics
TOPICS COVERED:

UNIT 1-The Business Demand for Data, Information, and Analytics 10 Hours

Just One Word:Data, Welcome to the Data Deluge, Data Volume, Variety, and Velocity, Taming the Analytics Deluge, The Importance of Analytics, Analytics Challenge, Analytics Strategy, Too Much Data, Too Little Information, The Difference Between Data and Information, The Role of BI in Creating Actionable Information, The Information Backbone, Data Capture versus Information Analysis, The Roles of BI and Operational Systems, Operational BI Blurs the Lines, Where Data Warehousing Fits in, The Five Cs of Data, Common Terminology from Our Perspective, References.

Justifying BI: Building the Business and Technical Case:Why Justification is Needed, Building the Business Case, Review Organization's Business Initiatives and Processes, Solicit BI Sponsorship, Enlist BI Stakeholders, Identify Business Processes Affected by BI, Document Business Benefits, Determine Business Value(Tangible Benefits), Business the Technical Case, Technology and Product Short Lists, Convincing Business People, Convincing the Technologists, Assessing Readiness, Data and Data Quality, Expertise and Experience, Organizational and Cultural Change, Financial and Resource Commitment, Creating a BI Road Map, Developing Scope, Preliminary Plan and Budget, Project Scope, Project Plan, Project Budget, Calculating Benefits and ROI, Obtaining Approval, Common Justification Pitfalls, Overzealous Business Sponsor, CIO is Sole Sponsor, Intangible or Too High-Level Benefits, Confusion Between BI Technology and Business Value.

UNIT 2-Defining Requirements-Business, Data and Quality 10 Hours

The Purpose of Defining Requirements, Goals, Deliverables, Roles, BI Team Participants, Business Participants, Other IT Participants, Defining Requirements Workflow, Business Requirements, Data(and Data Quality) Requirements,Functional Requirements, Regulatory/Compliance Requirements, Technical Requirements, Reverse Engineering(When Necessary), Putting It All Together, Prioritizing Requirements, Interviewing, Preparation for Interviews, Conducting the Interviews, Reviewing Interview Content, Interview Follow-ups, Documenting Requirements.
Architecture Framework:The Need for Architectural Blueprints, Architectural Framework, Information Architecture, Data Architecture, The Rise of the Enterprise Data Warehouse, Data Warehousing Replaces the Data Warehouse, Technical Architecture, Business Intelligence, Data Warehouse and BI Data Stores, Data Integration, Source Systems, BI Technology Keeps Evolving, Product Architecture, Metadata, What is It?, What to do About It, Security and Privacy, Getting Started, Implementing the Plan, Avoiding Accidents with Architectural Planning, The Signs of Accidental Architectural Planning, Recovering from an Accidental Architecture, Do Not Obsess over the Architecture.

UNIT 3-Information Architecture 10 Hours

The Purpose of an Information Architecture, Data Integration Framework, DIF Information Architecture, Data Preparation, Data Franchising, BI and Analytics, Data Management, Metadata Management, Operational BI versus Analytical BI, Shift All Reporting to the Application-Specific Environment, Shift All Reporting to the DW- Based BI Environment, Blend Application-Specific and DW BI Environments, Master Data Management, Identify the Data, Find the Problem Areas, Assess a Solution.
Data Architecture: The Purpose of a Data Architecture, History, Prehistory, In the Beginning, Data Warehousing Goes Public, The Data Mart, Multiple Data Marts, Operational Data Store(ODS), Federated DWs, BI Accidental Architecture, Hub-and-Spoke, Data Architectural Choices, Data Categories, Selecting a Data Architecture, The Same But Different, Analytical Data Architecture(ADA),Data Integration Workflow, Data Integration Workflow— Hub-and-Spoke, Data Workflow of the System of Integration(SOI), Data Workflow of the System of Analysis(SOA), Data Workflow—Rise of EDW Again, Operational Data Store, The Relational for an ODS, ODS Reexamined, ODS is Dead, Long Live ODS, References.

UNIT 4-Technology & Product Architectures 10 Hours

Where are the Product and Vendor Names?, Evolution Not Revolution, Technology Platforms, Enterprise Applications, Data Management, Technology Architecture, Business Intelligence and Analytics, Information Access and Data Integration, Databases, Product and Technology Evaluations, BI Product Vendors, Dazed and Confused, Technology and Product Evaluations, Product Migration.
Business Intelligence Applications: BI Content Specifications, Revise BI Applications List, BI Personas, Casual Consumers, Analyst, Power Users, Data Scientists, BI Design Layout—

Best Practices, Focus on the Purpose, Design Layout, Data Design for self-Services BI, The Last Data Preparation Step, When Inconsistency is Reintroduced, OLAP Cubes and In-Memory Columnar Databases, Matching types of analysis to Visualizations, Comparative Analysis, Time-series or Trending Analysis, Contribution Analysis, Correlation Analysis, Geographic Data, Distribution Analysis.

UNIT 5-BI Design and Development 12 Hours

BI Design, BI User Interface(UI) Standards, Create Privacy, Security and Access Standards, Designing Each BI Application, BI Development, Prototyping Lifecycle, BI Application Development Tasks, BI Application Testing.
Advanced Analytics: Advanced Analytics Overview and Background, The Window to the Future, Don't Ignore the Past, Advanced Analytics in Action, Predictive Analytics and Data Mining, Setting Up a Predictive Analytics or Data Mining Program, Tasks for Developing and Using Models, Selecting Tools, Architecture for Predictive Analytics and Data Mining, Techniques for Predictive Analytics and Data Mining, Resources and Skills, Roadblocks to Success, Analytical Sandboxes and Hubs, Analytical Sandboxes, Analytical Hubs, Hub and Sandbox Design Principles, Hub and Sandbox Architecture Options, Advice for Hubs and Sandboxes, Big Data Analytics, Scope, The Program, Hybrid Architecture, The Big Data Team, Big Data Analytics Worst Practices, Data Visualization, Why Data Visualization is Needed, Why Data Visualization is Not, References.

TUTORIALS:

1. Case study on requirement specification.
2. Defining a requirement workflow.
3. Writing technical requirement specification.
4. Prioritizing the requirements.
5. Writing a BIE roadmap.
6. Writing & Defining scope objectives & outcomes.
7. Writing a plan & budget.
8. Writing Data Management techniques.
9. Creating data marts & operational data stores.
10. Creating OLAP Cubes.

TEXT BOOKS / REFERENCES:

Text books:

1. "Business Intelligence Guidebook: From Data Integration to Analytics" Book by Rick Sherman, 1st Edition, 2014.

Reference books:

1. Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications by Larissa T. Moss and ShakuAtre, February 25th 2003.

2. Successful Business Intelligence, Second Edition: Unlock the Value of BI & Big DataHardcover– Import, 1 Nov 2013.
3. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Revised and UpdatedPaperback– 22 Feb 2016.

ADDITIONAL LEARNING SOURCES:

1. https://thebipalace.com/
2. https://www.analyticsvidhya.com/learning-paths-data-science-business-analytics-business-intelligence- big-data/tableau-learning-path/

MASTER OF SOCIAL WORK

MSW

SYLLABUS

CREDIT BASED, CHOICE BASED CONTINUOUS ASSESSMENT PATTERNED EDUCATION SYSTEM

(Regulations, Scheme of Examination and Course Content)

To be effective from the Academic Year 2020-21 onwards

DEPARTMENT OF STUDIES IN SOCIAL WORK
JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE

JSS College of Arts, Commerce and Science

(Autonomous)

Ooty Road, Mysore

Master of Social Work Programme

DISTRIBUTION OF COURSE CONTENT AND CREDITS

DISTRIBUTION OF CREDITS

Sl. No.	Course Type	Credits
1	HARD CORE (HC)	52
2	SOFT CORE (SC)	20
3	OPEN ELECTIVE (OE)	04
	TOTAL	76

Semester- wise Distribution of Course Content and Credits

I Semester

Sl. No.	Course Code	Course Title	L:T:P	Credits
1.	SWA HC-1	Social Work - History and Ideologies	2:1:0	3
2.	SWA HC-2	Work with Individuals and Families	2:1:0	3
3.	SWA HC-3	Work with Groups	2:1:0	3
4.	SWA HC-4	Work with Communities	2:1:0	3
5.	SWA HC-5	Human Growth and Development	2:1:0	3
6.	SWA HC-6	Social Work Practicum – I	0:1:2	3
		Total		**18**

II Semester

Sl. No.	Course Code	Course Title	L:T:P	Credits
1.	SWB HC-7	Management of Developmental and Welfare Services	2:1:0	3
2.	SWB HC-8	Social Work Research and Statistics	2:1:0	3
3.	SWB HC-9	Social Work Practicum – II (Social Work Camp and Summer Placement)	0:0:3	2
4.	SWB HC-10	Social Work Practicum - III	0:1:2	3
5.	SWB SC-1	Communication and Counselling /	3:1:0	4
6.	SWB SC-2	Personal and Professional Growth/ Population and Environment/Social Science Perspectives for Social Work Practice	2:1:0	3
			Total	**18**

III Semester

Sl. No.	Course Code	Course Title	L:T:P	Credits
1.	SWC HC-11	Human Resource Management	2:1:0	3
2.	SWC HC-12	Social Work Practicum – IV	0:1:2	3
3.	SWC SC-3	Social Work with Tribal and Rural communities/Employee Relations and Legislation	2:1:0	3
4.	SWC SC-4	Preventive and Social Medicine and Medical Social Work /Rehabilitation and After Care Services	2:1:0	3
5.	SWC SC-5	Social Policy, Planning and Development/ Legal System in India	2:1:0	3
6.	SWC OE	Gerentological Social Work / Social Work Practice with Children/Society and Social Work	4:0:0	4
			Total	**19**

IV Semester

Sl. No.	Course Code	Course Title	L:T:P	Credits
1	SWD HC-13	Organizational Behaviour and Organizational Development	2:1:0	3
2	SWD HC-14	Mental Health and Psychiatric Social Work	2:1:0	3
3	SWD HC-15	Major Project	0:2:4	6
4	SWD HC-16	Social Work Practicum – V	0:1:2	3
5	SWD HC-17	Social Work Practicum – VI (Block Placement)	0:0:2	2
6	SWD SC-6	Human Resource Development and Employee Wellness/Case Studies	3:1:0	4
			Total	**21**

Note: In a Semester for only one Soft Core Course, there can be two choices.

Even semester (II Semester)

Code: SWBHC -7

Paper Title: MANAGEMENT OF DEVELOPMENTAL AND WELFARE SERVICES

INTRODUCTION

The course aims to develop management competencies to function in organizations, participate as a team member and understand the role of a social work programmes manager.

OBJECTIVES

a. Understand the overall environment and its impact on the nature, structure and development of organizations in corporate, public and voluntary sectors in the context of social work profession.
b. Understand policies and procedures involved in establishing and maintaining human service organizations.
c. Acquire skills to network and participate in the management of resources - human, material and environmental.
d. Develop skills to participate in management of programmes, as a part of the inter-disciplinary team and initiate as well as develop new programmes.
e. Develop ability to analyse the practices applied in specific settings.

Course Content

UNIT I

Social Services: Need for welfare and developmental organisations, Factors determining social welfare programmes, Development and Welfare organizations' response to societal needs; role of state, voluntary and corporate sector.

Management services: Types of settings, organizational characteristics like origin, nature, size, structure, and design, organizational climate and impact of socio-political environment - Management process: Vision, Planning, Organizing, Directing, Staffing, Coordination, Reporting, Budgeting.

Establishment: Registration, different types of legislations, legal status, constitution, rules and procedure, goals - Financial resources: Organizational Budget, Sources of finance, Fund Raising, Records, Audit.

UNIT II

Physical: All activities related to acquiring, hiring and maintaining importable structure and infrastructure, maintenance of premises and daily upkeep.Enhancing the involvement and the potential of people in organization's executive boards, committees; professionals and other staff-relationship, communication, team work, and facilitating team building, supervision, and participation in training.

UNIT III

Programme Development: Programme management: long term, short term, and

Documentation.

Project proposals based on felt-needs, nature of resources, eligibility criteria, records, evaluation and research.
Impact analysis - Qualitative and quantitative.

UNIT IV

Public Relations: Public relations need and its promotion by all in the organisation. Representing the organization, networking, public, corporate and voluntary sector, resource building, accountability, transparency, use of media for publicity.

Change and its Management: Understand and manage change, innovation in a rapidly changing social environment: for policy programmes and structure.

Organizational understanding: Conflict, conflict resolution, creating positive climate.

REFERENCES

1. Choudhari, D. Paul. 1983	Social Welfare Administration, Delhi: Atma Ram and Sons.
2. Garain, S. 1998	Organizational Effectiveness of NGOs, Jaipur: University Book House.
3. Garain, S.	Towards a Measure of Perceived Organizational Effectiveness in Non-government Organization, Mumbai: Indian Journal of Social Work, 54 (2), 251 -270.
4. Goel, S. L. and Jain, R. K. 1988	Social Welfare Administration: Theory and: Practice, Vol. I and II, New Delhi: Deep and Deep Publications.
5. Government of India	Evaluation of Social Welfare Programmes, Encyclopedia of Social Work. Vol. 1, 297 - 310.
6. Haimann, A. 1982	Professional Management and Practice, Delhi: Eurasia Publications.

7. Hasenfeld, Y and English, R. (Eds.) 1978	Human Service Organizations. Ann Arbor: University of Michigan Press.
8. Hauman, A. 1962	Professional Management and Practice, Delhi: Eurasia Publications.
9. Jackson, J. 1989	Evaluation for Voluntary Organizations. Delhi: Information and News Network.
10. Kapoor, K. K. 1986	Directory of Funding Organizations, Delhi: Information and News Network.
11. Lauffer, A. 1977	Getting the Resources You Need, New Delhi: Sage Publications.
12. Lauffer, A. 1977	Understanding Your Social Agency, London: Sage Publications.
13. Luthans, Fred. 1990	Organizational Behaviour, Boston, Irwin McGraw Hill.
14. PRIA. 1990	A Manual on Financial Management - An Accounts Keeping for Voluntary Organizations, New Delhi: Society for Participatory Research in Asia.
15. PRIA b	Training of Trainers: A Manual for Participatory Training Methodology in Development, New Delhi: Society for Participatory Research in Asia.
16. Sachdeva, D. R. 1998	Social Welfare Administration in India, Allahabad, Kitab Mahal.
17. Siddiqui, H. Y. 1984	Social Work and Social Action, New Delhi: Hamam Publications.
18. Skidmore, R. A. 1983	Social Work Administration, New Jersey, Prentice-Hall.
19. Slavin, S. (Ed.) 1978	Managing Finance, Personnel and Information in Human Services, New York: Howorth Press.
20. Slavin, S. (Ed.) 1978	Social Administration, New York: The Haworth Press.
21. Weiner, M. 1982	Human Service Management, Illinois: The Dorsey Press.
22. Young, Pat 1985	Mastering Social Welfare, London, Macmillan Master Series, Macmil1an Education Ltd.

Paper Code: SWBHC-8

Paper Title: SOCIAL WORK RESEARCH AND STATISTICS

INTRODUCTION

This course is to equip learners to utilize, and conduct research as service managers to improve services, evaluate, and develop new services and intervention methods: strategies and techniques and also, be an effective consumer of other researches.

OBJECTIVES

a. Develop an understanding of scientific approach to human inquiry in comparison to the native or common sense approach in various aspects, and its process.
b. Understand major research strategies, meaning, scope and importance of social work research.
c. Develop an ability to see the linkages between practice, research, theory and their role in enriching one another.
d. Develop ability to conceptualize, formulate and conduct simple research projects/exercises (This would include a broad range of basic research skills such as conceptualization of a research strategy and problem; writing a research proposal; developing tools for col1ecting data; use of sampling, strategies; data collection, processing, presentation, analysis and interpretation; and writing research report etc).
e. Make informed assessment and judicious use of research studies and findings.
f. Develop skills for use of library and documentation services for research.

Course Content

UNIT I

Science - Meaning and assumptions, scientific approach in comparison to the native or common sense approach.

Scientific attitude; Scientific method; application of scientific method for the study of social phenomena.

Research: Definition and objectives, Social Work Research: Meaning, objectives, functions and limitations; Scope of social work research in India; Agencies sponsoring and conducting social work research, ethics in research.

Problem identification: Criteria for the selection of research problem; Problem formulation.
Concepts, constructs, variables, conceptual and operational definitions. Hypothesis: Meaning, importance, uses and requirements.

UNIT II

Design of research: Definition and importance; types of research design; exploratory,

descriptive, experimental, evaluative design, participatory research and action research.

Source and Types of Data: Primary and secondary, objective and subjective, qualitative and quantitative.

Sampling: Sample and population: Rationale and Characteristics of sampling; methods of sampling, general considerations in the determination of sample size.

Methods of collection of primary data:
Observation: Structured and unstructured; participant and non-participant. Questionnaire, interview schedule and interview guide. Pilot study and Pre-testing.

Scales: Need for scales, some prominent scaling procedures.
Case study: Meaning, uses, steps.

Secondary data: Official data, personal documents, problem in the use of secondary data

UNIT III

Processing of data: Content, editing, coding data classification, manual and mechanical tabulation of data; frequency distribution, diagrammatic and graphic presentation - use of computers.

Issues related to Social Work Research: Interpretation of data, research reporting: contents of research report: foot-note, references, bibliography, preparation of abstract; the art of making book review.

UNIT IV
Statistics: Definition, functions and importance
Measures of Central Tendency; Measures of Dispersion.
Chi-square, Correlation Coefficient, 't' distribution; Analysis of Variance and 'F' distribution.

SPSS package.

REFERENCES

1. Ackoff, R. L. 1962	Scientific Method: Optimizing Applied Research Designs, New York: John Wiley and Sons.
2. Anderson, J. et al. 1970	Thesis and Assignment Writing, New Delhi: Wiley Eastern Limited.
3. Bailey, Kenneth, D. 1987	Methods of Social Research, New York: The Free Press
4. Blaikie, Norman. 1993	Approaches in Social Enquiry, Cambridge: Polity Press.
5. Blalock, H. M. 1972	Social Statistics, New York: McGraw Hill.
6. Blalock, H. M. and Blalock, A. M. (Eds.) 1968	Methodology in Social Research; New York: McGraw-Hill.
7. Coolidge, Frederick L. 2000	Statistics: A Gentle Introduction, New Delhi: Sage Publications.
8. Crabtres, B. F. and Miller, W. L. (Eds.) 2000	Doing Qualitative Research, New Delhi: Sage Publications.
9. Cranstein, A. and Phillips, W.R.1978	Understanding Social Research: An Introduction, Boston: Allwyn and Bacon.
10. Denzin, Norman, K. & Lincoln, Y. S. (Eds.) 2000	Handbook of Qualitative Research (II ed.), New Delhi: Sage Publications.
11. Field, Andy. 2000	Discovering Statistics Using SPSS for Windows: Advanced Techniques for Beginning, New Delhi: Sage Publications.
12. Foster, J. J. 1998	Data Analysis Using SPSS for Windows: A Beginner's Guide, New Delhi: Sage Publications.
13. Gahan, Celis and Hannibal, Mike. 1998	Doing Qualitative Research Using QSR, NUD, IST, New Delhi: Sage Publications.
14. Geltung, J. 1961	Theory and Methods of Social Research, London: George Allen & Unwin
15. Goode, W. J. and Hatt, P. K. 1962	Methods in Social Research, New York, McGraw-Hill.
16. Gupta, S. P. 1984	Statistical Methods, New Delhi, Sultanchand and Sons.

17. Jefferies, J. and Diamons, I. 2000 Beginning Statistics: An Introduction for Social Scientists, New Delhi: Sage Publications.

18. Krishnaswamy, O. R. 1993 Methodology of Research in Social Sciences, Bombay, Himalaya Publishing House.

19. La1das, D. K. 2000 Practice of Social Research, Jaipur, Rawat Publications.

20. Manheim, Henry, L. 1977 Sociological Research: Philosophy and Methods, Illinois:The Dorsey Press.

21. Marshal1, Gatherine and Rosaman, G. B. 1999 Designing Qualitative Research, III Edition, New Delhi: Sage Publications.

22. May, Tim. 1997 Social Research: Issues, Methods & Process, Buckingham: Open University Press.

23. Moser, C. A. and Kalton, G, 1977 Survey Methods in Social Investigation, London: Heinemann Educational Books

24. Mukherji, Partha N. (Ed.) 2000 Methodology in Social Research: Dilemma, and Perspectives, New Delhi: Sage Publications.

25. Nagel, Ernest. 1984 The Structure of Science: Problems in the Logic of Scientific Explanation.

26. Padgett, Deborah, K. 1988 Qualitative Methods in Social Work Research, New Delhi: Sage Publications.

27. Polansky, N. A. (Ed.) 1960 Social Work Research, Chicago, University of Chicago.

28. Ramchandran, P. 1990 Issues in Social Work Research in India, Bombay: Institute for Community Organisation Research.

29. Ramachandran, P. 1990 Issues in Social Work Research in India, Bombay, Tata Institute of Social Sciences.

30. Reid, William J. and Smith, Andrey D. 1981 Research in Social Work, New York: Columbia University Press.

31. Rosenberg, M. 1968 The Logic of Survey Analysis, New York: Basic Books.

32. Rubin, A. and Babbie, K. 1993 Research Methods for Social Work, California: Brooks Cole Publishing Co.

33. Sellits, Glaire et al. 1976	Research Methods in Social Relations, New York:Holt, Rinebart and Winston.
34. Shah, F. V. 1977	Reporting Research, Ahmedabad: Rachna Prakashan.
35. Shaw, Ian and Lishman, Joyce. (Ed.) 1999	Evaluation and Social Work Practice, New Delhi: Sage Publications.
36. Silverman, David (Ed.)	Qualitative Research,. New Delhi: Sage Publications.1997
37. Society for Participatory Research in Asia, 1995	Participatory Research: An Introduction, Participatory Research, Network Series, No.3, New Delhi: PRIA.
38. Stewart, Alex. 1998	The Ethnographer's Method, New Delhi: Sage Publications.
39. Yanow, Dvora. 1999	Conducting Interpretive Policy Analysis, New Delhi: Sage Publications.
40. Yin, Robert, K. 1.994	Case Study Research: Design and Methods, New Delhi: Sage Publications
41. Young, Pauline V. 1982	Scientific Social Survey and Research, New Delhi, Prentice-Hall of India Pvt. Ltd.

Even semester
Paper Code: SWBSC-1

Paper title: COMMUNICATION AND COUNSELING

INTRODUCTION

This paper relates the relevance of components of communication and counseling in social work practice.

OBJECTIVES

a. Understand the meaning and importance of communication in day-to-day life.
b. Focus on interpersonal communication of interviewing and allied aspects.
c. Develop holistic understanding of counseling as a tool for help.
d. Acquire knowledge of various approaches: their theoretical under-pinnings for goals, values, processes and techniques,
e. Develop skills of application to real life situations.

Course Content

UNIT I

Communication: Meaning and importance of communication.
Process of communication: Key elements in the communication process - Communication, message, audience; channel of communication. Verbal and non-verbal communication.

Basics of Communication.
Education and communication for national development.

Interpersonal communication: Interviewing - Objectives, principles of interviewing; listening, qualities of effective communicator.
Seminars, conferences, lectures, group discussion, panel discussion, symposium, workshop, role playing, simulation exercises, written communication, report writing, letter writing, article/essay writing, games, brain storming, street play, field work exposure.

UNIT II

Visual aids in communication: Poster making, use of notice boards, flip charts, charts, flash cards, photographs, pamphlets, slide shows.
Mass Communication: Television, exhibition, newspapers and magazines, advertisements, radio, film, VCD/ DVD, e-mail, internet.

Impact of mass communication on society, family, marriage and child development.

Communication Analysis and Planning: Planning and executing a communication campaign on an issue using various methods of communication.

UNIT III

Counseling: Definition, nature and goals, areas of counseling; Historical background and origins of counseling, ethical nature of counseling, qualities of an effective counselor.

Counseling Situations: Developmental, preventive, facilitative, and crisis.
Counseling and Psychotherapy - Skills in counseling - Establishing the relationship.

Process of Counseling.

Approaches to Counseling: Approaches; Theoretical base, thrust, goals, key concepts, techniques - Approaches like person-centered, rational-emotive, behavioural approaches, gestalt, existential approaches, Egans three stage model, eclectic model.

Indigenous Approach: Indigenous approaches of help and self-help like yoga, reflection. Act of Prayashchit.

UNIT IV

Couple and Family Counseling: Issues in such counseling, its process and stages.
Crisis Counseling

Group Counseling: Counseling for groups - Process, advantages and disadvantages of group counseling.

Practice of counseling in family counseling centres, family courts, counseling bureau - Premarital and marital counseling, vocational counseling centres, mental health centres, child guidance clinics, correctional institutions, deaddiction and rehabilitation centres, educational institutions.

REFERENCES

1. Brown, Leland 1970	Communicating Facts and Ideas in Business, New Jersey: Prentice-Hall Inc., Englewood Cliffs.
2. Chandrashekar, C. R. (Ed.) 1999	A Manual on Counseling for Lay- Counselors, Bangalore, Prasanna Counseling Centre.
3. Dave, Indu 1983	The Basic Essentials of Counseling, New Delhi: Sterling Publishers Pvt., Ltd.
4. Desai, M. M.(Ed.) 1979	Creative Literature and Social Work Education, Bombay: Somaiya Publications Pvt. Ltd.
5. Desai, Murli (Ed.) 1994	Family and Interventions - A Course Compendium, Bombay, Tata Institute of Social Sciences.
6. D'souza, Y. K. 1999	Communication Today and Tomorrow, New Delhi: Discovery Publishing House.
7. Fisher, Dalmar 1999	Communication in Organisations, Second Edition, Mumbai: Jaico Publishing House.
8. Fullmer, D. W. and Bernard, H. W. 1972	Counseling: Content and Process, New Delhi: Thomson Press India.
9. Fuster, J. M. 2000	Personal Counseling, Eighth Updated Edition, Mumbai, Better Yourself Books.
10. Kennedy, E. 1977	On Becoming a Counselor - A Basic Guide for Non-professional Counsellors, Delhi: Gill and Macmillan.
11. Lakshmipathi Raju, M (Ed.) 1999	Family Counseling: Perspectives and Practices, Tirupati, Sri Padmavati Mahila Visvavidyalayam.
12. Lewis,E. Patterson and Elizabeth, Reynolds Welfel 2000	The Counseling Process, Stamford, Brooks / Cole Thomson Learning,
13. Melkote, Srinivas R. 1991	Communication for Development in the Third

World – Theory and Practice, New Delhi: Sage Publications.

14. Mohan, Krishna and Banerji, Meera. 1990 — Developing Communication Skills, Delhi: Macmillan India Ltd..

15. Murphy, Robert D. 1977 — Mass Communication. and Human Interaction, Boston:Houghton Miffiin Company.

16. Narang, Vaishna 1996 — Communicative Language Teaching, New Delhi: Creative Books.

17. Narayana, Rao S. 1981 — Counseling Psychology, New Delhi: Tata Mc Graw Hill Publishing Company Ltd.

18. Pollock, Thomas C1ark; Sheridan, Marion C; Ledbetter, Frances and Doll, Ronald C. 1955 — The Art of Communicating, New York: The Macmillan Company.

19. Robert, G. Madden 1998 — Legal Issues in Social Work Counseling and Mental Health, Sage Publications India Pvt., Ltd.

20. Small, Jacquelyn 1990 — Becoming Naturally Therapeutic: A Return to the True Essence of Helping, New York, Bantam Books.

21. Venkatramani, S. H. 1998 — Corporate Communications - The Age of Image, New Delhi: Sterling Publishers Private Ltd.

odd semester (III Semester)

Odd Semester

Paper code: SWCHC-11

Paper Title: HUMAN RESOURCE MANAGEMENT

INTRODUCTION

The main objective of this course is to prepare young graduates for management and administrative positions in various industrial, business, governmental/non-governmental organisations and service sector organisations.

OBJECTIVES

a. Develop managerial skills in different functional areas of management with practical focus on HRM.
b. Develop the competence to evolve the problem-solving approaches by applying conceptual and behavioural skills.
c. Develop interpersonal skills/ competence and leadership qualities to work in a group with team building approach.
d. Develop sound theoretical base in various concepts and theories to enable the student to develop a broad perspective of the management field.
e. Distinguish the strategic approach to Human Resources from the traditional functional approach.
f. Understand the relationship of HR strategy with overall corporate strategy.

Course Content

UNIT I

Human Resource Management: Concept, scope, philosophy and objectives; Evolution; Approaches, Structure and Functions; Line and staff relations of HRM; HRM Model. Hierarchy, formal and informal structure, Organization chart/reporting structure.

Human Resource Planning: Concept and objectives; Human resource inventory; Human resource planning process; job analysis; job description; job specification; job design; career planning and career paths; job rotation.

UNIT II

Talent Acquisition: Goals; polices, sources and methods. Selection: Concept, process. Talent Acquisition Tests, Theories and issues in psychological testing, Intelligence testing – theoretical background, Aptitude Testing, Personality Assessment, MBTI. Placement, Induction and socializing the new employee. Talent retention: Concept, importance and methods.

UNIT III

Compensation Management: Factors influencing compensation plans and policies; Job evaluation - Fixation of salary, components of salary. Pay for performance – Incentive Schemes, principles and types, Employee Stock Option Plan, compensation survey / review

UNIT IV

Strategic Human Resource Management (SHRM): Business strategy and organizational capability, SHRM: aligning HR with Corporate strategy, Strategic HR planning and Development, Change Management and restructuring and SHRM, Corporate Ethics, Values and SHRM, Competencies of HR professional in a SHRM scenario.

REFERENCES

1. Agarwal, R. D. (Ed.) 1973	Dynamics of Personnel Management in India, New Delhi: Tata McGraw-Hill Publishing Company.
2. Bhargava, P. P. 1990	Issues in Personnel Management, Jaipur: Printwell Publishers.
3. Chalofsky, Neal E and Reinhart, Carlene. 1988	Effective Human ResourceManagement, London: Jossey Bass.
4. ChatteIjee, Bhaskar 1999	The Executive Guide to Human Resource Management,New Delhi, Excel Books.
5. Desai, K. G. 1969	Human Problems in Indian Industries, Bombay, Sindhu,
6. Famularo, Joseph 1987	Handbook of Human Resource Administration, McGraw-Hill.
7. Fisher, Cynthia; Schoenfeldt Lyle F. and Shaw, James, G. 1997	Human Resource Management, Third Edition., Boston, Houghton Mifflin Company.
8. Gary Desslar 1997	Human Resource Management, 7th Edition, New Delhi: Prentice Hall of India Pvt. Ltd.
9. Mamoria,C.B. 1989	Personnel Management, Bombay: Himalaya Publishing House.10. McKenna, Eugene and The

Beech, Nic 1997 — Essence of Human Resource Mangaement, New Delhi, Prentice – Hall of India Pvt. Ltd.

11. Moorthy,.M. V. 1992 — Human Resource Management: Psycho-Sociological Social Work Approach, Bangalore, R & M Associates.

12. Pareek, Udai and Rao, T. V. 1982 — Designing and Managing Human Resources, New Delhi, Oxford & IBH.

13. Rudrabasavaraj, M. N. 1984 — Human Factors in Administration, Bombay: Himalaya Publishing House.

14. Rudrabasavaraj, M. N. 1986 — Cases in Human Resource Management, Bombay: Himalaya Publishing House.

15. Subba Rao, P. 1996 — Essentials of Human Resource Management and Industrial Relations, Himalaya Publishing House.

Paper code SWDHC-13

Paper Title: EMPLOYEE RELATIONS AND LEGISLATION

INTRODUCTION

The purpose is to provide an in-depth knowledge about the relationship between employer, employee and the state, to bring out the importance of cordial employee relations for organizational productivity and gain an understanding of the mechanism of inter-personal relations, collective bargaining and productivity improvement functions in the organisation through involvement of all groups.

OBJECTIVES

a. Develop the skills of interpersonal relationship as per organisational requirement.
b. Understand the trends and dynamics between the partners in the organisation.
c. Enhance the knowledge on organisational performance, role and responsibility.
d. Develop the knowledge on various statutory / legal aspects influencing the organizations.
e. To stimulate thinking on rationale behind the Laws and their enforcement.

Course Content

UNIT I

Employee relations, History of industria1ization in India - Issues related to employees in organized and unorganized sector.

Concept, Definition, Philosophy and Principles of employee relations. Employee relations with special reference to Occupation - Safety - Health and Environment (OSHE) Education.

Analysis of the terms 'industry' and 'industrial dispute', industrial discipline – misconduct, disciplinary proceedings.

Domestic Enquiry: Contents and Process, Principles of Natural Justice, Tribunal; Discharge/Dismissal.

UNIT II

Trade Unions: Trade Unionism in India, emergence, history and growth, Trade Union as an organization – Various Trade Unions in India, Trade Union policies, Role of Trade Unions in India, Employers'' Associations – Objectives, structure and activities. Contemporary issues in employee relations.

UNIT III

Employee Legislations: - The Payment of Bonus Act, 1965, Employees Provident Fund (and Misc. Previsions) Act 1952, Workmen's Compensation Act 1923, Employees State Insurance Act 1948, Payment of Gratuity Act, 1972,Child Labour (Prohibition and Regulation) Act, 1986.
Fundamentals of Labour laws, The Constitution of India: Preamble, Fundamental Rights including writs, Directive Principles of State Policy, The Factories Act 1948, The Contract Labour (Regulation and Abolition) Act 1970,The Minimum Wages Act 1948 and The Payment of Wages Act 1936; The Apprentices Act, 1961,The Maternity Benefit Act 1961.

UNIT IV

The Trade Union Act 1926, The Industrial Employment (Standing Orders) Act 1946, The Industrial Dispute Act 1947, The Employment Exchanges (Compulsory Notification of Vacancies) Act 1958. Introduction to Right to Information Act, Intellectual Property Rights, Patent Law, Copyrights, Trademark Law.Collective Bargaining: Definitions, characteristics, critical issues in collective bargaining, theories of collective bargaining, Hick's Analysis of Wages settingunder collective bargaining, conflict-choice model of negotiation, Behavioral Theory of Labor Negotiation, Collective Bargaining in India, Collective bargaining in practice, levels of bargaining, coverage and duration of agreements,administration of agreements, negotiating a contract, the negotiation process, effective negotiation, negotiation and collective bargaining, post negotiation – Administration of the agreement.

Employee relations in knowledge based industry - Concepts of self-managed teams (SMT) - Changing employee/ employer and trade union relationship. Current rules of Taxation of Salaries.

Labor Welfare Officer - Duties and functions; Social Work in Industry.

REFERENCES

1. Achar, M. R. 1976	Labour Rules in Karnataka, Bangalore, Shree Vidya Printers.
2. Arora, M, 2005	Industrial Relations, New Delhi, Excell Books.
3. Dasgupta, S. K.	Industrial Law, Sterling Publishers Pvt. Ltd.
4. Devar, R. S. 1967	Personnel Management and Industrial Relations, New Delhi, Vikas Publishing House.
5. Joseph, T.M. 2009	Industrial Law, Mumbai, Himalaya Publications Pvt., Ltd.
6. Lal Das, D. K. 1991	Personnel Management, Industrial Relations and Labour Welfare, Agra, Y. K. Publishers.
7. Madhusudhana Rao, M. 1986	Labour Management Relations and Trade Union Leadership, New Delhi, Deep and Deep Publications.
8. Malik P. L. 1986	Handbook of Labour and Industrial Law, Lucknow, Eastern Book Company.
9. Mamoria, C. B. and Mamoria S. 2006	Dynamics of Industrial Relations, Mumbai, Himalaya Publishing House.
10. Mamoria, C. B; Mamoria Satish, Gankar, S. V. 2000	Dynamics of Industrial Relations in India, Mumbai, Himalaya Publishing House.
11. Mishra M, 2006	Case Laws on Industrial Relations, New Delhi, Excell oks.12. orthy, M. V. 1968 Principles of, Labour Welfare, Vishakapatnam, Gupta Brothers.
13. Nagaraju, S. 1981	Industrial Relations System in India, Allahabad, Chugh Publications.
14. Pyle M and George, Simon A, 2009	Industrial Relations and Personnel Management, New Delhi,Vikas Publishing House Pvt Ltd.
15. Rudrabasavaraj, M. N. 1984	Human Factors in Administration, Bombay,

Himalaya Publishing House.

16. Sanajaoba, Naorem 1985 — Industrial Tribunal - Working, Procedure and Judicial Trends, New Delhi, Deep and Deep Publications.

17. Sharma, A. M. 1989 — Industrial Relations - Conceptual and Legal Frame Work, Bombay, Himalaya Publishing House.

18. Saiyed I A, 2009 — Labour Law, Mumbai, Himalaya Publishing House Pvt., Ltd.

19. Singh BD, 2005 — Industrial Relations: Emerging Paradigms, New Delhi, Excell Books.

20. Sinha, G. P. and Sinha, P. R. 1977 — Industrial Relations and Labour Legislation in India, New Delhi, Oxford IBH Publishing Co.

21. Somani, Anjan and Mishra, Shivani, 2009-10 — Employment Laws, Jaipur, Ramesh Book Depot

22. Srivastava S C, 2009 — Industrial Relations and Labour Law. New Delhi, Vikas Publishing House Pvt Ltd.

23. Subramanian, H. N. 1967 — Labour Management Relations in India, Bombay, Asia Publishing House.

24. Tripati, P. C. 1989 — Personnel Management and Industrial Relations, New Delhi, S. Chand and Sons,.

25. Tyagi, B. P. 1976 — Labour Economics and Social Welfare, Meerut, Jai Prakash Nath & Co.

26. Vaid, K. N. 1970 — Labour Welfare in India, New Delhi, Sri Ram Centre for Industrial Relations.

27. Yoder, D. 1972 — Personnel Management an Industrial Relations, New York, Prentice-Hall India.

Odd semester

Paper code: SWCSC-4

Paper Title: PREVENTIVE AND SOCIAL MEDICINE AND MEDICAL SOCIAL WORK

INTRODUCTION

This course introduces the basic health issues and the application of social work in health setting both in hospital and community.

OBJECTIVES

a. Understand the concept and dimensions of health.
b. Understand the issues related to the prevention, clinical features and treatment of major communicable and non-communicable diseases.
c. Trace the historical development of medical social work in India and abroad.
d. Understand the nature of medical social work services.
e. Understand the tenets of National Health Policy of India and modernization of community based health care services. .
f. Understand the health care services at different levels.

COURSE CONTENT

UNIT I

Concept of health : Physical, social, mental and spiritual dimensions of health - Positive health - Determinants of health - Health and development - Indicators of health. Concept of Prevention: Levels of prevention - Hygiene, public health, preventive medicine, community health, social medicine, community medicine.
Health Care of the Community; Concept of health care - Levels and principles of health care.

UNIT II

Communicable and Non-communicable Diseases: Leprosy, Tuberculosis, Sexually Transmitted Diseases (STDs), HIV/AIDS. Cancer, Hypertension, Accidents, Diabetes, Blindness, Neurological problems, Mental illnesses.
Maternal and Child Health Services - Immunization – Integrated Child Development Services (ICDS) Scheme - School health programmes.

UNIT III

Medical Social Work: Meaning, Definition and Scope - Historical background and nature: Medical Social Work in India and Abroad - Team work and Multidisciplinary approach in health care; Organization and administration of medical social work departments in hospitals.
Patient as a person and Role of Social Worker: Understanding the patient as a person; Illness behaviour and treatment behaviour of the patient - Impact of illness on the patient and family.

Role of social worker with patients and their families - Rehabilitation.

UNIT IV

National Health Policy of India, Directorate General of Health Services, Indian Council of Medical Research (ICMR), Health as a concurrent subject.

Health System in India - at the Centre, at the State level, at the district level, and village level. Health Education and Communication.
Voluntary Health Agencies in India - International health - World Health Organisation (WHO), UNICEF, UNDP, FAO, ILO, World Bank.

Non - governmental and other Agencies - Ford Foundation, CARE, International Red Cross, Indian Red Cross.

REFERENCES:

1. Bajpai, P. K. (Ed.) 1998	Social Work Perspectives on Health, Jaipur, Rawat Publications.
2. Brody, Elaine M. and Contributors. 1974	A Social Work Guide for Long-Term Care Facilities, U. S. Dept. of Health, Education and Welfare, Public Health Service, Maryland: National Institute of Mental Health.
3. Butrym, Zofia and Horder, John. 1983	Health, Doctors and Social Workers, London: Routledge and Kegan Paul.
4. Clark, D. W. and Medicine,MacMahon, B. (Ed.) 1981	Preventive and Community Boston. Little, Brown and Company,
5. Friedlander, W. A. 1967	Introduction to Social Welfare (Chapter 12: Social Work in Medical and Psychiatric Settings), New Delhi: Prentice-Hall of India.
6. Hilleboe, H. E. and Larimore, G.W.1966	Preventive Medicine, Philadelphia, W. B. Saunders Company.
7. Humble, Stephen and Unell Judith (Ed.) 1989	Self Help in Health and Social Welfare, London: Routledge.
8. Jordan, William. 1972	The Social Worker in Family Situations, London: Routledge and Kegan Paul.
9. Lathem, W. and Newbery, A. 1970	Community Medicine - Teaching, Research and Health Care, London, Butterworths.
10. Mathur,J. S. 1971	Introduction to Social and Preventive

Medicine, New Delhi, Oxford and LB.H. Publishing Company,

11. Mechanic, David 1968 — Medical Sociology- A Selective View, New York, Free Press.

12. Mishne, Judith (Ed.) 1980 — Psychotherapy and Training in Clinical Social Work, New York: Gardner Press.

13. Nichols, P. J. R. (Ed.) 1980 — Rehabilitation Medicine, London: Butterworths.

14. Park, K. 2002 — Park's Textbook of Preventive and Social Medicine, Jabalpur, Banarsidas Bhanot.

15. Pathak, S. H. 1968 — Medical Social Work, Chapter.25, In Wadia, A R (Ed.) : History and Philosophy of Social Work in India, Bombay: Allied Publishers.

16. Ramachandrudu, G. 1997 — Health Planning in India,' New Delhi, A. P. H. Publishing Corporation.

17. Rusk, Howard A. 1977 — Rehabilitation Medicine, Saint Louis: Mosby Company.

18. UNICEF — Health and Basic Services, New Delhi, UNICEF South Central Asia Regional Office.

Paper code: SWDHC-14
Paper Title: MENTAL HEALTH AND PSYCHIATRIC SOCIAL WORK

INTRODUCTION

This course is to provide awareness about mental health and mental health problems and also application of social work in mental health settings.

OBJECTIVES

a. Understand the concepts 'mental health' and 'mental illness'.
b. Understand the signs and symptoms, etiology, diagnosis and treatment of
mental health problems.
c. Understand different services for the care of mentally ill.
d. Understand historical background of psychiatric social work in India and
abroad.Understand the nature of psychiatric social work services and relevance of team work.
e. Understand the nature of collaboration with voluntary organisations for the
welfare of mentally ill.
f. Identify the issues related to psychiatric social work department in hospitals
and community mental health settings.

Course Content

UNIT I

Concept of mental health and mental illness - Mental health as a part of general health - Misconceptions about mental illnesses. General approaches to the mentally ill - International Classification of Mental Disorders.
Signs, symptoms, etiology, diagnosis, prognosis and management of the following:

- Neuroses
- Psychoses
- Psycho physiologic disorders
- Personality disorders
- Psychiatric disturbances in children and adolescents
- Organic psychotic conditions
- Mental retardation.

UNIT II

Introduction to Psychiatric Social Work: Meaning and Scope - Historical background of psychiatric social work in India and abroad - Reasons for its development as a specialty. Application of social work methods and other related techniques used in the field - Multi-disciplinary approach and team work in mental health care - Problems of hospitalization - Impact of mental illness on the patient, family and community.

Practice of Social Work: Importance of home visit and visit to the place of work - Role of family in the treatment of mentally ill - Preparing the family and community for the return of the affected individual, follow-up.

UNIT III

Care of mentally ill: Day-care centre, night-care centre, half-way-home, sheltered workshop, Occupational therapy units - Role of social worker and role of voluntary organisations.
Role of voluntary organisations, governmental-agencies and paraprofessionals in the welfare of mentally ill.

Role of social worker in mental health centers, departments of psychiatry in general hospitals, child guidance clinics, community mental health units, correctional institutions, industries, and family welfare centres.

Role of social worker with head injured, paraplegics and epileptics.

Role of social worker in the management of substance abuse – Educational avenues in psychiatric social work - Research avenue in the field of mental health for social workers.

UNIT IV

Organisation of psychiatric social work department - Functions; and collaboration with other departments.

Community mental health and social work, NMHP, Innovations like Satellite clinics, district mental health programme etc.

Rehabilitation and Acts: Occupational therapy - Principles and practice - Psychosocial rehabilitation.

Mental Health Act, 1987.

The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995.

REFERENCES

1. Ahuja, Niraj 1995 — A Short Textbook of Psychiatry, Third Edition, New Delhi, Jaypee Brothers.

2. Anderson, David. 1982 — Social Work with. Mental Handicap, London, Macmillan Press Ltd.

3. Banerjee, G. R. 1968 — Psychiatric Social Work, Chapter 26, In. Wadia, A. R. (Ed.): History and Philosophy of Social Work in India, Bombay: Allied Publishers.

4. Brody, Elaine M. and Contributors 1974 — A Social Work Guide for Long-term care Facilities, U. S. Department of Health, Education and Welfare, Public Health Service, Maryland: National Institute of Mental Health.

5. Coleman, J. C. 1976 — Abnormal Psychology and Modern Life, Bombay, D. B. Taraporevala and Sons.

6. Dickerson, Martha Ufford. 1981 — Social Work Practice with the Mentally Retarded, New York: Free Press.

7. Freedman, A. M. and Kaplan, H. I. (Eds.) 1967 — Comprehensive Textbook of Psychiatry, Baltimore, Williams and Wilkins Company.

8. French, Lois Meredity. 1940 — Psychiatric Social Work, New York; The Commonwealth Fund.

9. Friedlander, W. A. 1967 — Introduction to Social Welfare, (Chapter 12: Social Work in Medical and Psychiatric Settings), New Delhi: Prentice-Hall of India.

10. Feldman Robert S 1997 — Understanding Psychology, 4th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi

11. Golan, Naomi. 1978 — Treatment in Crisis Situations, New York: Free Press.

12. Henderson, Sir David and Batchelor, I. R. C. 1962 — Textbook of Psychiatry, New York Oxford University Press.

13. Hudson, Barbara L. 1982 — Social Work with Psychiatric Patients, London: Macmillan.

14. Humble, Stephen and Unell, Judith (Ed.) 1989 — Self Help in Health and Social Welfare, London: Routledge.

15. Jones, Kathleen. 1972 — A History of the Mental Health Services, London: Routledge and Kegan Paul.

16. Jordan, William. 1972 — The Social Worker in Family Situations, London: Routledge and Kegan Paul.

17. Maller, Joshua-o. 1971 — The Therapeutic Community with Chronic Mental Patients, S. Karger.

18. Mishne, Judith (Ed.) 1980 — Psychotherapy and Training in Clinical Social Work, New York: Gardner Press.

19. Page, J. D. 1983 — Abnormal Psychology, New York, McGraw-Hill.

20. Robbins, Arthur J. 1957 — Mental Hospitals in India and Social Work Service, Delhi School of Social Work.

21. Strean, Herbert S. 1979 — Psychoanalytic Theory and Social Work Practice, New York: Free Press.

22. Stroup, H. H. 1960 — Social Work - An Introduction to the Field, (Chapter 9: Psychiatric Social Work), New Delhi: Eurasia Publishing House.

23. Todd,F.Joan.1967 — Social Work with the Mentally Subnormal, New York: Routledge and Kegan Paul.

24. Towle, Charlotte. 1941 — Social Case Records from Psychiatric Clinics with Discuss Notes, Chicago; Illinois: University of Chicago Press.

25. Yelloly, Margaret. 1980 — Social Work Theory and Psychoanalysis, New York: Van Nostrand Reinhold Company.

26. National Mental Health Programme for India

Paper code: SWDSC-6

Paper Title: HUMAN RESOURCE DEVELOPMENT AND EMPLOYEE WELLNESS

INTRODUCTION

The purpose of this course is to provide practical exposure and knowledge in behavioural science to develop skills not only to understand and analyse problems but also to develop a problem-solving approach to issues.

OBJECTIVES

a. To develop multi facets of the personality and to build self confidence.
b. To develop a spirit of continuous learning and innovation.
c. To strengthen the competency base of individuals, teams and organization and also femilar with the organizational culture.
d. Understand and further the organization culture.
e. To appreciate the importance of bottom-line focus to the Human Resource
function and trend toward HR Accountability.
f. To understand the various approaches to and techniques of measuring HR issues.
g. To create awareness of different types of information systems in an organization so as to enable the use of computer resources efficiently, for effective decision- making.

Course Content

UNIT I

Human Resource Development (HRD): Concept, origin and needs for HRD; Overview of HRD as a Total system; Approaches to HRD; human capital approach; social psychology approach and poverty alleviation approach; HRD and its dimensions, Competency Mapping.

UNIT II

HRD Interventions: Performance Measurement Systems – Fundamental issues. Feedback sessions. Organizational goal setting process, Key Result Area (KRA) and Key Performance Indicator (KPI),Coaching, Mentoring, career planning, career development, reward system, quality of work life. HRIS: - Computers and computer based Information Systems. Measuring HR : Changing role of HR, HR as a strategic partner, the need for measuring HR. Approaches to measuring HR: - Competitive Benchmarking, HR Accounting, HR Auditing, HR Effectiveness Index, HR Key Indicators, HR MBO (Management by Objectives).

Instructional Technology: Learning and HRD; Building Learning Organization: measuring learning – the intellectual capital, architecting a learning organization, Organizational Learning, models and curriculum; factors and principles of learning; group and individual learning; HRD trends; behavioural sciences; transactional analysis; Concepts of continuous learning, behavior modeling and self-directed learning; evaluating the HRD effort; data gathering; analysis and feedback; HRD experience in Indian organizations; future of HRD - Organization culture and development.

UNIT III

Talent Development: Concept and importance; Training Need Analysis, process of training, designing and evaluating training and development programs. Use of information technology, Types and Methods of Training: Training within industry (TWI), External; on the job and off the job; Training methods; lecture, incident process, role play, structured and unstructured discussion, in-basket exercise, simulation, vestibule, training, management games, case study, programmed instruction, team development, and sensitivity training; review of training programs.

UNIT IV

Employee Wellness: Concept, philosophy, principles and scope; Importance and relevance of wellness programs, Role of Welfare Officer as per the Factories Act 1948. Relevance - with reference to Accidents, Absenteeism, Alcoholism, Domestic Violence: Preventive and remedial measures.

Employee Counseling. Role of Counselor in Organizations. Corporate Social Responsibility (CSR): CSR as a business strategy.

Environmental management systems ISO 14001, ISO 26000: Social responsibility guidance standard, environmental impact assessment.

REFERENCES

1. Bhattacharyya, Dipak Kumar.1999 — Managing People, New Delhi, Excel Books.

2. Business Today — Managing People: The Business Today, ExperientialGuide to Managing Workforce 2000, January 7-21, 1996.

3. Cowling, Alan and James Philip — The Essence of Personnel Management and Industrial Relations, New Delhi, Pentice-Hall of India Pvt., Ltd.

4. Davis, Keith. 1983 — Human Behaviour at Work, New Delhi: Tata McGraw-Hill

5. Fisher, Cynthia; Schoenfeldt, Lyle F. and Shaw, James, B. 1997 — Human Resource Management, Third Edition, Boston, Houghton Mifflin Company.

6. Jayagopal, R. 1990 — Human Resource Development: Conceptual Analysis and Strategies, New Delhi: Sterling Publishers Pvt. Ltd.

7. Moorthy, M. V. 1982 — Priciples of Labour Welfare, New Delhi, Oxford & IBH.

8. Moorthy, M. V. 1992 — Human Resource Management Psycho-Sociological Social Work Approach, Bangalore, R & M Associates.

9. Norman, M. 1960 — Psychology in Industry, London, Harrap & Company.

10. Prasad, L. M. 1996 — Organisational Behaviour, New Delhi, S.Chand & Co.

11. Rao, T. V. 1990 — HRD Missionary, New Delhi. Oxford & IBH.

12. Rao, T. V. 1991 — Reading in Human Resource Development, New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd

13. Rudrabasavaraj, M. N. 1984 — Human Factors in Administration, Bombay: Himalaya Publishing House.

14. Sahni, P. and Sharma, K. K. 1988 — Organisational Behaviour, New Delhi: Deep and Deep Publications.

15. Singh M. K. and Bhattacharya (Eds.) 1990 — Personnel Management, New Delhi : Discovery Publishing House.

16. Vroom, V. H. and Grant, L. 1969 — Organisational Behaviour and Human Performance, New York. Wiley.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
OOTY ROAD, MYSURU
PG DEPARTMENT OF ZOOLOGY
Syllabus from the academic year 2018-19

Semester	HC / SC	Paper title	CREDITS			Total Credits
			L	T	P	
I	HC - 1.1	Biosystematics & Non Chordata	2	0	2	**4**
	HC - 1.2	Biological Chemistry	2	0	2	**4**
	HC - 1.3	Cytogenetics	2	0	2	**4**
	SC - 1.4	Tools and techniques in Biology	3	1	0	**4**
	SC - 1.5	Chronobiology	3	1	0	**4**
	SC - 1.6	Histology and Histopathology	3	0	1	**4**
	Any two of the Soft core paper may be opted					**20**
II	HC - 2.1	Chordata	2	0	2	**4**
	HC - 2.2	Animal Physiology	2	0	2	**4**
	HC - 2.3	Entomology	2	0	2	**4**
	SC - 2.4	Developmental Biology	3	0	1	**4**
	SC - 2.5	Immunology	3	1	0	**4**
	SC - 2.6	Evolutionary Biology	3	1	0	**4**
	Any two of the Soft core paper may be opted					**20**
III	HC - 3.1	Molecular Biology & Biotechnology	2	0	2	**4**
	HC - 3.2	Reproductive Biology	2	0	2	**4**
	HC - 3.3	Ecology and Wildlife**	2	0	2	**4**
	SC - 3.4	Ethology *	3	1	0	**4**
	SC - 3.5	Pollution and Toxicology *	3	1	0	**4**
	OE - 3.6	concepts of Zoology	3	1	0	**4**
	Any one of the Soft core paper may be opted** * Field visits are included in this paper**					**20**
IV	HC - 4.1	Advanced Genetics and Computational Biology	2	0	2	4
	HC - 4.2	Applied Zoology*	2	0	2	4
	HC - 4.3	Project	0	2	6	**8**
	*** Field visits are included in this paper**					**16**

Total credits

Hard Core - 52 Credits

Soft Core - 20 Credits

Open Elective - 04 Credits

Total credits required to complete M.Sc Course - 76 Credits

M.Sc, I SEMESTER
HC 1.1 Biosystematics & Non Chordata

32hrs

UNIT I Basic concepts of animal taxonomy: **8 hrs**

A. Introduction and history of taxonomy
B. Species concept
C. Zoological classification - theories of classification - taxonomic ranks – hierarchy
D. Zoological nomenclature: Binomial nomenclature, trinomial nomenclature-ICZN
E. taxonomical keys: key to the species
F. Linnaean taxonomy and classical taxonomy - level of taxonomy.

Unit II : Classification, Locomotion and Nutrition: **8 hrs**

A. General Characteristics of Non chordata.
B. **Locomotion**: Muscle filaments and myonemes,
Flagella and cilia. Amoeboid movement.
C. **Nutrition in Protozoa:** Filter feeding in polychaetes, Filter feeding
and digestion in Deuterostomia and molluscs.
D. **Respiration:**
Structure and function of respiratory organs- Skin, gills, book lungs and
Trachea. Respiratory pigments

Unit III: **8 hrs**

A. **Excretion and osmoregulation:**
Osmoregulation in fresh water and marine Invertebrates
Structure and function of excretory organs- Coelom, Coelomoducts, Nephridia,
Maliphigian tubules and Coxal glands
B. **Nervous system:**
Primitive nervous system: Coelenterata and Echinodermata
Advanced nervous system: Annelida, Arthropoda(Crustacea and insecta) and
Mollusca (Cephalopod)
C. Sense organs and their importance

Unit IV: **8 hrs**

A. **Invertebrate paleontology and larval forms:**
Free living and parasitic Larval forms
B. **Fossil**: types and importance of fossil study, overview of Geological Time Scale

NON CHORDATA –PRACTICALS **4x16=64 Hrs**

1. PROTOZOA; **4x12=48 hrs**

Slides : 1) *Trypanosoma cruzi* 2) Plasmodium – signet ring stage 3) Ceratium 4)*Leishmania donovani* 5) Vorticella 6) Noctiluca 7) Radiolaria 8*) Entamoeba histolytica* 9) Foraminifera 10) Opalina

2. PORIFERA;

a) Slides: 1)Sponge spicules 2)Sponge gemmules

b) Specimen: 1) Grantia 2) Euspongia

3. CNIDARIA:

a) Slides: 1) Obelia polyp and Medusa 2) Pennaria 3) Aurelia-tentaculocyst

b) Specimens: 1) Physalia 2) Gorgonia 3) Spongodus 4) Zoanthus 5) Favia 6) Pennatula 7)Sea anemone 8) *Corallium rubrum*

4. HELMINTHES:

a) Slides: 1) *Fasciola hepatica* 2) *Ancylostoma*

b) Specimens: 1) Planaria 2) Male and female *Ascaris lumbricodes* 3) *Taenia solium* 4)

5. ANNELIDA:

a) Slides: 1) Leech 2) Earthworm setae

b) Specimens: 1)Neries 2) *Chloea flava* 3) *Pheretima postuma* 4) Terebella 5) Eurythoe

6. ARTHROPODA:

a) Slides: 1) Daphnia 2) Sacculina 3) T.S of Peripatus

b) Specimens: 1) Balanus 2) Lepas 3) Palinurus 4) Scolopendra 5) Rhinocerous beetle 6)Spider 7) Gongylus 8) Belostoma 9) Limulus 10) Squilla 11) Eupagarus 12) Julus

7. MOLLUSCA :

Specimens: 1) Aplysia 2) Glochidium 3) Loligo 4) Chiton 5) Cypreae 6) Octopus 7)Sanguinolaria 8) Chicoreus 9) Ficus 10) Lambis 11) Mytillus 12) Doris 13) Onchidium 14) Oliva 15) Murex 16) Turritella 17) Cardium

8. ECHINODERMATA:

Specimens: 1) Sea Urchin 2) Linckia 3) Echinodiscus 4) Holothuria 5) Antedon

9. MINOR PHYLA: —1) Lingula

10. LARVAL FORMS:

Slides: 1) Cercaria 2) Trochophore 3) Megalopa larva 4) Nauplius 5) Zoea 6) Mysis

7) Phyllosoma 8) Protozoea 9) Bipinnaria 10) Veliger 11) Tornaria

12) Glochidium 13) Pluteus

11. Field Study: Visit to different areas around the college campus, to observe and study Non chordates in their natural habitat. **4x2=8 hrs**

II. Study of Nervous system, Respiratory system, Reproductive system and Excretory system in invertebrates by employing computer animation/charts: **4x2=8 hrs**

REFERENCES :

1. Barnes, R.D.1974. Invertebrate Zoology, III edition. W.B Saunders Co., Philadelphia
2. Barrington, E.J.W, 1976. Invertebrate Structure and Function. Thomas Nelson and Sons Ltd.,London.
3. Hyman L,H. 1940. The invertebrates. Vol. 1. Protozoa through Ctenophora, McGraw hill Co.,N.Y.
4. Hyman. L H. 1959. The Invertebrates smaller coelomate groups, Vol. V. McGraw Hill Co.,
5. Hyman. L. H. 1951. The Invertebrates. Vol. 2. McGraw Hill Co., N.Y.
6. Hyman. L H. 1968. The invertebrates Vol. 8. McGraw Hill Co., N.Y and London.
7. Simpson, G C. Principles of Taxonomy.

M.Sc, I SEMESTER
HC -1.2 BIOLOGICAL CHEMISTRY

32 hrs

UNIT I Chemical Bonds and Carbohydrates: 8 Hrs

A. Structure of an atom, orbitals, chemical bonds - covalent, co-ordinate, ionic and hydrogen; Vander-Waal's force; hydrophobic interactions; Normality and Molarity of solutions.

B. Carbohydrates – Chemistry and biological properties

UNIT II Proteins and Lipids: 8 Hrs

A. Proteins- Chemistry and biological properties, Christian Anfinsen's experiment, Biological values of proteins

B. Lipids: Chemistry, triglycerides; prostaglandins and steroids –biosynthesis, Chemical importance of lipids.

UNIT III Enzymes: 8 Hrs

A. Enzymes: Nomenclature – current status; factors influencing velocity of enzyme reaction, enzyme dynamics and enzyme inhibition.
Ribozymes and abzymes; co-enzymes, isozymes, clinical importance.

UNIT IV Nucleic acids & Vitamins: 8 Hrs

A. Nucleic acids: Chemistry, alternative models of DNA,

B. Vitamins and trace elements – chemical nature, vitamins as co-enzymes, Deficiency diseases, role of trace elements

Biological Chemistry practicals 4x16=64 Hrs

1. Qualitative analysis for identification of carbohydrates (Starch, Glycogen, Sucrose, Lactose, Maltose, Glucose, Fructose).
2. Qualitative analysis for identification of Proteins (Egg albumin, Casein, Gelatin, Peptone)
3. Precipitation reaction of proteins (Egg albumin, Peptone)
4. The absorbance curves for two dyes and demonstration of Beer-Lambert's law.
5. Estimation of amino acids by Sorenson's formal titration (Arginine, Alanine, Leucine, lysine)
6. Determination of concentration of Glucose and Maltose by calibration curve.
7. Determination of amylase activity.
8. Determination of effect of temperature, pH and incubation period on amylase activity.
9. Test for non-esterified fatty acid.
10. Demonstration of gel electrophoresis.

REFERENCES

1. Barrington, E. J. W (1976) An introduction to general and comparative endocrinology, Oxford University press, London.
2. Conn, E. E., Stumpt, P. K., Bruencing, G. and Dol, R. G. 1995. Outlines of Biochemistry. Pub. John Wiley, Singapore.
3. Eckert, R and Randall, D. 2002, Animal physiology, 2nd Edn, W.H..Freman
4. Guyton. A.G. 1986, Text book of Medical Physiology, 7th Edn., Saunders Publication
5. Harper, H. A. 1993. A review of Physiological Chemistry, Lange Medical Publication, 2nd Edn.
6. Lehninger, A. L., Nelson, D. L. and Cox, M. M., 2nd Edn. 1993. Principles of Biochemistry,CBS Publishers and Distributors, New Delhi.
7. Oser, B. L. (Ed.) 1993. Hawk's Physiological Chemistry. Tata Graw Hill Publishing Co. Ltd.New Delhi.

M.Sc., I SEMESTER
HC – 1.3 CYTOGENETICS

32 Hrs

Unit I: Introduction to the Cell & Cell Organelles **8 hrs**

A. The origin and evolution of the cell, From molecules to first cell, from Prokaryotes to eukaryotes, from single cell to multicellular organisms.
B. Membrane Structure and Function,
C. Structural organization and functions of intracellular organelles- The nucleus, Mitochondria, Lysosomes, Peroxisomes, Golgi apparatus, and endoplasmic reticulum.

Unit II: Cell Cycle and Cell signalling **8 Hrs**

A. Phases of cell cycle.
B. Biochemical studies with oocytes, eggs and early embryos.
C. Regulation of cell cycle: Molecular mechanisms regulating mitotic events.
   Regulation of cell cycle progression.
   Check points in cell cycle regulation.
   Cell cycle control in polytene cells.
D. Molecular basis of signal transduction
E. Cellular aging and death: (a)Causes of aging
   (b)Cellular changes due to aging
   (c)Theories of aging
   (d) Apoptosis
   (e) Longivity genes

UNIT III Gene mutations **8 Hrs**

A. Types of mutations (Spontaneous, Induced, Base substitutions and frameshifts - Transitions, Transversions, gain in function, loss in function, Neutral mutations),
B. Molecular mechanism of mutations (Base analogs, alkylating agents); Detection of mutations: Dominant lethal test, Sex-linked recessive lethal test, II-III translocations, Ames test, P-mediated mutagenesis

UNIT IV Chrmosomal mutations **8 Hrs**

A. Structure and organization of eukaryotic chromosomes
B. Structural and numerical variations of chromosomes, Chromosomal rearrangements and their cytogenetic consequences with examples from plants, Drosophila and Man, Practical applications of chromosome rearrangements - Balancers and attached X-chromosome in Drosophila. Cytogenetic effects of ionizing and nonionizing radiations

CYTOGENETICS PRACTICALS **4X16 =64 Hrs**

1) Life cycle of *Drosophila melanogaster* 1x4=04hrs
2) Preparation of culture media. Culture of Drosophila - Methods of maintenance. 1x4=04hrs
3) Study of morphology of *Drosophila melanogaster* 1x4=04hrs
4) Mounting of Sex comb of *Drosophila melanogaster* 1x4=04hrs
5) Mounting of Wing of *Drosophila melanogaster* 1x4=04hrs
6) Study of mutants of *D. melanogaster* 1x4=04hrs
7) Preparation of genital plate of *D. melanogaster* 2x4=08hrs
8) Chi square Analysis of F1, F2 and Test cross progeny in *Drosophila melanogaster* to understand pattern of inheritance of different characters and to demonstrate. 3x4=12hrs
   a) Law of segregation
   b) Law of Independent assortment
   c) Sex-linked inheritance

9) Temporary squash preparation of Mitotic chromosomes from root tip meristem of *Allium cepa*
2x4=08hrs

10) Temporary squash preparation of Meiotic chromosomes from testis of *Poicelocerus pictus*
2x4=08hrs

11) Study of Barr body using buccal smear of volunteers 1x4=04hrs

REFERENCES:

1. Alberts, B., A. Jhonson, J. Lewis, M. Raff, K. Roberts and P. Walter 2008. Molecular Biology of the cell. V Ed. Garland Science, New York.
2. Brachet, J. 1985. Molecular Cytology, Academic Press, N. Y.
3. Furukawa, R., and M. Fechheimer. 1997. The structure, function and assembly of actin filament bundles. Int. Rev. Cytol. 175: 29-90.
4. Lewin B. (1997) Gene VI Oxford University Press, Oxford
5. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. 2008. Sixth Edition, Molecular Cell Biology. W. H. Freeman and Co., N. Y.
6. Pollard, T. D. and W. C. Earnshaw. 2002. Cell Biology. Saunders
7. Russel P.J (1998) Genetics. The Benjamin Cummings Publishing Co Inc.
8. Snustad D.P and M.J.Simons. (1997) Principles of Genetics. John Wiley and Sons Inc. N.Y.
9. Strickberger M.W. (1977) Genetics. MacMillan Collier Co. Pvt Ltd
10. Watson J.D, Hopkins, N.H, Roberts J.A, Steitz and A.M.Weiner. (1987) Molecular biology of gene. The Benjamin Cummings Publishing Co Inc.
11. Wolfe, A. 1995. Chromatin: Structure and function. Academic Press, N. Y.

****

M.Sc., I SEMESTER

SC – 1.4 TOOLS AND TECHNIQUES OF BIOLOGY

48 hrs

UNIT I: MICROSCOPY: 12hrs

Basic principles of microscopy, Types of microscopes and their biological applications Bright-field microscope, numerical aperture, limit of resolution, types of objectives, ocular & stage micrometers, Electron Microscope, SEM, Confocal microscope.

Dark-field microscope

Phase-contrast microscope

Differential interference contrast microscope

Fluorescence microscope

Photomicrography and image processing

UNIT II: SEPARATION TECHNIQUES: 12hrs

Centrifugation - Basic principles, Types of rotors, Clinical, high speed & ultracentrifuge

Electrophoresis – Agarose and polyacrylamide gel, Two-dimensional, Isoelectrofocussing

Chromatography - Paper and Thin layer chromatography, Column chromatography, Gel filtration, Ion-exchange, Affinity, Introduction to FPLC and HPLC

UNIT III: 12hrs

A. Radio-tracer techniques

Unit of radioactivity and half life, Measurement of radioactivity (β and γ emission), Applications of radioisotopes, Safety measures

B. Techniques in immunodetection: Immunoblotting and immunofluorescence

C. Immunological techniques: Immunodiffusion and Imunoelectrophoresis

UNIT IV: 12hrs

A. Cell culture techniques: Design and functioning of tissue culture laboratory; Culture media, essential components and preparation; Cell viability testing

B. Cytological techniques: Mitotic & Meiotic chromosome preparations from insects and vertebrates Chromosome banding techniques (G-, C-, Q-, R- banding etc.)

C. Molecular cytological techniques: In situ hybridization (radiolabelled & non-radiolabelled methods), FISH, and Restriction banding

D. Molecular biology techniques: Southern hybridization and Northern hybridization DNA sequencing Polymerase chain reaction (PCR)

TUTORIALS 2x16 = 32 Hrs

REFERENCES

1. Alberts et al: Molecular Biology of the Cell, Garland, 2002
2. Karp: Cell and Molecular Biology, John Wiley & Sons, 2002
3. Lodish et al: Molecular Cell Biology, Freeman, 2000
4. Pollard & Earnshaw: Cell Biology, Saunders, 2002
5. Ruthman: Methods in Cell Research, Bell & Sons, 1970.
6. Boyer: Modern Experimental Biochemistry and Molecular biology (2nd Ed.), Benjamin/Cumin, 1993
7. Freifelder: Physical Biochemistry (2nd Ed.), Freeman, 1982
8. Holme and Peck: Analytical Biochemistry (3rd Ed.), Tata McGraw Hill, 1998
9. Plumer: An Introduction to Practical Biochemistry (3rd Ed.), Tata-McGraw Hill, 1990
10. Switzer and Garrity: Experimental Biochemistry 92nd Ed.), Freeman, 1999
11. Wilson and Walker: Practical Biochemistry (3rd Ed.), Cambridge Univ. Press, 2000

*****

M.Sc., I SEMESTER
SC – 1.5 CHRONOBIOLOGY

48 hrs

UNIT I: Introduction: **4 hrs**

History, Biological rhythms, Biological clocks, Significance of biological timekeeping

UNIT II: Biological rhythms: 10 hrs

A. Types of rhythms- Circadian, Circatidal,Circalunar, Circannual
B. Methods of measurement
C. Properties: Entrainment, Re-entrainment, Phase angle difference, Freerun, Phase shift, Phase response curve, Arrhythmia.

UNIT III: Factors influencing biological rhythms: 10 hrs

A. Environmental: Photoperiod -Photoreception and photo-transduction;
The physiological clock and measurement of day length;
Role of photic and non-photic cues in seasonality,Other zeitgebers
Reversal of roles of principal and supplementary cues.
B. Evolution of photoperiodism: comparative studies; Circannual rhythms and seasonality.

UNIT III: Circadian pacemaker system: 8 hrs

A. Suprachiasmatic nuclei, B. Pineal gland, C. Optic lobes.

UNIT IV: Molecular basis of circadian rhythms 8 hrs

A. Clock genes, B. Drosophila, C. Mouse

UNIT V: Applied Chronobiology: 8 hrs

A. Human circadian rhythms: Melatonin: Input or output signal of the clock system, Clock function (dysfunction); Human health and diseases
B. Applications of circadian rhythm principles: Jet-lag/shift work, Depression and sleep disorders, Chronopharmacology and Chronotherapy

TUTORIALS 2X16=32 Hrs

References

1. Binkley, S. (1990): The clockwork sparrow: time, clocks, and calendars in biological organisms, Prentice-Hall, New Jersey.
2. Chandrashekaran, M. K. (1985): Biological rhythms, Madras Science Foundation, Chennai.
3. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004: Chronobiology Biological Timekeeping, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
4. Nelson, R. J. (2000) An Introduction to Behavioural Endocrinology, 2nd edition, Sunderland Publishers, Massachusetts.
5. Saunders D.S., C.G.H. Steel, X., afopoulou (ed.)R.D. Lewis. (3rd Ed) 2002: Insect Clocks, Barens and Noble Inc. New York, USA
6. Shapiro, C. M. and Heslegrave, R. J. (1996): Making the shift work, Joli Joco Publications, Inc. Toronto.
7. Vinod Kumar (ed 2002) : Biological Rhythms Narosa Publishing House, Delhi/ Springer-Verlag, Germany

******

M.Sc., I SEMESTER
SC – 1.6 HISTOLOGY AND HISTOPATHOLOGY

48 Hrs

UNIT – I Basics of Histology **8Hrs**

A. Objectives and applications
B. Tissue fixation : Objectives, methods, chemical fixatives-types and chemistry of fixation; Physical methods-:freezing and microwave fixation; choice of fixatives, fixation artifacts.
C. Dyes. –Natural and Synthetic, Classification

UNIT-II Functional Morphology (mammalian) **8 Hrs**

A. Histological organization of GI tract- stomach and intestine,
B. Histological organization of lungs & kidney
C. Histological organization of spleen & thymus,
D. Bone and bone marrow.

Unit-III Histochemistry **8 Hrs**

A. Principles and methods of application
B. Classical histochemical Techniques: for localization of glycoproteins (PAS), nucleic acids (Feulgen) and steroid dehydrogenase activity.

Unit-IV Immunohistochemistry **8 Hrs**

A. Principles, method of application
B. Imunohistochemistry techniques for localization of proteins in endocrine cells (Pituitary cell types or islet of Langherhans)
C. Immunofluorescence: In situ hybridization of nucleic acids

UNIT-V Histopathology **8 Hrs**

A. Morphological alterations in cells due to disease,
B. Types of degeneration: clouding, hyaline, hydrophic and fatty degeneration.
C. Etiology, pathogenesis and histopathology of Liver cirrhosis and atheroscelerosis
D. Neuropathology of alcoholism and methanol poisioning.

Unit-VI Histopathology of tumors **8 Hrs**

A. Malignant and non-malignant
B. Types of carcinoma
C. histopathology of breast and prostate tumors

PRACTICALS **2x8= 16 Hrs**

I. Histology:

1. Microtomy and staining: Hematoxylin-eosin - Demonstration 2x2=4 hrs
2. Histology: 2x2=4 hrs

Observations of permanent slides of mammalian organs – stomach, intestine, spleen, liver, kidney, lungs, testis, epididymis, vas deferens, ventral prostate, seminal vesicle, ovary, uterus and Fallopian tube.

II. Histometry: **2x3=6hrs**

Histometrical measurements and statistical analysis of some tissues.

III. Histopathology: **2x1=2hrs**

Study of histopathological changes (permanent slides) – gastric ulcers, cirrhosis of liver, breast tumors, cystic follicles of ovary, pancreas in diabetics, cryptorchid testis and leukemia.

REFERENCES:

1. Boyd,W. 1976:A text book of Pathology. Structure and function in disease, 4th edition. Lea and Fibiger, Philadephia.
2. Pearse, A.G.E. (1980): Histochemistry, theoretical and Applied ,J & A, Churchill Ltd., London.
3. Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.
4. Telford, I.R. and Bridgman,C.F.(1990). Introduction to Functional Histology, Harper and Row, NY.

******

M.Sc., II SEMESTER
HC – 2.1 CHORDATA

32 Hrs

UNIT I General characters and outline classification of Chordata **8hrs**

A. General and Comparative study: Comparision of three Protochordates, Subphyla in terms of General comparision, Habits and habitats,
B. Alimentary canals and associated glands, Pharynx, Food and feeding and excretory system in Protochordates.
C. Adaptive radiation in vertebrates – fishes, amphibians, reptiles, aves and mammals

UNIT II **8hrs**

A. **Integument and its Derivatives**: Epidermal Integument or Skin Functions, Structure & its Derivatives (Glands, Scales and scutes, digital cornifications, horns, feathers, hairs), Integument in different classes of Chordates.
B. **Nervous system**- Development of Brain, spinal cord, Peripheral nerves and sense organs

UNIT III **8hrs**

A. **Respiratory System**: Introduction Respiratory organs: Gills (Internal or true gills, External or Larval gills). Lungs and Ducts, Accessory Respiratory organs and Swim Bladders.
B. **Circulatory system:** Evolution of heart and aortic arches

UNIT IV **8hrs**

A. **Digestive System:** Introduction Embryonic Digestive Tract
Alimentary Canal: Divisions, Digestive Glands
B. **Urinogenital System:** Vertebrate kidneys and ducts, Gonads and their ducts

CHORDATA PRACTICALS **4x16=64 Hrs**

1. **Protochordates**: Specimens:1)Amphioxus , Herdmania

Slides- Salpa (sexual), Doliolum

2. **Fishes** : 1) *Rhinobatus* 2) *Hippocampus* 3) Goldfish (aquarium fish) 4) *Clarius*

5) *Anabas* 6) Coffer fish 7) *Acipenser* 8) *Periopthalmus* 9) *Triacanthus*

10) *Notopterus* 11) *Exocoetus* 12) *Diodon hysterix* 13) *Echenenis neucrates*

3. **Amphibians** : 1) Ichthyophis 2) Axolotl Larva 3) *Rana tigrina* 4) *Amblystoma*

4. **Reptiles** : 1) *Calotes* 2) *Mabuya* 3) Chameleon 4) *Phrynosoma* 5) *Chelone mydas*

5) Varanus 6)*Naja naja* 7) Krait 8) Hydrophis 9)Viper

5. **Birds** : 1) Blue jay 2) Indian koel -male and female 3) Kite

6. **Mammals** : 1) Guinea pig 2)Domestic cat 3) Loris 4) *Megaloderma lyra* (bat)

5) Pangolin

7. **Integuments of vertebrates**: Scales of fish, Hoofs, nails, horns, claws,

plastron and carapace of tortoise, snout of saw fish

8. **Osteology :**

1) **Skull and lower jaw**:- a) Crocodile b) Bird c) Carnivore mammal (dog) d) Herbivore mammal (horse)

2) **Types of vertebrae**:- a) Procoelous b) Ophisthocoelous c) Amphicoelous d) Amphiplatian e) Heterocoelous f) Axis and atlas vertebrae.

II. Study of following systems in rat by employing computer animation/charts:

a) Circulatory system b) Nervous system c) Reproductive system
d) Digestive system e) Sense organs f) Urinary system

REFERENCES :

1. Alexander, R. M. 1975. The Chordata. Canbridge University Press, London.
2. Barrington, E.J.W. 1965. The Biology of Hemichordata and Protochordata, Oliver and Boyd, Edinbourgh.
3. Colbert, E. H, 1969. Evolution of the vertebrates, John Wiley and Sons, Inc., N.Y.
4. Kent, C. G. 1954. Comparative anatomy of vertebrates
5. Kingsley, J.S. 1962. Outlines of Comparative anatomy of vertebrates. Central book depot Allahabad.

M.SC., II SEMESTER
HC – 2.2 ANIMAL PHYSIOLOGY

32 Hrs

UNIT I: Membrane Transport, Bioenergetics & Circulation 8 Hrs

A. Membrane Transport:

Molecular mechanisms of passive and active transport.

B. Bioenergetics:

a) Energy – Concept, laws of thermodynamics
b) Redox potential
c) Stepwise release of energy through cytochromes, production of ATP, uncoupling of oxidative phosphorylation,inhibitors.
d) Anaerobic and aerobic breakdown of glucose, alternate pathway – HMP shunt and glucoronic acid pathway.
e) Citric acid cycle as common metabolic pathway.

C. Circulation:

a) Major types of body fluids and their composition.
b) Neurogenic and myogenic hearts.
c) Mammalian heart – cardiac cycle, ECG.

UNIT II: Physiology of excitation & Excretion 8 Hrs

A. Muscle Physiology:

a) Molecular organization of sarcomere.
b) Mechanism of contraction with emphasis on sliding filament and Davies models, regeneration of storage phosphate.
c) Physiological adaptations of muscles for jumping, swimming and flight.

B. Neurophysiology:

a) Axonal and synaptic transmission of nerve impulses.
b) Synaptic integrity, synaptic plasticity.
c) Molecular mechanism of sensory transduction and neural output in receptor cells.

C. Excretion:

a) Comparative physiology of excretion in animals- Nitrogenous wastes and waste elimination.
b) Mammalian kidney- Structure and physiology of urine formation.

Unit III: Basic Concepts of Endocrinology 8 hrs

A. Chemical messengers:

Autocrine, Paracrine and endocrine secretions,
Types of hormones, an overview of human endocrine system

B. Hormone synthesis: Peptide and steroid hormones.

Role of Hormones in homeostasis- Glucose and Water balance

C. Hypothalamus and pituitary gland:

Structure, function and control of hypothalamic hormones.
Pituitary hormones and their physiological actions
chemical structure and. Feedback regulation. Pathophysiology.
Hyppothalamo - hypophysial portal system

D. Pineal gland–Structure and function**.**

Unit IV: **8 hrs**

A. **Thyroid gland:** Structure, function and biosynthesis of thyroid hormone
B. **Parathyroid** : Structure and PTH – Calcitonin – Role of hormones in calcium and phosphate metabolism.
C. **Adrenal gland hormones**
   Adrenal cortex hormones: Corticoids: role played in Stress management – Aldosterone and the rennin- angiotensin system
   Adrenal medullary hormones: Catecholamines as emergency hormones
D. **Gastrointestinal hormones: S**ecretion, control and function
E. **Pancreatic Hormones**: Insulin and glucagons, their role in the regulation of Carbohydrate, protein and lipid metabolisms.

ANIMAL PHYSIOLOGY PRACTICALS **4x16=64 Hrs**

1. Estimation of Proteins by Lowry *et al* method. (in tissue sample from slaughter house)
2. Determination of serum cholesterol. (Clinical sample)
3. Determination of glucose content by Anthrone method. ((in tissue sample from slaughter house)
4. Estimation of liver and skeletal muscle glycogen. (in tissue sample from slaughter house)
5. Determination of serum/ blood urea by DAMO method. (Clinical sample)
6. Estimation of creatinine in the urine sample.
7. Total count of RBC and WBC.
8. Differential count of WBC
9. Response of RBC's to Hypertonic, hypotonic and isotonic solutions
10. Observation of permanent slides of T.S of endocrine glands
    a. Pituitary gland b. Thyroid gland c. Adrenal gland d. Pancreas
11. Identification of chemical structures of steroid hormones

REFERENCES:

1. Adler N. T (1981) Neurcendocrinology of Reproduction, Physiology and Behaviour.Austin, C. R and R. V. Short (eds) (1972) Reproduction in mammals. (1) Germ cells andFertilization (2) Embryonic and Foetal development (3) Hormones in Reproduction (4) Reproduction pattern (5) Artificial control of reproduction, Cambridge University press,London.
2. Barrington, E. J. W (1976) An introduction to general and comparative endocrinology,Oxford University press, London
3. Raghavendra Puri (2003) Mammalian endocrinology Vol. I & II, Dominant Publishers and Distributors, New Delhi.
4. Eckert, R and Randall, D. 2002, Animal physiology, 2nd Edn, W.H..Freman
5. Guyton. A.G. 1986, Text book of Medical Physiology, 7th Edn., Saunders Publication

M.Sc., II SEMESTER
HC – 2.3 ENTOMOLOGY

32hrs

Unit I: General Entomology **10 hrs**

A. Classification of class Insecta up to orders with suitable examples; Integument appendages.

B. Insect Endocrinology

I. Insect Hormones and their regulation**:** Chemistry and functions of hormones, Hormones in metamorphosis, Ecdysis and Diapause

II. Semiochemicals:**:** Allelochemicals and Pheromones (Primer & releaser)

Unit II: Agricultural Entomology **10hrs**

A. Role of insects in plant pollination

B. Insects pests: Classification and categories of pests, origin and emergence of pests, pest out breaks and pest resurgence
Structure, life history, significance, nature of damage and control methods of major pests of sugarcane, Paddy and Coconut.

C. Structure, life history, significance, nature of damage and control measures of stored grain pests: (a) *Sitophilus* (b) *Trogoderma* (c) *Rhizopertha* (d) *Tribolium* (e) *Bruchus* (f) *Sitotruga* (g) *Ephestia*

Unit III: General and household insect pests **06hrs**

A. Structure, life history, significance, nature of damage and control measures of following general pests: (a) grasshoppers & locusts (c) termites (d) aphids (e) hairy caterpillars

B. Household pests: Cockroaches, Ants, Wasps, Silverfish, furniture beetle, and their control

Unit IV: Medical Entomology **06hrs**

A. Insect vectors: Role of insect as vectors of human diseases (Malaria, filariasis, Kala azar and their control)
Mosquitoes as pests and their control.
Housefly: A human health hazard and its control

B. Arboviral diseases: Dengue, chicken gunya, swine flu.

PRACTICALS: **4x16=64 Hrs**

1. Collection and preservation of dead insects for systematic studies & field report 4x4=16 hrs
2. Identification of different insects upto orders- House fly, Cockroach :
Mosquitoes, stored grain beetles, destructive insects, important crop and household pests
4x4=16 hrs
4. Fixing and preservation of dead insects by Plastination technique. 4x4=16 hrs
5. Field studies of insects to understand their habit: Ants, Butterflies, termite, wasps, Moths.
4x2=08 hrs
6**.** Study of insect mouth parts: Mosquito, Cockroach, House fly, Butterfly 4x2=08 hrs

REFERENCES:

1. Awasti V.B. 2009 Introduction to general entomology 3rd Ed. Scientific publication (India), Jodhpur
2. Awasti V.B.2007, Agricultural Insect Pests and their control. Scientific publishers (India) Jodhpur
3. Trigunayat M.M. 2009, A Mannual of practical entomology, scientific publishers, Jodhpur, India.
4. Dhaliwal G.S. Ramsingh and B.S. Chillar 2006, Essentials of Agricultural entomology. Kalyani Publishers, New Delhi.
5. L . K Jha. Applied Agricultural Entomology. New central book agency. Culcutta

M.Sc., II- SEMESTER
SC – 2.4 DEVELOPMENTAL BIOLOGY

48 Hrs

Unit I:

A) Introduction : Descriptive V/s. Experimental Embryology **8hrs**

B) Fertilization : a) An overview of structure and differentiation of egg and sperm
b) General sequence and molecular events during fertilization

Unit II: Early development - I **8 hrs**

a) Nucleocytoplasmic interactions in early development: An overview of Nuclear transplantation experiments in Amphibians and mammals
b) Creations of multicellularity: Cleavage-Regulatory mechanism
c) Gastrulation: Morphogenetic movements and regulatory mechanisms in amphibian and mammalian embryo.

Unit III: Early development - II **8hrs**

a) Morphogenetic determinants and their role in development:
Yellow cytoplasm in Ascidians, Polar body in Mollusca, Pole plasm in *Drosophila*

b) Laying down the embryonic body plan :
Determination of embryonic axes in *Drosophila* – Anterior-posterior (maternal effect genes) & Dorsoventral; Amphibians (cell-cell interaction) & Mammals (Hox Genes)

c) Cell lineage studies and cell death genes in *Caenorhabditis elegans*.

Unit IV: Morphogenesis –I **8 hrs**

a) Early embryogenesis in Drosophila : Regional specification by. Segmentation genes: Gap genes, Pair rule genes, Segment polarity genes, and Homeotic genes.
b) Cellular differentiation and morphogenesis:
   i. Neuronal v/s epidermal fate specification in *Drosophila*.
   ii. Vulval inducation in Caenorhabditis elegans.

Unit V: Morphogenesis-II **8 hrs**

a) Role of Cell Adhesion molecules in morphongenesis : Cadherins and Fibronectins
b) Genetics of imaginal discs and transdetermination
c) Limb development-an over view :
   i. Proximo-distal axis specification in developing limb.
   ii. Cell death and formation of digits.

Unit VI: Post embryonic development **8 hrs**

a) Metamorphosis : Endocrine and molecular control of metamorphosis in insects and amphibians b) Types of growth c) Regeneration : Types, Blastema formation,Sources of cells for regeneration d) Abnormal development as seen in Teratogenesis.

PRACTICALS **16X2=32Hrs**

1. Study of internal changes during early development of frog & chick (permanent slides) 3X2=06hrs
2. Development of chick-Embryo mounting-permanent preparation 2X2=04hrs
3. Study of early developmental stages of *Drosophila* (Live Observation of embryo) and dechorionation and observation of embryos 2X2=04hrs
4. Study of Imaginal discs – the precursors of adult structures in *Drosophila* 3X2=06hrs
5. Demonstration of window technique to observe chick embryo development 2X2=04hrs
6. Effect of thyroid hormone on development in frog 2X2=04hrs
7. Study of various developmental stages in frog up to tadpole stage 2X2=04hrs

REFERENCES:

1. Balinsky, B.I., 1965. An introduction to embryology, W.B.Saunders company.
2. Gilbert, S. F. 2006, Developmental Biology, 8th Ed.Sinauer Associates Inc.,
3. Kalthoff, 2000, Analysis of Biological Development, 2nd Ed., McGraw-Hill Science, New Delhi, INDIA. Massachusetts, USA.
4. Vasudeva Rao, 1994. Developmental Biology: A modern synthesis, Oxford & IBH, New Delhi.
5. Wolpert, Beddington, Brockes, Jessell, Lawrence,Meyerowitz, (3rd Ed., 2006)Principles of Development, , Oxford University Press, New Delhi, INDIA.
6. Wolpert, L, Beddington, R Jessell, T. Lawrence P, Meyerowitz, E, Smith J., 2001, Principles of Deveopment Oxford University Press Oxford.
7. Ann Kiessling and Scott C. Anderson, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, 2003. Jones and Bartlett Publishers, Boston MA, USA

****

M.Sc., II SEMESTER
SC – 2.5 IMMUNOLOGY

48hrs

Unit I: Introduction to immunity **8hrs**

A. History; types of immunity – Innate and acquired immunity.
B. Cells and Organs of immune system: Cells: Lymphocytes (T & B cells), monocytes, macrophage; eosinophills, basophills, neutrophils and mast cells.
C. Primary and secondary lymphoid organs: Bone marrow, Thymus, Spleen, Lymph nodes

Unit II: Antigens and Immunoglobulins **8hrs**

A. Antigens: factors influencing immunogenicity, adjuvant, epitope, hapten
B. Immunoglobulins: Basic structure of the immunoglobulin; Types and functions of immunoglobulins.
C. Monoclonal antibodies:Antigen-antibody reactions

Unit III: Immune response **8hrs**

A. Humoral and cell mediated immune responses
B. Primary and secondary immune modulation; Cytokines; role of complement system in immune response (Classical pathway, Alternate pathway);
C. Immune response against bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections;

Unit IV Immunotechniques **8hrs**

A. Agglutination; Precipitation;
B. Immunofluorescence; RIA, ELISA, Immuno-electrophoresis and Western blotting.

Unit V Major histocompatibility complex and Hypersensitivity **8hrs**

A. Transplantation and graft rejection,
B. Genetic organization of H2 and HLA complexes, HLA typing;
C. Immediate and delayed hypersensitivity.

Unit VI Vaccines and Vaccination **8hrs**

A. Types of Vaccines and their significance
B. Vaccine delivery systems.
C. Congenital and acquired immunodeficiencies

TUTORIALS **2X16=32 Hrs**

References:

1. Austyn, J.M. and Kathym, J. Wood. 1993. Principles of cellular and molecular Immunology. Oxford University Press. Oxford.
2. Benjamin, Elisunshine, Geoffrey Leskowitz.1996. Immunology: A short course. 3rd Edition. New York.
3. Kubey, J.M. 1990. Essential Immunology. 6th Edition. Blackwell Scientific Publication, New York.
4. Rao, C.V. 2002. An introduction to Immunology. Narona Publishing House, New Delhi.
5. Rotti, I. 1994. Essential Immunology. Blackwell, London.
6. Stibes, D.P. and Terr, A.I. 1991. Basic and Clinical Immunology. 7th Edition. Appleton and Large. California.

M.Sc., II SEMESTER
SC – 2.6 EVOLUTIONARY BIOLOGY

48 Hrs

UNIT I Emergence of concept of evolution: **8 Hrs**

A. Pre Darwinian concepts, Darwinism and its impact in the development of synthetic theory.
B. Neodarwinism: Birth of population genetics, Components of population genetics, Mendelian population, gene pool, allele frequencies and genotype frequencies,

UNIT II Speciation: **8 Hrs**

A. Concept of species,
B. Types of species
C. Models of speciation,
D. Patterns and mechanisms of reproductive isolation,
E. Hybridization, polyploidy and speciation.

UNIT III Molecular evolution **8 Hrs**

A. Phyletic gradualism and punctuated equilibrium.
B. Micro and macroevolution.
C. Molecular evolution: Selectionists theory of evolution, Neutral theory of evolution and Molecular clock and emergence of non-darwinism,

UNIT IV Phylogeny **8 Hrs**

A. Phylogenetic trees : Construction with nucleic acid and amino acid sequences,
B. Types of trees and Techniques employed in construction of phylogenetic trees,
C. Molecular phylogenetics of Homo sapiens.

UNIT V Population genetics and Evolution **8 Hrs**

A. Gene pool, gene frequency, Hardy-Weinberg Law.
B. Destabilizing forces of evolutionary equilibrium (Mutation, Migration, Selection, Meiotic drive and genetic drift).
C. Founder effect, Isolating mechanisms and speciation.
D. Micro Macro and Mega evolution, Co-evolution.

UNIT VI Genome and Evolution **8 Hrs**

A. Genes and gene clusters
B. Origin of new genes by gene duplication (Ohno's concept)
C. Selfish DNA
D. Karyotypic evolution (Drosophila).

TUTORIALS **2X16=32Hrs**

REFERENCES:

1. Dobzhansky Th, (1951) Genetics and origin of species, 3rd Edn. Chapman and Hall, London.
2. Dobzhansky Th, Ayala F.J, Stebbins G.L and J.M. Valentine, (1976) Evolution, Surjeet Publication, New Delhi.
3. Futuyama D.J (1986) Evolutionary Biology, Sinuauer Associates Inc. USA
4. Hartl D.L (2000) A primer of population genetics, Sinuauer Associates Inc. USA
5. Jha A.P (1992) Genes and Evolution - John Wiley Publicaion, New Delhi
6. King M (1993) Species evolution - The role of chromosomal change. The Cambridge University Press, Cambridge

M.Sc., III SEMESTER
HC – 3.1 MOLECULAR BIOLOGY AND BIOTECHNOLOGY

32 hrs

Part A: Molecular Biology

Unit I Introduction to nucleic acids **8hrs**

A. DNA Replication: i) Enzyme components of replication unit ii) Mechanism with emphasis on Dna A in initiation, Co-ordinated synthesis, End replication in eukaryotes iii) Fidelity.
B. Transcription: i) Transcription apparatus and process (RNA polymerase, cis-regulatory elements, terminators, transcription factors). ii) Post transcriptional modifications of mRNA in eukaryotes (G-cap, PolyA tail, Splicing).
C. Translation: i) Genetic code (major features, usage of different codons). ii) Enzymes, factors and the process (Aminoacyl t-RNA synthatase, Peptidyl transferase, IFs, EFs, RFs and Ribosome)

Unit II Gene regulation **8hrs**

A. Gene regulation in Prokaryotes: (i) Regulation at transcription initiation: Eg. lac operon (+ve and -ve control) (ii) Regulation beyond transcription initiation: trp attenuator (iii) Regulation in Lambda Phage - Lytic and lysogenic cycle induction.
B. Gene regulation in Eukaryotes: (a) Transcriptional activators (b) Transcriptional repression: (i) direct repression, indirect repression (ii) Gene silencing by modification of histones and DNA (c) RNA interference
C. Molecular basis of homologous recombination: Models and protein machinery
D. Molecular mechanisms of DNA damage repair**.**

Part B: Biotechnology

Unit III: **8 hrs**

A. **Genetic engineering:**
   Definition, objectives and outline of recombinant DNA technology procedure.
   Enzymes**:** Restriction Enzymes; DNA ligase, Klenow enzyme,
   T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase.
   Cloning vectors: Plasmids, Phages, Cosmids, Phagemids, Artificial chromosomes (YAC, BAC, HAC),
B. **Cloning:**
   Construction of Genomic and cDNA libraries.
   Indetification of Recombinants: Genetic selection, Use of chromogenic substrates, Insertional activation.
   Analysis of recombinant DNA clones: Characterization of clones, Restriction mapping, Southern hybridization.
   Polymerase chain reaction and DNA sequencing-Maxam and Gilbert's method, Sanger's method, Automated DNA sequencing

Unit IV: **8 hrs**

C. **Applications of Biotechnology:**
   Production of medicinally important products – vaccines, Gene therapy, AIDS therapy, Biofertilizers, biopesticides, medicine and human health

D. **Animal Biotechnology**
   Animal cell and Tissue culture: Principles of cell culture, cell and tissue types, cell lines, transformation.
   Cell and tissue culture media: Natural and defined, role and components of serum in culture.
   Applications of tissue culture: Tissue culture in biomedical research karyological studies, amniocentesis, mutagenesis, Cytotoxicity assays.

PRACTICALS **4x16=64 Hrs**

1. Extraction of DNA by rapid method.
2. Extraction of DNA by standard method.
3. Estimation of DNA concentration by Diphenylamine method.
4. Localization of DNA in prefixed paramecium slides by Feulgen staining
5. Localization of nucleic acids in prefixed paramecium slides by Toluidine blue staining
6. Estimation of RNA concentration by Orcinol method
7. PCR amplification of DNA and gel electrophoresis.
8. Restriction digestion and gel electrophoresis.
9. Isolation of plasmid DNA from bacteria.
10. Molecular biology problems

REFERENCES

1. Griffiths A J F, H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart 2000. An introduction to genetic analysis. W. H. Greeman. New York.
2. Lewin, B 2003 Genes VIII. Oxford University Press. Oxford
3. Dale, Jeremy W and Schantz, Malcom V. 2002. From Gene to Genomes. John Wiley and Sons Ltd,NY,USA
4. Das, H.K. 2007. Text book of Biotechnology.Wiley India Pvt. Ltd. New Delhi
5. Freshney, Ian, R. 2006. Culture of Animal Cell (5th edn).Wiley- Liss publications
6. Pandian, T.T. and Kandavel, D.2008. Text Book of Biotechnology. I.K International Publishing House, New Delhi. 47
7. Primrose, S.B., Twyman, R.M., and Old, R.W. 2001. Principle of Gene Manipulation (6th edn). Blackwell Science Ltd, London
8. Singh .B.D. 2006. Biotechnology. Kalyani Publishers, New Delhi
9. Sobti, R. C. and Pachauri, Suparna S. 2009. Essentials of Biotechnology. Ane Books Pvt. Ltd. New Delhi

M.Sc., III SEMESTER

HC – 3.2 REPRODUCTIVE BIOLOGY

32 hrs

UNIT I: Male reproduction: 8 hrs

- **A.** Functional morphology of male reproductive system
- **B.** Kinetics of spermatogenesis – wave and cycle
- **C.** Hormonal control of mammalian testis and spermatogenesis
- **D.** Ultrastructure of spermatozoa
- **E.** Abnormalities of sperm
- **F.** Brief description of histomorphology and hormonal control of male accessory organs viz., epididymis, vas deferens, seminal vesicles, ventral prostate, bulbourethral gland and preputial gland
- **G.** Sperm maturation – morphological and biochemical events, influence of accessory organ secretions
- **H.** Biochemistry of semen and capacitation

UNIT – II Female reproduction: 8 hrs

- **A.** Origin and migration of primordial germ cells; genetic and hormonal control of differentiation of gonads and gonadal ducts in mammals.
- **B.** Female Reproductive System-Functional morphology of mammalian ovary, Fallopian tube and uterus.
- **C.** Ovarian steroid hormones and their actions

UNIT III: Reproductive cycles in Mammals: 8 hrs

- **A.** Comparison of estrous and menstrual cycles
- **B.** Menstrual cycle : Different phases, changes in the ovary and uterus and hormonal control
- **C.** Implantation – Process, Types and hormonal control
- **D.** Pregnancy – length of gestation, hormonal control
- **E.** Parturition – Process of birth and influence of hormones
- **F.** Lactation – Hormonal control of mammary gland, development and lactogenesis

UNIT – IV: Fertility and reproductive management 8 hrs

- **A.** Fertility control – Need, principles of different male and female temporary and permanent contraceptive methods.
- **B.** Assisted Reproduction: Causes of infertility, Artificial insemination, different methods of assisted reproduction (*In-vitro* Fertilization, Gamete Intra Fallopian tube Transfer, Zygote Intra Fallopian tube Transfer).

PRACTICALS 16X4=64 hrs

1. Demonstration of surgical technique by video clipping
2. Counting of spermatozoa in semen sample collected from volunteers
3. Staining of spermatozoa for abnormalities in semen samples collected from volunteers /clinical samples
4. Study of different contraceptive devices
5. Observation of permanent Histology slides
   a. Comparative morphology of ovary
   b. Comparative morphology of testis
   c. Comparative study of male accessory organs
   d. Comparative study of female accessory organs
6. Observation of permanent slides of T.S of endocrine glands
   a. Pituitary gland b. Thyroid gland c. Adrenal gland d. Pancreas

REFERENCES

1. Adler N. T (1981) Neurcendocrinology of Reproduction, Physiology and Behaviour.
2. Austin, C. R and R. V. Short (eds) (1972) Reproduction in mammals. (1) Germ cells andFertilization (2) Embryonic and Foetal development (3) Hormones in Reproduction (4) Reproduction pattern (5) Artificial control of reproduction, Cambridge University press,London.
3. Barrington, E. J. W (1976) An introduction to general and comparative endocrinology,Oxford University press, London
4. Raghavendra Puri (2003) Mammalian endocrinology Vol. I & II, Dominant Publishers and Distributors, New Delhi.
5. Muneeth Kainth (2005) Chordate Embryology, Dominant Publishers and Distributors, New Delhi.
6. Moudgal, N. R. Yoshinaga K Rao, A. J. and P. R. Adiga (1991) Perspectives in primate reproductive biology. Wiley Eastern Ltd., New Delhi, Bangalore
7. Paul Wassar man and Jimmy D. Neill (2005) Knogbil and neill's physiology of reproductive volume 1st and 2nd and 3rd edition
8. Jones, R. E (1991) Human Reproductive Biology press N.Y
9. Knobil, E and Neil J. D (1994) The physiology of reproduction, Vol. I & II. Raven press, New York.

M.Sc., III SEMESTER

HC – 3.3 ECOLOGY AND WILDLIFE

32 hrs

Part-A Ecology

UNIT - I **8 hrs**

A. Ecosystem: Historical account, Scope, Basic concepts and Approaches to the study of Environmental Biology. Components of Environment - An overview of abiotic factors and Biotic factors. Concepts of habitat and Ecological niche. Ecotone and Edge effect. Food chains, Food-webs and their structure in Ecological Pyramids in aquatic, terrestrial and parasitic Environments.

B. Population Ecology: Introduction. An overview of important population attributes – Density, Natality, Growth rates, Growth forms and concept of carrying capacity, Patterns in human population growth and its explosion -Remedial measures. Mortality - life tables and survivorship curve, sex ratio, age distribution, dispersal and dispersion, aggregation and Allee's principle, population fluctuation and cyclic oscillations and Population interactions.

UNIT - II **8 hrs**

A. Community Ecology Concept of community - community structure and attributes, concept of climax Species diversity in community and it's measurement- Alpha diversity- Simpson's diversity index, Shannon index, Fisher's alpha, rarefaction. Beta diversity- Sorensen's similarity index, Whittaker's index, Evenness, Gamma diversity. Drivers of species diversity loss and conservation.

B. Bioecology of Freshwater Zooplankton: Definition, Types and adaptations of Zooplankton. Brief study of organizations, life cycles and Ecological importance of Rotifers, Cladocerans, Copepods-Calanoids, Harpacticoids and Cyclopoids, and Ostracods. Mass culturing of Zooplankton.

C. Microbial Ecology: Ecological role, beneficial and pathogenic Microorganisms. Indicator Microorganisms. Role of microorganisms in biodegrading and bioremediation of organic and metal pollution.

Part B Wildlife Biology

UNIT – III **8hrs**

- **A.** Scope and values of wildlife (Ecological, Aesthetic, Scientific, Recreational, Medicinal)
- **B.** Causes of wildlife depletion: Degradation and destruction of natural habitats, Exploitation for commercial purposes, Deforestation, Agricultural expansion, Urbanization and Industrialization, forest fires and hunting.
- **C.** Wildlife corridors, Human-wildlife conflicts
- **D.** Wildlife awareness and education, Wildlife and tribal welfare

UNIT – IV

- **A.** Conservation strategies: Red data book, protected area network, Role of NGOs in conservation.
- **B.** Wildlife act and legislation: Wildlife Protection Act 1972; Biological Diversity Act 2002.
- **C.** Wildlife conservation projects in India (with special reference to Project Tiger, Project Hungul and Gir Project)
- **D.** In-situ conservation: Bioreserves, National parks, Wildlife sanctuaries and Safari's in India
- **E.** Management of Bioreserves, National parks, Wildlife sanctuaries and Safari.
- **F.** Ex-situ conservation: Zoo garden, Management of Zoos, Captive breeding, Artificial insemination, Cryopreservation (techniques and applications) Germplasm banks,

PRACTICALS: **4X16=64 Hrs**

1. Qualitative and Quantitative study of freshwater planktons.
2. Determination of species diversity by Shannon-Weiner Index
3. Determination of species diversity by Simpson's index
4. Field visit to Sewage pond, Natural lake (and if possible river): Collection of water samples and study of physico-chemical parameters such as colour, pH, temperature, conductivity, total solids and turbidity
5. Estimation of Dissolved Oxygen in three natural (sewage, pond and Tap) water samples.
6. Estimation of free Carbon di-Oxide in three natural (sewage, pond and Tap) water samples.
7. To study the relationship between Dissolved Oxygen and free Carbon di-Oxide, if any, in three natural (sewage, pond and Tap) water samples.
8. Determination of BOD in three natural (sewage, pond and Tap) water samples
9. Determination of COD in three natural (sewage, pond and Tap) water samples
10. To study the relationship between BOD and COD, if any, in three natural (sewage, pond and Tap) water samples
11. Collection, observation of planktons (Phytoplankton and Zooplankton) from polluted and non-polluted water bodies.
12. Estimations of bacterial abundance in different water samples – using DEMT.
13. Visit to RMNH, Mysore, to study models of freshwater, marine, estuarine and terrestrial habitats.
14. Survey of Animal Population - to visit different habitats/areas in and around Mysore and collect data on some population attributes, application of Bio-statistical tests to the collected data and its interpretation.
15. Visit to nearby Zoological garden, wildlife sanctuaries, Animal rehabilitation centres.

REFERENCES

1. Begon, Harper and Townsend, 1995. Ecology: Individuals, populations and community. II edition. Blackwell Series, U.S.A.
2. Bhatia, H.S. 1998: A Text book on Environmental Pollution and Control, Galgotia, New Delhi.
3. Clarke, G.L. 1963. Elements of Ecology, . Wiley Eastern Limited. New Delhi.
4. Emmel, T.C. 1976. Population Biology, Harper and Row publishers, N.Y.
5. Kormondy, E.J. 1978. Concepts of Ecology, Prentice Hall of India Pvt. Ltd., New Delhi.
6. Odum E.P. 1971. Fundamentals of Ecology. III Edition. W.B.Saunder's Co., Philadelphia.
7. Odum, E.P. 1983. Basic Ecology, Holt Saunders, Japan.
8. Sharma, P.D. 1996: Ecology and Environment Rastogi, Publications, Meerut.
9. APHA, 1992: Standard methods for examination of water and waste water, 18th edition
10. Negi,S.S and Bahuguna, V.K. 1983. An Introduction to wildlife management. Bishen Singh Mahendra Pal Singh. Dehara Dun, India.
11. NBA. 2004. The Biological Diversity Act (2002) and Biological Diversity rules (2004). National Biodiversity Authority, India.
12. Saharia, V.B. 1982. Wildlife in India. Natraj Publishers. Dehara Dun.

M.Sc., III SEMESTER
SC 3.4 ETHOLOGY

48 Hrs

UNIT - I **8 Hrs**

A. Descriptive versus experimental approaches

B. Reflexes and complex behaviour- Latency, after discharge, summation, warm up, fatigue inhibition and feedback control

C. Instinctive Behaviour - Fixed action pattern, Types of sign stimuli and releasers as triggers, Genetic basis of instinctive behaviour.

UNIT- II **8 Hrs**

A. Development and behaviour- Causes of behavioral changes during development, development of bird song.

B. Learning- Classical conditioning experiment, latent and insight learning. Social learning, learning sets and play.

C. Importance of early experience – Critical period- Filial imprinting, Sexual imprinting in birds, Imprinting like process in mammals.

UNIT- III Foraging and anti-predator behaviour **8 Hrs**

i. Anti predator behaviour – avoiding detection through colour and Markings (Mullarian mimicry)
ii. Warning coloration
iii. Batesian mimicry

UNIT-IV Biological communication **8 Hrs**

i. Forms of signals,
ii. Visual communication with suitable examples,
iii. Auditory Communication
iv. Tactile and Chemical communication

UNIT -V Sexual Behaviour **8 Hrs**

i. Hormones and sexual behaviour – Selected examples of courtship and mating behaviour.
ii. Pheromones in Insects and Mammals
iii. Lee Boot, Whitten, Bruce, Collidge and Castro-Vandenberg effect/s
iv. Selected examples of courtship and mating behaviour

UNIT-VI Social Behaviour **8 Hrs**

i. Introduction
ii. Advantages of grouping
iii. Social organization in insects with special reference to ants and honeybees
iv. Social organization in sub human primates
v. Altruism, Kin selection and Genetic control of behaviour

TUTORIALS – On the basis of the proposed chapters. **2x16 = 32 Hrs.**

REFERENCES

1) Goodenough J.E., Mc Guire B. and Wallace R. A. (1993) Perspectives on Animal Behaviour. John Wiley and sons, New York.
2) Tinbergen (2006) Social ehaviour in Animals. J.V. Publishing House Jodhpur India.
3) Vandenbergh. J.E.(Ed) (1983). Pheromones and Reproduction in mammals. Academic Press. NewYork.
4) Agrawal, K.C. 2000. Biodiversity. Agrobios. India.

M.Sc., III SEMESTER
SC – 3.5 POLLUTION AND TOXICOLOGY

48hrs

Part A - Pollution **24 hrs**

Unit I: **8 hrs**

A. Concept of Biosphere: Its components, hydrosphere, atmosphere, and lithosphere, Origin of life in the biosphere.

B. Water pollution: Definition, sources Types and classification of pollutants. Effects of Water Pollution, River Pollution, Oxygen sag curves and Eutrophication Drinking water: Collection, purification and distribution. Wastewater treatment: Primary, secondary and tertiary treatment.

Unit II: **8 hrs**

A. Atmospheric pollution: Primary and secondary air pollutants. Biological effects of Nox, SOx, SPM, Hydrocarbons, Acid rain, Global warming, Photochemical smog and Ozone hole.

B. Solid waste and Biomedical waste: Sources, collection, transport, treatment and Disposal methods.. Noise Pollution: Sources, Biological effects, Control measures and OSHA standards.

UnitIII: **8hrs**

A. Radiation & Thermal pollution: Sources, types, effects, Atmospheric fallout and abatement.

B. Environmental Impact Assessment: Basic elements, Methods Guideline for industrial EIA, Aquaculture related EIA, Transport related EIA and Water related EIA. Case studies: Konkan Railway, Silent valley, Bhopal Tragedy and Love canal tragedy, Mangalore Bojpe tragedy

Part B – Toxicology **24 hrs**

Unit IV: **8hrs**

A. General Principles of Toxicology: Introduction, Definition of toxicology Importance of Dose and Dose-response, factors influencing toxicity, Bioassay-toxicity evaluation studies using fish as model.

B. Toxic compounds: Heavy metals-Lead and mercury, Hydrocarbons- Aromatic and Aliphatic, and cyanides, and toxic gases - Bhopal tragedy.

Unit V: **8hrs**

A. Biotransformation: Bioactivation, Biodetoxification of organo phosphates and organo chorines in the bodies of animals.

B. Natural toxins, Venoms and poisons: Properties and their effects, Major Sites and mechanism of action, Toxins in lower and higher organisms, Toxin and Venom therapy.

Unit VI: **8hrs**

A. Smoking aids: Active and Passive smoking, Consumption of tobacco, Mariguana(Ganja), their effects and Prevention measures.

B. Cosmetics: Types of cosmetics, Chemical Characteristics, Applications, Exposure and risk assessment, Cosmetic safety regulations.

C. Risk assessment: Exposure assessment, Dose-Dosage, Risk characterization, Risk analysis and communications, Occupational health and illness.

TUTORIALS – On the basis of the proposed chapters **2x16 = 32 Hrs**

REFERENCES:

1. Nandini, .N. Sunitha N. and T. Sucharita 2010. Environmental Studies, Sapna Book House Bangalore
2. Frant C.L.V. 1991, Basic Toxicology II (Eds.), Hemisphere publishing corporation, Washington, London
3. Sambasiva Rao K.R.S. 1999. Pesticide impact on fish metabolism. (Eds.) Discovery Publishing House, New Delhi.
4. Bio-pesticides in Insect Pest Management 1999. S. Ignacimuthu and Alok Sen, Phoenix Publishing House Pvt., Ltd., New Delhi.
5. APHA, AWWA and WEF. 1992: Standard Methods for Examination of Water and Wastewater, XVIII Ed, American Public Health Association. NY, USA
6. Nebel, B.T. and Wrigly R.T. 1998. Environmental Science, VI Ed. Prentice Hall New Jersey, USA
7. Hosetti, B.B. 2001. A Text Book of Applied Aquatic Biology, Daya Publishing House, Delhi.
8. Hassall, K.A. 1990. The Biochemistry and uses Pesticides structure, metabolism and Mode of action and uses in crop protection, John Wiley & Sons. Inc.
9. Pandey, K. and J.P. Shukla, 1990. Elements of Toxicology. Radha publ. New Delhi.

M.Sc., III Semester:
OPEN ELECTIVE-(For Science discipline students).
CONCEPTS OF ZOOLOGY.

48 Hrs

1. Introduction: 8 Hrs

a) Branches of animal science: Taxonomy, Animal Physiology, Genetics, Developmental Biology, Evolution, Ethology, Ecology, Applied Zoology, Entomology, Histology, c) Indian Wildlife- Status, Causes of wildlife depletion, Wildlife corridors, Conservation strategies- *In situ* and *Ex situ* d) e) Animals and human welfare.

2. Animal Taxonomy: 4 Hrs

a) Carl Linnaeus – Taxonomic hierarchy: Kingdom, Division, Phylum, Class, Order, Family and Binomial nomenclature

3. Animal cells and Tissues : 8 Hrs

a) Brief description of animal cell (light and ultra structure) b) Functions of cell organelles c) Structure and functional diversity in animal cell d) Cell division: Types and significance e) Structure and functions of basic tissues.

5. Structure and functions of organ systems: 16 Hrs

a) Human alimentary canal and outlines of digestion and absorption
b) Respiration: Human respiration – exchange of gases.
c) Circulation : Structure of human heart, Blood vessels and capillaries, composition of blood, blood coagulation.
d) Excretion : Mammalian kidney and urine formation.
e) Locomotion in vertebrates – Swimming, walking running, flying
f) Nervous system and their functions, A brief account of human endocrine system
g) Reproduction : Asexual and sexual reproduction, significance of sexual reproduction, outlines of human reproduction and fertility control

6. Ecology and Environmental Biology: 8 Hrs

a) Abiotic and Biotic factors b) Environmental Pollution – brief account of Air, Water and Noise pollution.

7. Heredity: 4 Hrs

a) Continuity of life – Mendel's laws b) Structure of chromosomes c) DNA and RNA

TUTORIALS 2x16=32 Hrs

REFERENCES :

1. Barnes, R. D. 1974. Invertebrate Zoology, III edition, W. B. Saunders Co., Philadelphia.
2. Barrington, E. J. W. 1976. Invertebrate structure and function. Thomas Nelson and Sons
3. Ltd., London
4. Hyman L. H. 1940. The invertebrates Vol.1 Protozoa through Ctenophora, McGraw hill
5. co., N. Y.
6. Hyman. L. H. 1968. The Invertebrates Vol.8 McGraw Hill Co., N. Y and London.
7. Parker, T. J. Haswell, W. A. 1961. Text book of Zoology, Vol.I, Macmillon Co., London.
8. Russel – Hunter, W.D 1969. A. biology of higher invertebrates, Mac millon Co., Ltd.,
9. London.
10. Barrington, E. J. W. 1965. The Biology of Hemichordata and Protochordata – Oliver and Boyd, Edinbourgh.

11. Clark, W. E 1963. History of the Primates IV Edn., Univ. of Chicago Press, Chicago.
12. Malcom Jollie, 1962. Chordata morphology – East-West Press Pvt. Ltd., New Delhi.
13. Romer, A. S. 1966. Vertebrate Paleontolgy, 3rd Ed., Univ. of Chicago Press, Chicago.
14. Romer A. S., 1960. Vertebrate body, 3rd Ed., W. B. Saunders Co., Philadelphia.
15. Young. J. Z., 1950. Life of vertebrates The Oxford University Press, London
16. Young J Z 1957 Life of mammals, Oxford University Press, London.

M.Sc., IV SEMESTER

HC – 4.1 ADVANCED GENETICS AND COMPUTATIONAL BIOLOGY

32 hrs

Part A-Advanced Genetics

Unit I: Genome organization: 3 hrs

Prokaryotes, Eukaryotic nuclear genomes - C-value paradox, Eukaryotic organelle genomes Split Genes Mobile genetic elements in Prokaryotes (bacteria) and Eukaryotes (Drosophila, maize and humans), Genome Projects of model organisms (*C. elegans*, *Drosophila* and Mouse).

Unit II: Cancer Genetics: 5 hrs

Cancer incidence and mortality, types of cancer, causes of cancer, properties of cancer cells, Genetic basis of Carcinogenesis- Oncogenes: proto-oncogenes, oncogenes, retroviral oncogenes in human cancer. Tumor suppressor genes: Functions of tumor suppressor gene products. Cancer as a multistep process. Animal models of cancer research: Transgenic mouse and Drosophila models.

Unit III: Human genetics: 5 hrs

History of human genetics, pattern of inheritance, pedigree analysis. Human genome: Organization, distribution of genes, gene families. Genetic basis of syndromes and disorders: Cystic fibrosis, Neurofibromatosis, Schizophrenia, Anxiety disorder, Congenital heart diseases, Dyslexia.

Unit IV: Quantitative genetics: 3hrs

Introduction, types of quantitative trait, Nature of quantitative traits and their inheritance- Polygenic inheritance (Multifactorial hypothesis) – analysis of continuous variation; Variations associated with polygenic traits.

Part B-Computational Biology

Unit VII: Introduction and Scope of the Computational Biology 4 hrs

Genomics: Definition and types of genomics Structural genomics: whole genome shotgun sequencing, gene annotation, gene families and clusters. Orthologs and paralogs. Functional genomics: Transcriptome, Microarray technology.

Unit VIII: Proteomics: 4 hrs

Definition, Protein structure determination, protein domains, protein folding, Computer aided protein structure analysis, Protein-protein interactions, Protein microarrays.

Unit IX: Nucleic acid sequence and Protein analysis: 4 hrs

Alignment, similarity searches including remote similarity searches, secondary structure element, motifs, Single nucleotide polymorphism(SNP), Two dimensional polyacrylamide gel electrophoresis, Mass Spectrometry.

Unit X: Genomics and proteomics databases and tools: 4 hrs

Nucleic acid sequence databases and tools: Genbank, UCSC, ENSEMBL, EMBL, DDBJ, BLAST vs FASTA, file formats-FASTA, GCG, Genscan and ClustalW. Protein sequence databases and tools: Uni- prot, PDB, PIR, BLAST, PSI- BLAST (steps involved in use and interpretation of results).

PRACTICALS:

1. Study of mitotic chromosomes of *Drosophila* species- *Drosophila melanogaster*, *Drosophila nasuta*.
2. Preparation of metaphase chromosomes from bone marrow cells of mouse.
3. Karyotypic studies of normal human chromosomes and syndromes.
4. Creation of pedigrees and study of patterns of inheritance.
5. Studies on phenotypes of different diseases and syndromes.
6. Study of Quantitative characters: Sternopleurals, Acrosticals – mean, standard deviation.
7. Data mining for sequence analysis.
8. Web– based tools for sequence searches and homology screening-BLAST, FASTA
9. Nucleic acid sequence databases: GenBank retrieval, GeneScan.
10. Proteomics data bases: Uni-Prot, PROSITE, PDB, PIR, ProtParam.
11. Annotations: ORF finder, Use of ARTEMIS or any other suitable software

REFERENCES:

1. The Human Genome 2001, Nature Vol. 409.
2. The Drosophila Genome. 2000, Science Vol. 267.
3. The Caenorhabditis elegans genome 1998. Science Vol. 282.
4. Introduction to Genetic Analysis. Griffiths, Anthony J.F.; Miller, Jeffrey H.; Suzuki, David T.; Lewontin, Richard C.; Gelbart, William M. New York: W.H. Freeman & Co.; 1999
5. Fundamental Neuroscience. Larry R. Squire, Darwin Berg, Floyd Bloom, and Sascha du Lac. Third Edition, Academic Press; 3 edition (2008)
6. Principles of Neural Science. Eric R. Kandel, James H. Schwartz, and Thomas M. Jessell. McGraw-Hill Medical; 4 edition(2000)
7. Neurogenetics: Scientific and Clinical Advances (Neurological Disease and Therapy) David R. Lynch, Informa HealthCare; 1 edition (2005)
8. The Molecular and Genetic Basis of Neurologic and Psychiatric Disease. Roger N Rosenberg, Salvatore DiMauro, Henry L Paulson, and Louis Pt (2007) Lippincott Williams & Wilkins; Fourth edition
9. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007), Wiley Publishing, Inc., New York, USA
10. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
11. A.Malcolm Campbell and Laurie J.Heyer. Discovering Genomimcs, Proteomics and Bioinformatics. 2004. Low Price edition. Pearson Education, Inc.

M.Sc., IV SEMESTER
HC – 4.2 APPLIED ZOOLOGY

32 hrs

UNIT I: Aquaculture **8hrs**

Aquaculture in India: an overview – nutritional value and food security - Site selection and preparation of culture ponds - Fish culture: carps, marine fishes and ornamental fishes. Prawn culture: Freshwater prawns and marine shrimps. Fattening of crabs. Crayfish and Lobster - Molluscs: mussels, clams, chanks and oysters including pearl oyster. Live feeds: micro algae, micro-invertebrates (*Artemia* nauplii, Rotifers, Cladocerans, Copepods, Ostracodes) and worms as live baits – Water quality management and maintenance of sanitation - Plant and animal nutrients - Balanced diet (iso-nitrous and iso-caloric) - Artificial feed formulation – Low cost feed formulation - Aquatic weeds.

UNIT II: Sericulture **8hrs**

Salient features of Saturnidae and Bombycidae. Mulberry and non mulberry silkworms, classification based on voltinism, moulting and geographic origin.
Morphology and life cycle of *Bombyx mori*. Structure and functions of Silk glands.
Silkworm rearing technology: Building, equipments, disinfection, environmental factors, Seed cocoons, preservation, grainage activity, LSPs, egg production, incubation, artificial hatching.
Pests and diseases: Protozoan, Fungal, Viral and Bacterial diseases and their control measures. Silkworm pests and Predators

UNIT III: Apiculture **8hrs**

Scope and its importance, Classification and morphology of honey bees, species and races of honey bees, tribal life and bee hunting. sex seperation, comb building, orientation of comb, communication, collection of propolis and water.
Honey and its chemical composition, medicinal importance.
Eonomic importance of honey, wax, bee pollination, pollen and Venom.

UNIT IV: Vermiculture **8hrs**

A. Introduction to vermiculture. Definition, meaning, history, economic importance, their value in maintenance of soil structure. Useful species : Local species and Exotic species of earthworms. Role of four R's.
B. Taxonomy Anatomy, Physiology and Reproduction of Lumbricidae and Eudrilidae.
C. Earthworm Farming (Vermiculture) for home gardens, larger scale, Extraction (harvest), vermicomposting harvest and processing.
D. Nutritional Composition of Vermicompost for plants, comparison with other fertilizers
E. Enemies of Earthworms, Sickness

PRACTICALS: **16X4=64 hrs**

1. Study of morphometric characters of Indian major carps.
2. Diversity of fishes.
3. Collection of phytoplankton and zooplankton from natural resources and their identification.
4. Study of morphology of honey bee and cast system.
5. Mounting of mouth parts, stinging apparatus of honey bee.
6. Study of digestive system of honeybee.
7. Study of structure and types of honey comb.
8. Study of bee plants.
9. Study of morphology of lifecycle of *Bombyx mori*
10. Study of digestive and silk gland of *Bombyx mori*

11. Study of Non mulberry silkworms and their food plants.
12. Field trip- Collection of native earthworms & their identification
13. Study of systematic position& External characters of locally available earthworm species.
14. Mounting of setae and identification of earthworm species.
15. Study of equipments used in Vermiculture.

REFERENCES

1. Ashok Kumar (2009) Textbook of Animal Diseases
2. Edwards, C.A. and J.R. Lofty (1977) "Biology of Earthworms" Chapman and Hall Ltd., London.
3. G.S. Shukla, V.B. Upadhyay (2006) Economic Zoology.
4. Kevin, A and K.E.Lee (1989) " Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils)
5. Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney.
6. Pradip. V Jabde, (2005) Text Book of Applied Zoology.
7. R. L. Kotpal (2000) Modern Textbook of Zoology. Rastogi Publications
8. Satchel, J.E. (1983) "Earthworm Ecology" Chapman Hall, London.
9. Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London.

M.Sc., IV SEMESTER
HC – 4.3 Project

M.Sc., Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
<u>HARD CORE- Model question paper</u>

Time: 3 hrs **Max Marks: 70**

Instructions: ***1. Answer all questions***
2. Illustrate your answer wherever necessary

I. Write short notes on the following: **[8×2=16]**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write elaborate notes on any FIVE of the following: **[5×6=30]**

9.
10.
11.
12.
13.
14.
15.
16.

Q3. Answer the following: **[2×12=24]**

17. (i)
Or
(ii)

18. (i)
Or
(ii)

M.Sc Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
Softcore - Model question paper

Time: 3 hrs **Max Marks: 70**

Instructions: ***1. Answer all questions***
2. Illustrate your answer wherever necessary

I. Write short notes on the following: **[8×2=16]**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write elaborate notes on any FIVE of the following: **[5×6=30]**

9.
10.
11.
12.
13.
14.
15.
16.

Q3. Answer the following: **[2×12=24]**

17. **(i)**
Or
(ii)

18. **(i)**
Or
(ii)

M.Sc Examination
(Scheme CBCS)
M.Sc., ZOOLOGY
Open Elective-Model question paper

Time: 3 hrs **Max Marks: 70**

Instructions: ***1. Answer all questions***
2. Illustrate your answer wherever necessary

I. Write short notes on the following: **[8×2=16]**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write elaborate notes on any FIVE of the following: **[5×6=30]**

9.
10.
11.
12.
13.
14.
15.
16.

Q3. Answer the following: **[2×12=24]**

17. (i)
Or
(ii)

18. (i)
Or
(ii)

NEP-2020 Model Syllabus for BSc (Basic and Honors), Semesters I and II

Semester: I

Course Code: **DSC-1** [**FSA450**]	Course Title: **Computer Fundamentals and Programming in C**
Course Credits: **04**	Hour of Teaching / Week: **04Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **52Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):
After completing this course satisfactorily, a student will be able to:
- Confidently operate Desktop Computers to carry out computational tasks
- Understand working of Hardware and Software and the importance of operating systems
- Understand programming languages, number systems, peripheral devices, Networking, Multimedia and internet concepts
- Read, understand and trace the execution of programs written in C language
- Write the C code for a given problem
- Perform input and output operations using programs in C
- Write programs that perform operations on arrays

Course Content	Hours
Unit - 1	
Fundamentals of Computers: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution and History of Computers, Types of Computers, Basic Organisation of a Digital Computer; Number Systems – different types, conversion from one number system to another; Computer Codes – BCD, Gray Code, ASCII and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Types of Software – System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program - Algorithm, Flowchart and Pseudo code with Examples. **Introduction to C Programming:** Over View of C; History and Features of C; Structure of a C Program with Examples; Creating and Executing a C Program; Compilation process in C.	13
Unit - 2	
C Programming Basic Concepts: C Character Set; C tokens - keywords, identifiers, constants, and variables; Data types; Declaration & initialization of variables; Symbolic constants. **Input and output with C:** Formatted I/O functions - *printf*and *scanf,* control stings and escape sequences, output specifications with *printf*functions; Unformatted I/O functions to read and display single character and a string - *getchar, putchar, gets* and *puts* functions. **C Operators & Expressions:** Arithmetic operators; Relational operators; Logical operators; Assignment operators; Increment & Decrement operators; Bitwise operators; Conditional operator; Special operators; Operator Precedence and Associatively; Evaluation of arithmetic expressions; Type conversion.	13
Unit - 3	
Control Structures: Decision making Statements - S*imple if, if_else*, *nested if_else, else_if ladder, Switch-case*, *goto, break &continue* statements; Looping Statements - Entry controlled and Exit controlled statements, *while, do-while, for* loops, Nested loops. Arrays: One Dimensional arrays - Declaration, Initialization and Memory representation; Two Dimensional arrays - Declaration, Initialization and Memory representation. Strings: Declaring & Initializing string variables; String handling functions - *strlen, strcmp, strcpy and strcat;* Character handling functions - *toascii, toupper, tolower, isalpha, isnumeric*etc.	13

Unit - 4	
Pointers in C: Understanding pointers - Declaring and initializing pointers, accessing address and value of variables using pointers; Pointers and Arrays; Pointer Arithmetic; Advantages and disadvantages of using pointers; **User Defined Functions:** Need for user defined functions; Format of C user defined functions; Components of user defined functions - return type, name, parameter list, function body, return statement and function call; Categories of user defined functions - With and without parameters and return type. **User defined data types:** Structures - Structure Definition, Advantages of Structure, declaring structure variables, accessing structure members, Structure members initialization, comparing structure variables, Array of Structures; Unions - Union definition; difference between Structures and Unions.	13

Text Books

1. Pradeep K. Sinha and Priti Sinha: Computer Fundamentals (Sixth Edition), BPB Publication
2. E. Balaguruswamy: Programming in ANSI C (TMH)

References

1. Kamthane: Programming with ANSI and TURBO C (Pearson Education)
2. V. Rajaraman: Programming in C (PHI – EEE)
3. S. ByronGottfried: Programming with C (TMH)
4. Kernighan & Ritche: The C Programming Language (PHI)
5. Yashwant Kanitkar: Let us C
6. P.B. Kottur: Programming in C (Sapna Book House)

Course Code: **DSC-1L [FSA450]**	Course Title: **C Programming Lab**
Course Credits: **02**	Hour of Teaching / Week: **04Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52Hours**
Exam Marks: **25**	Exam Duration: **03Hours**

Practice Lab

The following activities be carried out/ discussed in the lab during the initial period of the semester.

1. Basic Computer Proficiency
   a. Familiarization of Computer Hardware Parts
   b. Basic Computer Operations and Maintenance.
   c. Do’s and Don’ts, Safety Guidelines in Computer Lab
2. Familiarization of Basic Software – Operating System, Word Processors, Internet Browsers, Integrated Development Environment (IDE) with Examples.
3. Type Program Code, Debug and Compile basic programs covering C Programming fundamentals discussed during theory classes.

Programming Lab

Part A:

1. Write a C Program to read radius of a circle and to find area and circumference
2. Write a C Program to read three numbers and find the biggest of three
3. Write a C Program to demonstrate library functions in *math.h*
4. Write a C Program to check for prime
5. Write a C Program to generate n primes
6. Write a C Program to read a number, find the sum of the digits, reverse the number and check it for palindrome
7. Write a C Program to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers
8. Write a C Program to read percentage of marks and to display appropriate message

(Demonstration of else-if ladder)

9. Write a C Program to find the roots of quadratic equation (demonstration of switch-case statement)
10. Write a C program to read marks scored by n students and find the average of marks (Demonstration of single dimensional array)
11. Write a C Program to remove Duplicate Element in a single dimensional Array
12. Program to perform addition and subtraction of Matrices

Part B:

1. Write a C Program to find the length of a string without using built in function
2. Write a C Program to demonstrate string functions.
3. Write a C Program to demonstrate pointers in C
4. Write a C Program to check a number for prime by defining *isprime( )* function
5. Write a C Program to read, display and to find the trace of a square matrix
6. Write a C Program to read, display and add two m x n matrices using functions
7. Write a C Program to read, display and multiply two m x n matrices using functions
8. Write a C Program to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters.
9. Write a C Program to Reverse a String using Pointer
10. Write a C Program to Swap Two Numbers using Pointers
11. Write a C Program to demonstrate student structure to read & display records of n students.
12. Write a C Program to demonstrate the difference between structure & union.

Note: Student has to execute a minimum of 10 programs in each part to complete the Lab course **Evaluation Scheme for Lab Examination**

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on C Programming		05
Total		**25**

Semester: II

Course Code: **DSC-2 [FSB450]**	Course Title: **Data Structures using C**
Course Credits: **04**	Hour of Teaching / Week: **04Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **52 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms a
- Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
- Demonstrate different methods for traversing trees
- Compare alternative implementations of data structures with respect to performance
- Describe the concept of recursion; give examples of its use
- Discuss the computational efficiency of the principal algorithms for sorting and searching

Course Content	Hours
Unit - 1	
Introduction to data structures: Definition; Types of data structures - Primitive & Nonprimitive, Linear and Non-linear; Operations on data structures. Algorithm Specification, Performance Analysis, Performance Measurement Recursion: Definition; Types of recursions; Recursion Technique Examples - Fibonacci numbers, GCD, Binomial coefficient $_nC_r$, Towers of Hanoi; Comparison between iterative and recursive functions.	13
Unit - 2	
Arrays: Basic Concepts – Definition, Declaration, Initialisation, Operations on arrays; Types of arrays; Arrays as abstract data types (ADT); Representation of Linear Arrays in memory; Traversing linear arrays; Inserting and deleting elements; Sorting – Selection sort, Bubble sort, Quick sort, Selection sort, Insertion sort; Searching - Sequential Search, Binary search; Iterative and Recursive searching; Multidimensional arrays; Representation of multidimensional arrays; Sparse matrices. Dynamic memory allocation: Static & Dynamic memory allocation; Memory allocation and de-allocation functions - *malloc*, *calloc*, *realloc* and *free.*	13
Unit - 3	
Linked list: Basic Concepts – Definition and Representation of linked list, Types of linked lists - Singly linked list, Doubly liked list, Header liked list, Circular linked list; Representation of Linked list in Memory; Operations on Singly linked lists – Traversing, Searching, Insertion, Deletion; Memory allocation; Garbage collection. Stacks: Basic Concepts – Definition and Representation of stacks; Operations on stacks; Applications of stacks; Infix, postfix and prefix notations; Conversion from infix to postfix using stack; Evaluation of postfix expression using stack; Application of stack in function calls.	13
Unit - 4	
Queues: Basic Concepts – Definition and Representation of queues; Types of queues - Simple queues, Circular queues, Double ended queues, Priority queues; Operations on Simple queues; Trees: Definition; Tree terminologies –node, root node, parent node, ancestors of a node, siblings, terminal & non-terminal nodes, degree of a node, level, edge, path, depth; Binary tree: Type of binary trees - strict binary tree, complete binary tree, binary search tree and heap tree; Array representation of binary tree. Traversal of binary tree; *preorder, inorder* and *postorder* traversal; Reconstruction of a binary tree when any two of the traversals are given.	13

Text Books

1. Satraj Sahani: Fundamentals of Data Structures

References

1. Tanenbaum: Data structures using C (Pearson Education)
2. Kamathane: Introduction to Data structures (Pearson Education)
3. Y. Kanitkar: Data Structures Using C (BPB)
4. Kottur: Data Structure Using C
5. Padma Reddy: Data Structure Using C
6. Sudipa Mukherjee: Data Structures using C – 1000 Problems and Solutions (McGraw Hill Education, 2007))

Course Code: **DSC-2Lab [FSB 450]**	Course Title: **Data Structures Lab**
Course Credits: **02**	Hour of Teaching/Week: **04 Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52Hours**
Exam Marks: **25**	Exam Duration: **03Hours**

Programming Lab

Part A:

1. Write a C Program to find GCD using recursive function
2. Write a C Program to display Pascal Triangle using binomial function 3. Write a C Program to generate n Fibonacci numbers using recursive function.
4. Write a C Program to implement Towers of Hanoi.
5. Write a C Program to implement dynamic array, find smallest and largest element of the array.
6. Write a C Program to create two files to store even and odd numbers.
7. Write a C Program to create a file to store student records.
8. Write a C Program to read the names of cities and arrange them alphabetically.
9. Write a C Program to sort the given list using selection sort technique.
10. Write a C Program to sort the given list using bubble sort technique.

Part B:

1. Write a C Program to sort the given list using insertion sort technique.
2. Write a C Program to sort the given list using quick sort technique.
3. Write a C Program to sort the given list using merge sort technique.
4. Write a C Program to search an element using linear search technique.
5. Write a C Program to search an element using recursive binary search technique.
6. Write a C Program to implement Stack.
7. Write a C Program to convert an infix expression to postfix.
8. Write a C Program to implement simple queue.
9. Write a C Program to implement linear linked list.
10. Write a C Program to display traversal of a tree.

Evaluation Scheme for Lab Examination

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on C Programming		05
Total		**25**

Skill Enhancement Courses (SEC)
for B.A.,B.Com., BBA , B.Sc. & BCA
Semester: I / II

Course Code: [FHA210 / FSB210 / [FAB210]

Course Title:SEC**Digital Fluency** **Course Credits: 2**

Total Contact Hours: 15 hours of theory and 30 hours of practical's Duration of ESA:

Formative Assessment Marks: 5**0 marks**

Summative Assessment Marks: 50 marks

Model Syllabus Authors:

Course Outcomes (COs):

At the end of the course the student should be able to:

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

1. Have an intelligent conversation on the key concepts and applications of Artificial Intelligence (AI), Big Data Analytics (BDA), Internet of Things (IoT), Cloud Computing, and Cybersecurity
2. Develop holistically by learning essential skills such as effective communication, Problemsolving, design thinking, and teamwork
3. Build his/her personal brand as an agile and expansive learner – one who is interested in Horizontal and vertical growth?

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

This mapping needs to be done considering POs of respective programs.

Course Outcomes (COs) / Program Outcomes (POs) 1 2 3 4 5 6 7 8 9 10 11 12

1. Have an intelligent conversation on the key concepts and applications of AI, BDA, IoT, Cloud Computing, and Cyber security
2. Develop holistically by learning essential skills such as effective communication, problemsolving, design thinking, and teamwork
3. Build his/her personal brand as an agile and expansive learner – one who is interested in horizontal and vertical growth

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Content (Digital 101)

Details of topic	**Duration**
Module 1: Emerging Technologies	05 hours

Overview of Emerging Technologies:

i. Artificial Intelligence, Machine Learning, Deep Learning,
ii. Database Management for Data Science, Big Data Analytics,
iii. Internet of Things (IoT) and Industrial Internet of Things (IIoT)
iv. Cloud computing and its service models &
v. Cyber Security and Types of cyber attack

Module 2: Applications of Emerging Technologies	05 hours

Applications of emerging technologies:

i. Artificial Intelligence
ii. BigData Analytics

iii. Internet of Things
iv. Cloud Computing v. Cyber Security

Module 3: Building Essential Skills beyond Technology 05 hours
Importance of the following:
i. Effective Communication Skills
ii. Creative Problem Solving & Critical Thinking iii. Collaboration and Teamwork Skills iv. Innovation & Design Thinking v. Use of tools in enhancing skills

References to learning resources:
1. The learning resources made available fo the course titled "Digital 101" on Future Skills Prime Platform of NASSCOM

Open Elective Courses offered by the Department of Computer Science I Semesters

Course Code: **Open Elective OE-1 [FSA880]**	Course Title: **Office Automation**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):
- Be familiar various office automation tools.
- Create and format a document**.**
- Create and analyse data using Excel.
- Create and customize a presentation for a specific topic.

Course Content	Hours
Unit – 1	
Introduction, Block diagram of a computer, Input and output devices, memory and storage devices, Types of software, Introduction to operating system – functions, types of operating system and examples. Introduction to word processing – creating and saving a document, formatting a document – Line spacing, paragraph, Fonts, inserting symbols, header and footer, shape, Tables, Find and replace, Mail merge, saving a document in different formats	14
Unit – 2	
Introduction to spread sheet – entering different types of data like text, numbers, date, functions and formulae- different categories of functions, chart-creating and formatting a chart, filter, working with single and multiple work books, cell referencing, printing and previewing a document.	14
Unit – 3	
Introduction to presentation tools-creating and viewing a presentation, applying design template, formatting options, inserting different objects in a presentation, customize a presentation, adding audio to a presentation, Slide animation, preview Slide transitions Slide show options, adding effect to presentation.	14

Reference books

1. Computer Basics with Office Automation- Archana Kumar, Dreamtech press, First Edition.
2. The Handbook of Office Automation- Ralph Tomas Reilly, Iuniverse publication, First Edition.

Course Code: **Open Elective OE-2 [FSA890]**	Course Title: **C Programming Concepts**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to Confidently operate Desktop Computers to carry out computational tasks.

- Understand working of Hardware and Software and the importance of operating systems.
- Understand programming languages, number systems, peripheral devices, networking,
- multimedia and internet concepts.
- Read, understand and trace the execution of programs written in C language.
- Write the C code for a given problem.
- Perform input and output operations using programs in C.
- Write programs that perform operations on arrays.

Course Content	**Hours**
Unit – 1	
Fundamentals of Computers: Introduction to Computers -Hardware, software System software, Application software, Utility software, Operating System; Computer Languages – Machine Level, Assembly Level & High-Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program – Algorithm and Flowchart with Examples. Introduction to C Programming: Over View of C; History and Features of C; Structure of a C Program with Examples; Creating and Executing a C Program; Compilation process in C. C Programming Basic Concepts: C Character Set; C tokens - keywords, identifiers, constants, and variables; Data types; Declaration & initialization of variables; Symbolic constants.	14
Unit – 2	
Input and output with C: Formatted I/O functions - printf and scanf, control stings and escape sequences, output specifications with printf functions; Unformatted I/O functions to read and display single character and a string - getchar, putchar, gets and puts functions, C Operators & Expressions: Arithmetic operators; Relational operators; Logical operators; Assignment operators; Increment & Decrement operators; Bitwise operators; Conditional operator; Special operators; Operator Precedence and Associatively; Evaluation of arithmetic expressions; Type conversion. Control Structures: Decision making Statements - Simple if, if_else, nested if_else, else_if ladder, Switch-case, goto, break & continue statements; Looping Statements - Entry controlled and Exit controlled statements, while, do-while, for loops, Nested loops.	14
Unit – 3	
User Defined Functions: Need for user defined functions; Format of C user defined functions; Components of user defined functions - return type, name, parameter list, function body, return statement and function call; Categories of user defined functions - With and without parameters and return type. Arrays: One Dimensional arrays - Declaration, Initialization and Memory representation; Two Dimensional arrays - Declaration, Initialization and Memory representation. Strings: Declaring & Initializing string variables; String handling functions - strlen, strcmp, strcpy and strcat; Character handling functions - toascii, toupper, tolower, isalpha, isnumeric etc. Basics of Pointers in C: Understanding pointers - Declaring and initializing pointers, accessing address and value of variables using pointers; Pointer Arithmetic; Advantages and disadvantages of using pointers;	14

Text Books:
1. Pradeep K. Sinha and Priti Sinha: Computer Fundamentals (Sixth Edition), BPB Publication
2. E. Balgurusamy: Programming in ANSI C (TMH)

References:
1. Kamthane: Programming with ANSI and TURBO C (Pearson Education)
2. V. Rajaraman: Programming in C (PHI –EEE)
3. S. ByronGottfried: Programming with C (TMH)
4. Kernighan & Ritche: The C Programming Language (PHI)
5. Yashwant Kanitkar: Let us C 6. P.B. Kottur: Programming in C (Sapna Book House)

II Semesters

Course Code: **Open Elective OE-3 [FSB880]**	Course Title: **e-Commerce**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):
- Be familiar with different e-commerce theories and terminology.
- Assess the impact of internet and internet technology in a business electronic commerce and electronic business.
- Learn strategies for e-commerce and electronic payment system.

Course Content	Hours
Unit – 1	
Introduction to e-commerce, the difference between e-commerce and e-business, Technological building blocks underlying e-commerce: the Internet, Web, and Mobile Platform, Major Trends in e-commerce, Unique Features of e-commerce Technology. Modes of electronic commerce: Overview, Electronic data interchange (EDI), ecommerce with WWW/Internet. Payments and Security: Electronic cash and electronic payment Schemes: Internet monetary payment and Security requirements, payment and purchase order process, Online electronic cash.	14
Unit – 2	
Types of e-commerce: Business-to-Consumer (B2C), Business-to-Business (B2B) , Consumer-to-Consumer (C2C), Mobile e-commerce (M-commerce), Social ecommerce, Local e-commerce. Consumer-oriented e-commerce: Introduction, Traditional retailing and e-retailing, benefits of e-retailing, Key success factors, Models of e-retailing, features of eretailing, developing a consumer-oriented e-commerce system, The PASS model.	14
Unit – 3	
e-Commerce Infrastructure: The Internet, Technology Background, Internet — Key Technology concepts, **TCP/IP, IP** addresses, Domain names, DNS and URLs, Client Server Computing, Cloud computing model, Mobile platform. Internet and Web: Hypertext, HTML, XML, Web servers and clients, Web browsers, Communication tools — E mail, messaging apps.	14

Text Books:
1. Laudon, Kenneth C., and Carol Guercio Traver. *E-Commerce 2020-2021.* Pearson, 2020.
2. Laudon, Kenneth C., and Carol Guercio Traver. *E-commerce Essentials.* Pearson, 2014.

References:
1. Ravi Kalakota, Andrew B. Frontiers of Electronic Commerce, Addison Wesley 1996.

Course Code: **Open Elective OE-4 [FSB890]**	Course Title: **Web Designing**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

- Be familiar with different web design theories and terminology.
- Analyze a web page and identify its elements and attributes.
- Create web pages using XHTML and Cascading Style Sheets.
- Build dynamic web pages using JavaScript (Client-side programming)

Course Content	**Hours**
Unit – 1	
Fundamentals: Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox. Introduction to XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, <Span> and <Div> tags	14
Unit – 2	
The Basics of JavaScript: Overview of JavaScript, Object orientation and JavaScript, Syntactic characteristics, Primitives, operations, and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors, Pattern matching using regular expressions, Errors in scripts, Examples. The JavaScript execution environment, The Document Object Model, Element access in JavaScript, Events and event handling, handling events from the Body elements	14
Unit – 3	
Button elements, Text box and Password elements, The DOM 2 event model, the navigator object, DOM tree traversal and modification. Dynamic documents with JavaScript: Introduction, positioning elements, moving elements, Element visibility, changing colors and fonts, Dynamic content, Stacking elements, locating the mouse cursor, Reacting to a mouse click, slow movement of elements, Dragging and dropping elements.	14

Text Books:

1.Robert W. Sebesta: Programming the World Wide Web,4th Edition, Pearson Education, 2008.

References:

1. M. Deitel, P.J. Deitel, A. B. Goldberg: Internet & World Wide Web How to Program, 4th Edition, Pearson Education, 2004.
2. Chris Bates: Web Programming Building Internet Applications,3rd Edition, Wiley India, 2007.
3. Xue Bai et al: The web Warrior Guide to Web Programming, Cengage Learning, 2003.

NEP-2020 Model Syllabus for BSc (Basic and Honors), Semesters I and II

Semester: I

Course Code: **DSC-1** [**FSA450**]	Course Title: **Computer Fundamentals and Programming in C**
Course Credits: **04**	Hour of Teaching / Week: **04Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **52Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- Confidently operate Desktop Computers to carry out computational tasks
- Understand working of Hardware and Software and the importance of operating systems
- Understand programming languages, number systems, peripheral devices, Networking, Multimedia and internet concepts
- Read, understand and trace the execution of programs written in C language
- Write the C code for a given problem
- Perform input and output operations using programs in C
- Write programs that perform operations on arrays

Course Content	Hours
Unit - 1	
Fundamentals of Computers: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution and History of Computers, Types of Computers, Basic Organisation of a Digital Computer; Number Systems – different types, conversion from one number system to another; Computer Codes – BCD, Gray Code, ASCII and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Types of Software – System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program - Algorithm, Flowchart and Pseudo code with Examples. **Introduction to C Programming:** Over View of C; History and Features of C; Structure of a C Program with Examples; Creating and Executing a C Program; Compilation process in C.	13
Unit - 2	
C Programming Basic Concepts: C Character Set; C tokens - keywords, identifiers, constants, and variables; Data types; Declaration & initialization of variables; Symbolic constants. **Input and output with C:** Formatted I/O functions - *printf*and *scanf,* control stings and escape sequences, output specifications with *printf*functions; Unformatted I/O functions to read and display single character and a string - *getchar, putchar, gets* and *puts* functions. **C Operators & Expressions:** Arithmetic operators; Relational operators; Logical operators; Assignment operators; Increment & Decrement operators; Bitwise operators; Conditional operator; Special operators; Operator Precedence and Associatively; Evaluation of arithmetic expressions; Type conversion.	13
Unit - 3	
Control Structures: Decision making Statements - S*imple if, if_else*, *nested if_else, else_if ladder, Switch-case*, *goto, break &continue* statements; Looping Statements - Entry controlled and Exit controlled statements, *while, do-while, for* loops, Nested loops. Arrays: One Dimensional arrays - Declaration, Initialization and Memory representation; Two Dimensional arrays - Declaration, Initialization and Memory representation. Strings: Declaring & Initializing string variables; String handling functions - *strlen, strcmp, strcpy and strcat;* Character handling functions - *toascii, toupper, tolower, isalpha, isnumeric*etc.	13

Unit - 4	
Pointers in C: Understanding pointers - Declaring and initializing pointers, accessing address and value of variables using pointers; Pointers and Arrays; Pointer Arithmetic; Advantages and disadvantages of using pointers; **User Defined Functions:** Need for user defined functions; Format of C user defined functions; Components of user defined functions - return type, name, parameter list, function body, return statement and function call; Categories of user defined functions - With and without parameters and return type. **User defined data types:** Structures - Structure Definition, Advantages of Structure, declaring structure variables, accessing structure members, Structure members initialization, comparing structure variables, Array of Structures; Unions - Union definition; difference between Structures and Unions.	13

Text Books

1. Pradeep K. Sinha and Priti Sinha: Computer Fundamentals (Sixth Edition), BPB Publication
2. E. Balaguruswamy: Programming in ANSI C (TMH)

References

1. Kamthane: Programming with ANSI and TURBO C (Pearson Education)
2. V. Rajaraman: Programming in C (PHI – EEE)
3. S. ByronGottfried: Programming with C (TMH)
4. Kernighan & Ritche: The C Programming Language (PHI)
5. Yashwant Kanitkar: Let us C
6. P.B. Kottur: Programming in C (Sapna Book House)

Course Code: **DSC-1L [FSA450]**	Course Title: **C Programming Lab**
Course Credits: **02**	Hour of Teaching / Week: **04Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52Hours**
Exam Marks: **25**	Exam Duration: **03Hours**

Practice Lab

The following activities be carried out/ discussed in the lab during the initial period of the semester.

1. Basic Computer Proficiency
   a. Familiarization of Computer Hardware Parts
   b. Basic Computer Operations and Maintenance.
   c. Do's and Don'ts, Safety Guidelines in Computer Lab
2. Familiarization of Basic Software – Operating System, Word Processors, Internet Browsers, Integrated Development Environment (IDE) with Examples.
3. Type Program Code, Debug and Compile basic programs covering C Programming fundamentals discussed during theory classes.

Programming Lab

Part A:

1. Write a C Program to read radius of a circle and to find area and circumference
2. Write a C Program to read three numbers and find the biggest of three
3. Write a C Program to demonstrate library functions in *math.h*
4. Write a C Program to check for prime
5. Write a C Program to generate n primes
6. Write a C Program to read a number, find the sum of the digits, reverse the number and check it for palindrome
7. Write a C Program to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers
8. Write a C Program to read percentage of marks and to display appropriate message

(Demonstration of else-if ladder)

9. Write a C Program to find the roots of quadratic equation (demonstration of switch-case statement)
10. Write a C program to read marks scored by n students and find the average of marks (Demonstration of single dimensional array)
11. Write a C Program to remove Duplicate Element in a single dimensional Array
12. Program to perform addition and subtraction of Matrices

Part B:

1. Write a C Program to find the length of a string without using built in function
2. Write a C Program to demonstrate string functions.
3. Write a C Program to demonstrate pointers in C
4. Write a C Program to check a number for prime by defining *isprime( )* function
5. Write a C Program to read, display and to find the trace of a square matrix
6. Write a C Program to read, display and add two m x n matrices using functions
7. Write a C Program to read, display and multiply two m x n matrices using functions
8. Write a C Program to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters.
9. Write a C Program to Reverse a String using Pointer
10. Write a C Program to Swap Two Numbers using Pointers
11. Write a C Program to demonstrate student structure to read & display records of n students.
12. Write a C Program to demonstrate the difference between structure & union.

Note: Student has to execute a minimum of 10 programs in each part to complete the Lab course **Evaluation Scheme for Lab Examination**

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on C Programming		05
Total		**25**

Semester: II

Course Code: **DSC-2 [FSB450]**	Course Title: **Data Structures using C**
Course Credits: **04**	Hour of Teaching / Week: **04Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **52 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms a
- Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
- Demonstrate different methods for traversing trees
- Compare alternative implementations of data structures with respect to performance
- Describe the concept of recursion; give examples of its use
- Discuss the computational efficiency of the principal algorithms for sorting and searching

Course Content	Hours
Unit - 1	
Introduction to data structures: Definition; Types of data structures - Primitive & Nonprimitive, Linear and Non-linear; Operations on data structures. Algorithm Specification, Performance Analysis, Performance Measurement Recursion: Definition; Types of recursions; Recursion Technique Examples - Fibonacci numbers, GCD, Binomial coefficient $_nC_r$, Towers of Hanoi; Comparison between iterative and recursive functions.	13
Unit - 2	
Arrays: Basic Concepts – Definition, Declaration, Initialisation, Operations on arrays; Types of arrays; Arrays as abstract data types (ADT); Representation of Linear Arrays in memory; Traversing linear arrays; Inserting and deleting elements; Sorting – Selection sort, Bubble sort, Quick sort, Selection sort, Insertion sort; Searching - Sequential Search, Binary search; Iterative and Recursive searching; Multidimensional arrays; Representation of multidimensional arrays; Sparse matrices. Dynamic memory allocation: Static & Dynamic memory allocation; Memory allocation and de-allocation functions - *malloc*, *calloc*, *realloc* and *free.*	13
Unit - 3	
Linked list: Basic Concepts – Definition and Representation of linked list, Types of linked lists - Singly linked list, Doubly liked list, Header liked list, Circular linked list; Representation of Linked list in Memory; Operations on Singly linked lists – Traversing, Searching, Insertion, Deletion; Memory allocation; Garbage collection. Stacks: Basic Concepts – Definition and Representation of stacks; Operations on stacks; Applications of stacks; Infix, postfix and prefix notations; Conversion from infix to postfix using stack; Evaluation of postfix expression using stack; Application of stack in function calls.	13
Unit - 4	
Queues: Basic Concepts – Definition and Representation of queues; Types of queues - Simple queues, Circular queues, Double ended queues, Priority queues; Operations on Simple queues; Trees: Definition; Tree terminologies –node, root node, parent node, ancestors of a node, siblings, terminal & non-terminal nodes, degree of a node, level, edge, path, depth; Binary tree: Type of binary trees - strict binary tree, complete binary tree, binary search tree and heap tree; Array representation of binary tree. Traversal of binary tree; *preorder, inorder* and *postorder* traversal; Reconstruction of a binary tree when any two of the traversals are given.	13

Text Books

1. Satraj Sahani: Fundamentals of Data Structures

References

1. Tanenbaum: Data structures using C (Pearson Education)
2. Kamathane: Introduction to Data structures (Pearson Education)
3. Y. Kanitkar: Data Structures Using C (BPB)
4. Kottur: Data Structure Using C
5. Padma Reddy: Data Structure Using C
6. Sudipa Mukherjee: Data Structures using C – 1000 Problems and Solutions (McGraw Hill Education, 2007))

Course Code: **DSC-2Lab [FSB 450]**	Course Title: **Data Structures Lab**
Course Credits: **02**	Hour of Teaching/Week: **04 Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52Hours**
Exam Marks: **25**	Exam Duration: **03Hours**

Programming Lab

Part A:

1. Write a C Program to find GCD using recursive function
2. Write a C Program to display Pascal Triangle using binomial function 3. Write a C Program to generate n Fibonacci numbers using recursive function.
4. Write a C Program to implement Towers of Hanoi.
5. Write a C Program to implement dynamic array, find smallest and largest element of the array.
6. Write a C Program to create two files to store even and odd numbers.
7. Write a C Program to create a file to store student records.
8. Write a C Program to read the names of cities and arrange them alphabetically.
9. Write a C Program to sort the given list using selection sort technique.
10. Write a C Program to sort the given list using bubble sort technique.

Part B:

1. Write a C Program to sort the given list using insertion sort technique.
2. Write a C Program to sort the given list using quick sort technique.
3. Write a C Program to sort the given list using merge sort technique.
4. Write a C Program to search an element using linear search technique.
5. Write a C Program to search an element using recursive binary search technique.
6. Write a C Program to implement Stack.
7. Write a C Program to convert an infix expression to postfix.
8. Write a C Program to implement simple queue.
9. Write a C Program to implement linear linked list.
10. Write a C Program to display traversal of a tree.

Evaluation Scheme for Lab Examination

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on C Programming		05
Total		**25**

Skill Enhancement Courses (SEC)
for B.A.,B.Com., BBA , B.Sc. & BCA
Semester: I / II

Course Code: [FHA210 / FSB210 / [FAB210]

Course Title:SEC**Digital Fluency** **Course Credits: 2**

Total Contact Hours: 15 hours of theory and 30 hours of practical's Duration of ESA:

Formative Assessment Marks: 5**0 marks**

Summative Assessment Marks: 50 marks

Model Syllabus Authors:

Course Outcomes (COs):

At the end of the course the student should be able to:

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

1. Have an intelligent conversation on the key concepts and applications of Artificial Intelligence (AI), Big Data Analytics (BDA), Internet of Things (IoT), Cloud Computing, and Cybersecurity
2. Develop holistically by learning essential skills such as effective communication, Problemsolving, design thinking, and teamwork
3. Build his/her personal brand as an agile and expansive learner – one who is interested in Horizontal and vertical growth?

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

This mapping needs to be done considering POs of respective programs.

Course Outcomes (COs) / Program Outcomes (POs) 1 2 3 4 5 6 7 8 9 10 11 12

1. Have an intelligent conversation on the key concepts and applications of AI, BDA, IoT, Cloud Computing, and Cyber security
2. Develop holistically by learning essential skills such as effective communication, problemsolving, design thinking, and teamwork
3. Build his/her personal brand as an agile and expansive learner – one who is interested in horizontal and vertical growth

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Course Content (Digital 101)

Details of topic	**Duration**
Module 1: Emerging Technologies	05 hours

Overview of Emerging Technologies:

i. Artificial Intelligence, Machine Learning, Deep Learning,

ii. Database Management for Data Science, Big Data Analytics,

iii. Internet of Things (IoT) and Industrial Internet of Things (IIoT)

iv. Cloud computing and its service models &

v. Cyber Security and Types of cyber attack

Module 2: Applications of Emerging Technologies	05 hours

Applications of emerging technologies:

i. Artificial Intelligence

ii. BigData Analytics

iii. Internet of Things
iv. Cloud Computing v. Cyber Security

Module 3: Building Essential Skills beyond Technology 05 hours
Importance of the following:
i. Effective Communication Skills
ii. Creative Problem Solving & Critical Thinking iii. Collaboration and Teamwork Skills iv. Innovation & Design Thinking v. Use of tools in enhancing skills

References to learning resources:
1. The learning resources made available fo the course titled "Digital 101" on Future Skills Prime Platform of NASSCOM

Open Elective Courses offered by the Department of Computer Science I Semesters

Course Code: **Open Elective OE-1 [FSA880]**	Course Title: **Office Automation**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):
- Be familiar various office automation tools.
- Create and format a document**.**
- Create and analyse data using Excel.
- Create and customize a presentation for a specific topic.

Course Content	Hours
Unit – 1	
Introduction, Block diagram of a computer, Input and output devices, memory and storage devices, Types of software, Introduction to operating system – functions, types of operating system and examples. Introduction to word processing – creating and saving a document, formatting a document – Line spacing, paragraph, Fonts, inserting symbols, header and footer, shape, Tables, Find and replace, Mail merge, saving a document in different formats	14
Unit – 2	
Introduction to spread sheet – entering different types of data like text, numbers, date, functions and formulae- different categories of functions, chart-creating and formatting a chart, filter, working with single and multiple work books, cell referencing, printing and previewing a document.	14
Unit – 3	
Introduction to presentation tools-creating and viewing a presentation, applying design template, formatting options, inserting different objects in a presentation, customize a presentation, adding audio to a presentation, Slide animation, preview Slide transitions Slide show options, adding effect to presentation.	14

Reference books
1. Computer Basics with Office Automation- Archana Kumar, Dreamtech press, First Edition.
2. The Handbook of Office Automation- Ralph Tomas Reilly, Iuniverse publication, First Edition.

Course Code: **Open Elective OE-2 [FSA890]**	Course Title: **C Programming Concepts**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs): After completing this course satisfactorily, a student will be able to Confidently operate Desktop Computers to carry out computational tasks.

- Understand working of Hardware and Software and the importance of operating systems.
- Understand programming languages, number systems, peripheral devices, networking,
- multimedia and internet concepts.
- Read, understand and trace the execution of programs written in C language.
- Write the C code for a given problem.
- Perform input and output operations using programs in C.
- Write programs that perform operations on arrays.

Course Content	Hours
Unit – 1	
Fundamentals of Computers: Introduction to Computers -Hardware, software System software, Application software, Utility software, Operating System; Computer Languages – Machine Level, Assembly Level & High-Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program – Algorithm and Flowchart with Examples. Introduction to C Programming: Over View of C; History and Features of C; Structure of a C Program with Examples; Creating and Executing a C Program; Compilation process in C. C Programming Basic Concepts: C Character Set; C tokens - keywords, identifiers, constants, and variables; Data types; Declaration & initialization of variables; Symbolic constants.	14
Unit – 2	
Input and output with C: Formatted I/O functions - printf and scanf, control stings and escape sequences, output specifications with printf functions; Unformatted I/O functions to read and display single character and a string - getchar, putchar, gets and puts functions, C Operators & Expressions: Arithmetic operators; Relational operators; Logical operators; Assignment operators; Increment & Decrement operators; Bitwise operators; Conditional operator; Special operators; Operator Precedence and Associatively; Evaluation of arithmetic expressions; Type conversion. Control Structures: Decision making Statements - Simple if, if_else, nested if_else, else_if ladder, Switch-case, goto, break & continue statements; Looping Statements - Entry controlled and Exit controlled statements, while, do-while, for loops, Nested loops.	14
Unit – 3	
User Defined Functions: Need for user defined functions; Format of C user defined functions; Components of user defined functions - return type, name, parameter list, function body, return statement and function call; Categories of user defined functions - With and without parameters and return type. Arrays: One Dimensional arrays - Declaration, Initialization and Memory representation; Two Dimensional arrays - Declaration, Initialization and Memory representation. Strings: Declaring & Initializing string variables; String handling functions - strlen, strcmp, strcpy and strcat; Character handling functions - toascii, toupper, tolower, isalpha, isnumeric etc. Basics of Pointers in C: Understanding pointers - Declaring and initializing pointers, accessing address and value of variables using pointers; Pointer Arithmetic; Advantages and disadvantages of using pointers;	14

Text Books:
1. Pradeep K. Sinha and Priti Sinha: Computer Fundamentals (Sixth Edition), BPB Publication
2. E. Balgurusamy: Programming in ANSI C (TMH)

References:
1. Kamthane: Programming with ANSI and TURBO C (Pearson Education)
2. V. Rajaraman: Programming in C (PHI –EEE)
3. S. ByronGottfried: Programming with C (TMH)
4. Kernighan & Ritche: The C Programming Language (PHI)
5. Yashwant Kanitkar: Let us C 6. P.B. Kottur: Programming in C (Sapna Book House)

II Semesters

Course Code: **Open Elective OE-3 [FSB880]**	Course Title: **e-Commerce**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):
- Be familiar with different e-commerce theories and terminology.
- Assess the impact of internet and internet technology in a business electronic commerce and electronic business.
- Learn strategies for e-commerce and electronic payment system.

Course Content	**Hours**
Unit – 1	
Introduction to e-commerce, the difference between e-commerce and e-business, Technological building blocks underlying e-commerce: the Internet, Web, and Mobile Platform, Major Trends in e-commerce, Unique Features of e-commerce Technology. Modes of electronic commerce: Overview, Electronic data interchange (EDI), ecommerce with WWW/Internet. Payments and Security: Electronic cash and electronic payment Schemes: Internet monetary payment and Security requirements, payment and purchase order process, Online electronic cash.	14
Unit – 2	
Types of e-commerce: Business-to-Consumer (B2C), Business-to-Business (B2B) , Consumer-to-Consumer (C2C), Mobile e-commerce (M-commerce), Social ecommerce, Local e-commerce. Consumer-oriented e-commerce: Introduction, Traditional retailing and e-retailing, benefits of e-retailing, Key success factors, Models of e-retailing, features of eretailing, developing a consumer-oriented e-commerce system, The PASS model.	14
Unit – 3	
e-Commerce Infrastructure: The Internet, Technology Background, Internet — Key Technology concepts, **TCP/IP, IP** addresses, Domain names, DNS and URLs, Client Server Computing, Cloud computing model, Mobile platform. Internet and Web: Hypertext, HTML, XML, Web servers and clients, Web browsers, Communication tools — E mail, messaging apps.	14

Text Books:
1. Laudon, Kenneth C., and Carol Guercio Traver. *E-Commerce 2020-2021.* Pearson, 2020.
2. Laudon, Kenneth C., and Carol Guercio Traver. *E-commerce Essentials.* Pearson, 2014.

References:

1. Ravi Kalakota, Andrew B. Frontiers of Electronic Commerce, Addison Wesley 1996.

Course Code: **Open Elective OE-4 [FSB890]**	Course Title: **Web Designing**
Course Credits: **03**	Hour of Teaching / Week: **03Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

- Be familiar with different web design theories and terminology.
- Analyze a web page and identify its elements and attributes.
- Create web pages using XHTML and Cascading Style Sheets.
- Build dynamic web pages using JavaScript (Client-side programming)

Course Content	**Hours**
Unit – 1	
Fundamentals: Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox. Introduction to XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, <Span> and <Div> tags	14
Unit – 2	
The Basics of JavaScript: Overview of JavaScript, Object orientation and JavaScript, Syntactic characteristics, Primitives, operations, and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors, Pattern matching using regular expressions, Errors in scripts, Examples. The JavaScript execution environment, The Document Object Model, Element access in JavaScript, Events and event handling, handling events from the Body elements	14
Unit – 3	
Button elements, Text box and Password elements, The DOM 2 event model, the navigator object, DOM tree traversal and modification. Dynamic documents with JavaScript: Introduction, positioning elements, moving elements, Element visibility, changing colors and fonts, Dynamic content, Stacking elements, locating the mouse cursor, Reacting to a mouse click, slow movement of elements, Dragging and dropping elements.	14

Text Books:

1.Robert W. Sebesta: Programming the World Wide Web,4th Edition, Pearson Education, 2008.

References:

1. M. Deitel, P.J. Deitel, A. B. Goldberg: Internet & World Wide Web How to Program, 4th Edition, Pearson Education, 2004.
2. Chris Bates: Web Programming Building Internet Applications,3rd Edition, Wiley India, 2007.
3. Xue Bai et al: The web Warrior Guide to Web Programming, Cengage Learning, 2003.

ECC21001

III SEMESTER

DSC 7A: Programming in JAVA
Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate in depth java programming fundamental
CO2. Specify in details with examples Basic java OOPs Concepts
CO3. Understand in depth OOPs Concepts
CO4. Understand in depth java Interface and packages
CO5. Deliberate the details of Exception handling in java
CO6. Deliberate the details of Multithreading & I/O operations in java
CO7. Identify the classification and characteristics of File handling in java
CO8. Learn the details of File handling in java
CO9. Learn the characteristics of Applet Programming

Unit - 1 15 Hours

Introduction to Java: Features of Java, JDK Environment, Object Oriented Programming Concept Overview of Programming, Paradigm, Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Difference between C++ and JAVA, JDK Environment

Java Programming Fundamental: Structure of java program, Data types, Declaration of Variables, scope of variables, Keywords, operators, separators, literals, Machine neutral JVM, Command line arguments, Decision Making statements, iterative statements, jumping statement, type conversion and casting

Unit - 2 15 Hours

Classes and Objects: Defining a Class, Field Declaration, Methods Declarations, Creating an Object, Accessing class members, Assigning Object Reference Variables, Access specifies, Constructor, Type of Contractors, this keyword instance variable hiding, Garbage Collection, Finalize method, method overloading, overloading Constructor, Understanding Static, Introducing final, Recursion.

Inheritance: Definition, Types of Inheritance, Member Access, Uses of Super, Method Overriding, Dynamic Method Dispatch, Abstract class and Methods, Uses final, Object Class Nested and Inner classes

Arrays and Strings: Arrays, Creating an array, Types of Arrays, arrays accessing methods/operations String class Methods, String Buffer methods.

Unit - 3 15 Hours

Abstract Class, Interface and Packages: Modifiers and Access Control, Abstract class and methods, Interfaces, Packages Concept- definition, JAVA API packages, naming conventions, creating packages, Accessing Packages using packages, adding a class to a package, hiding class static import

Interface: Introduction, Defining Interfaces, implementing Interfaces, Nested Interfaces, Extending Interfaces, accessing interface variables

Exception handling: Introduction, Types of Errors, Exception, Syntax of Exception handling, try and catch statement, multiple catch Statements, Nested try Statements, throws, throwing our own exception, finally statement, java built in exception classes

Unit - 4 **15 Hours**

Multithreading: Introduction, Creating Threads, Extending the thread Classes, implementing runnable interface, Declaring the Class, implementing the run () Method, starting new thread, stopping and blocking thread, thread life cycle, thread Priority

Input and Output: Concept of Streams, Stream Classes, Byte Stream classes, Character Stream classes, reading Console input, Writing Console Output, wrapper Classes.

Applet Programming: Introduction, Types of Applet, How applets differ from applications, Applet Life cycle, Creating Applet, Applet tag

Reference Books:

1. Ivan Bayross, Web Enabled Commercial Application Development Using Html, Dhtml,javascript, Perl Cgi , BPB Publications, 2009.
2. Cay Horstmann, BIG Java, Wiley Publication , 3rd Edition., 2009
3. Herbert Schildt , Java 7, The Complete Reference, , 8th Edition, 2009.
4. E Balagurusamy , Programming with JAVA, TMH, 2007

ECC21101

III SEMESTER

DSC 7A: Programming in JAVA Lab
Credit (L: T: P = 0: 0: 2)

Software Lab based on Java

PART A

1. Write a java program to find whether given number is positive, negative or zero
2. Write a java program to find the largest of three number using ternary operator
3. Write a java program to find out roots of the quadratic Equation
4. Write a java program to check whether given date is valid or not
5. Write a java program to implement ATM Transaction Using Switch statement
6. Write a java program to generate the following pattern

```
            A
         A  B  A
      A  B  C  B  A
   A  B  C  D  C  B  A..
```

7. Write a java program to find sum of all digits of a given number until given number become single digit
8. Write a program to create an array of 10 integers. Accept values from the user in that array Input another number from the user and find out how many numbers are equal to the number passed, how many are greater and how many are less than the number passed
9. Write a java program to sort the given element using selection sort
10. Write a java program to find the trace and norm of the given square matrices

PART B

1. Write a java program to Generate Employee Salary slip Using Class and Object
2. Write a java program to check whether entered character is a vowel or consonant using Constructor
3. Write a java program to Demonstrate Method Overloading
4. Write java program to generate Student marks card Using Inheritance
5. Write a java program to calculate bonus for different departments using abstract class
6. Write a java program to Demonstrate Method Overriding
7. Write a java program to that reads two integer numbers for the variables a and b. If any other character except number (0-9) is entered then the error is caught by Number Format Exception object. After that ex. getMessage () prints the information about the error occurring causes
8. Write a java program to Demonstrate multiple Inheritance using Interface
9. Write a java program to Demonstrate multithreading
10. Write a applet program to generate the following pattern

ECC22001

III SEMESTER

DSC 8A: Database Management Systems

Credit (L: T: P = 4: 0: 0)

Course Outcome

After successful completion of the course, the student is able to

CO 1 Understand the characteristics of DBMS with examples

CO 2 Deliberate the details of types of database languages with examples

CO 3 Learn the details of ER- Diagrams and Relationship

CO 4 Understand in depth Basic concepts of Relational Model

CO 5 Learn in details with examples MYSQL Commands

CO 6 Learn in details with examples in PL-SQL

Unit - 1 **15 Hours**

Introduction to Database Management Systems: Definition of Data, Information, DBMS, Data base system application, Purpose of database systems, Characteristics of DB – Self describing nature, Insulation between programs, data and data Abstraction (data Independence), support of multiple views of the data, sharing of data and multiples transaction processing. Storage management, Database language – DDL, DML,DCL, File processing system v s DBMS, Data models, Levels of Abstraction in a DBMS, Three Schema architecture, Characteristics of database approach,, data models, DBMS architecture and data independence.

Unit - 2 **15 Hours**

Entity Relationship and Enhanced ER Modelling: Entity types, Entity Sets, Attributes and Keys, Relationships, Relationship Types, Roles, and Structural Constraints, Weak Entity Types, ER Diagrams, Naming Conventions, SQL99: Schema Definition, constraints, and object modelling

Unit - 3 **15 Hours**

Relational Data Model: Basic concepts, Relational Constraints and Relational Database Schemas, Update Operations and Dealing with Constraint Violations, Basic Relational Algebra Operations.

Database design: ER and EER to relational mapping, functional dependencies, normal forms-first normal form, second normal forms, Third normal form BCNF

Unit - 4 **15 Hours**

MYSQL (SQL/PL-SQL): sql vs. Sql * plus: sql commands and data types, operators and expressions, introduction to sql * plus.

Managing tables and data: Creating and altering tables (including constraints)

Data manipulation command like insert, update, delete Select statement with where, group by and having, order by, distinct, special operator like - in, any, all between, exists, like SQL Wildcards joins, built in functions other database objects

Synonyms, index transaction control statements
Commit, rollback, save point
Introduction to pl/sql: sql v/s pl/sql, pl/sql block structure
Language construct of pl/sql (variables, basic and composite data type, conditions, looping ...
% type and % row type using cursor (implicit, explicit)
Trigger and its types

Reference Books:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education,2013.

ECC22101

III SEMESTER
DSC 8A: Database Management Systems Lab
Credit (L: T: P = 0: 0: 2)

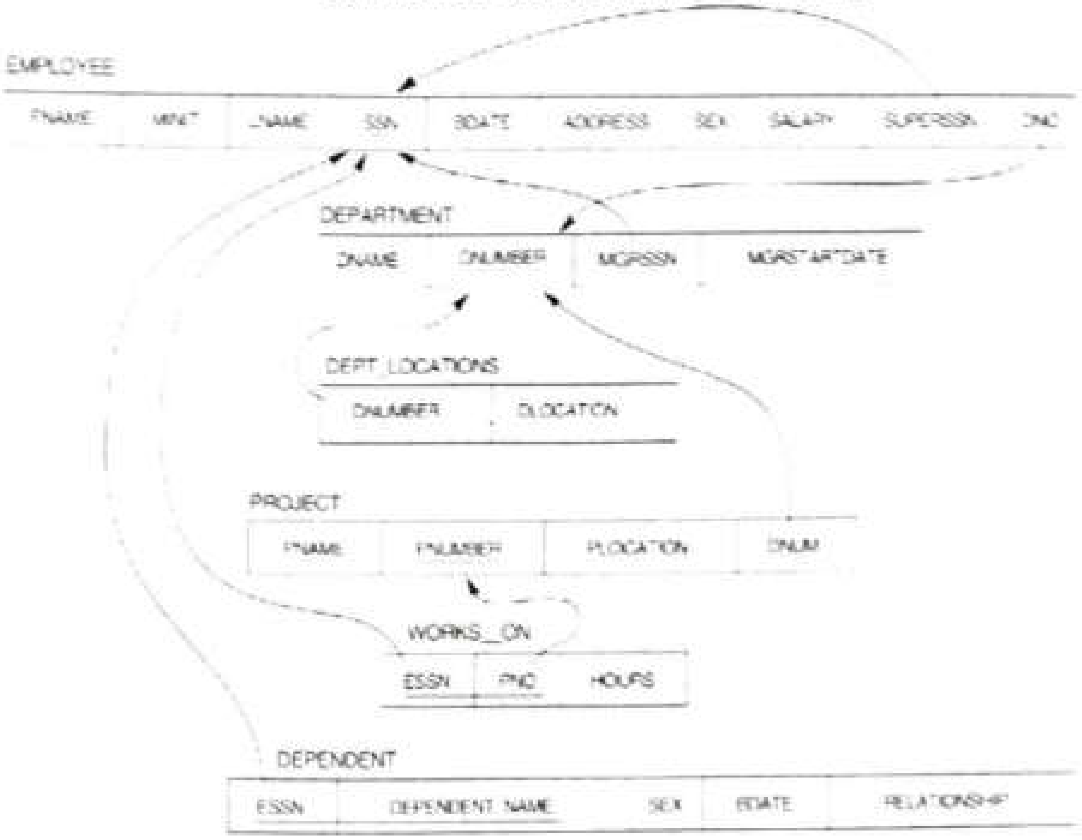
Software Lab based on Database Management Systems

The following concepts must be introduced to the students: **Note:** MS Access / MySQL may be used.

DDL Commands
- Create table, alter table, drop table

DML Commands
- Select, update, delete and insert statements
- Condition specification using Boolean and comparison operators (and, or, not,=,<>,>,<,>=,<=)
- Arithmetic operators and aggregate functions (Count, sum, avg, Min, Max)
- Multiple table queries (join on different and same tables) • Nested select statements
- Set manipulation using (any, in, contains, all, not in, not contains, exists, not exists, union, intersect, minus, etc.)
- Categorization using group by........having
- Arranging using order by

Relational Database Schema - COMPANY



1. Create tables with relevant foreign key constraints
2. Populate the tables with data
3. Perform the following queries on the database:
   a. Display all the details of all employees working in the company.
   b. Display ssn, lname, fname, address of employees who work in department no 7.
   c. Retrieve the birthdate and address of the employee whose name is 'Franklin T. Wong'
4. Retrieve the name and salary of every employee
5. Retrieve all distinct salary values
6. Retrieve all employee names whose address is in 'Bellaire'
7. Retrieve all employees who were born during the 1950s
8. Retrieve all employees in department 5 whose salary is between 50,000 and 60,000(inclusive)
9. Retrieve the names of all employees who do not have supervisors
10. Retrieve SSN and department name for all employees
11. Retrieve the name and address of all employees who work for the 'Research' department 12. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birth date.
13. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
14. Retrieve all combinations of Employee Name and Department Name

15. Make a list of all project numbers for projects that involve an employee whose last name is 'Narayan', either as a worker or as a manager of the department that controls the project. 16. Increase the salary of all employees working on the 'ProductX' project by 15%. Retrieve employee name and increased salary of these employees.
17. Retrieve a list of employees and the projects they are working on, ordered by the department and, within each department, ordered alphabetically by employee first name.
18. Select the names of employees whose salary does not match with salary of any employee in department 10.
19. Retrieve the name of each employee who has a dependent with the same first name and same sex as the employee.
20. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford.
21. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings.
22. Find the sum of the salaries and number of employees of all employees of the 'Marketing' department, as well as the maximum salary, the minimum salary, and the average salary in this department.
23. Select the names of employees whose salary is greater than the average salary of all employees in department 10.
24. For each department, retrieve the department number, the number of employees in the department, and their average salary.
25. For each project, retrieve the project number, the project name, and the number of employees who work on that project.
26. Change the location and controlling department number for all projects having more than 5 employees to 'Bellaire' and 6 respectively. 27. For each department having more than 10 employees, retrieve the department no, no of employees drawing more than 40,000 as salary.
28. Insert a record in Project table which violates referential integrity constraint with respect to Department number. Now remove the violation by making necessary insertion in the Department table.
29. Delete all dependents of employee whose ssn is '123456789'.
30. Delete an employee from Employee where ssn = '12345' (make sure that this employee has some dependents, is working on some project, is a manager of some department and is supervising some employees). Check and display the cascading effect on Dependent and Works on table. In Department table MGRSSN should be set to default value and in Employee table SUPERSSN should be set to NULL. 31. Perform a query using alter command to drop/add field and a constraint in Employee table.

ECC23001

III SEMESTER

DSC 9A: Web Technologies

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO 1. Learn the details of HTML tags

CO 2. Understand in details with examples Document object Model

CO 3. Understand the details of Basic CSS and implements

CO 4. Understand the details of Basic Concepts of Java Scripts

CO 5. Write down in details with application and Usage of Java scripts

CO 6. Deliberate in depth JQuery& Bootstrap with Examples

Unit - 1 15 Hours

Introduction to Web Design: Introduction to Hyper Text Markup Language (HTML), header, footer, formatting tags, graphical elements, inserting images, lists, hyperlinks, tables.

Frames- Introduction, frameset, Forms- attributes of forms. Creating web pages

DOM: Basics of DOM, DOM methods, functions Forms collection, table collections Inner HTML.

Unit - 2 15 Hours

Cascading Style Sheets: Introduction, Understanding the Basic CSS syntax, Types of style sheets, multiple sheets, and Background properties, Text properties, Font properties, and Border properties, Margin properties padding list & table properties, DIV, SPAN, CSS Layout - The position Property, float and clear, the display-inline-block Property, Overflow

CSS Advanced - Rounded Corners, Border Images, Backgrounds, Colors, Gradients, Shadows, Text Effects, Web Fonts, 2D & 3D Transforms, Transitions, Animations

Unit - 3 15 Hours

JavaScript: Introduction, Java script in HTML, Java script statement, comments, Expressions, Data types, operators, Conditional statements, Loop statements, functions, Popup boxes ,Array & Boolean Objects Math & Date Objects String & Number Objects, events and event handling & form document object.

Unit - 4 15 Hours

JQuery: Introduction, Syntax, Selectors, Events, Effects, Hide/Show, Fade, Slide, Animate, stop (), Callback, Chaining

JQuery HTML Interface: Get, Set, Add, Remove, CSS Classes, css (), Dimensions

JQuery Traversing: Ancestors, Descendants, Siblings & Filtering

Bootstrap 4: Introduction, Grid Basic, Typography, Colors, Tables, Images, Jumbotron, Alerts, Buttons, Badges, List Groups, Cards, Dropdowns, Collapse, Navs, Navbar, Forms, Inputs, Input Groups, Custom Forms, Carousel, Modal, Tooltip, Popover, Toast, Scrollspy, Utilities, Flex, Icons, Media Objects, Filters

Reference Books:

1. M.Deitel, P.J.Deitel, A.B.Goldberg: Internet & World Wide Web How to program, 3rd Editior Pearson Education / PHI, 2004.
2. Chris Bates: Web Programming Building Internet Applications, 3rd Edition, Wiley India, 200
3. 3. XueBai et al: The Web Warrior Guide to Web Programming, Thomson, 2003.
4. *Learning jQuery Fourth Edition-Jonathan Chaffer.*
5. *Web Development with jQuery -Richard York*
6. *Bootstrap-Jake Spurlock*
7. *Mastering Bootstrap4- Benjamin Jakobus, Jason Marah*

ECC23101

III SEMESTER

DSC 9A: Web Technologies Lab
Credit (L: T: P = 0: 0: 2)

1. Program for formatting tags.
2. Creating a Webpage having Hyperlink.
3. Creating Types of Lists (Ordered, Unordered, Definition).
4. Creating a Nested List.
5. Creating a Time Table.
6. Creating a HTML document having vertical frames.
7. Creating Student Application Form.
8. Program to insert audio & video files
9. Creating Internal & External Style Sheets.
10. Program to Margin & Padding.
11. Program to create a Greeting card
12. Program to Image Transparency
13. Program to generate Fibonacci series in JavaScript.
14. Program to display Rainbow Colors in JavaScript.
15. Program to create Pop-Up Boxes.
16. Program to generate multiplication table.
17. Program to find even and odd numbers.
18. Program to add 2 numbers.
19. Program to find factorial of a numbers.
20. Program to generate 2 different patterns.
21. Program to change background color after 5 sec of page load.
22. Display reverse of a given number.
23. Display Time Using Jquery
24. Design Simple Department web Site Using Bootstrap
25. Design Web page using Bootstrap and Jquery

ECD21001

IV SEMESTER

DSC 10A: Numerical Analysis and Statistics
Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Understand the details of Computer Numerical data and arithmetic

CO2. Understand the classification and characteristics of Iterative Methods in numerical analysis

CO3. Deliberate in details with examples Matrices and linear system of Equations

CO4. Specify in details with examples Interpolation

CO5. Understand in depth Numerical integration and differentiation

CO6. Learn the details of Importance and limitations of statistics

Unit - 1 **15 Hours**

Computer Arithmetic: Fixed- and Floating-point representation, Normalization of numbers. Errors in numbers.

Iterative methods: Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method

Unit - 2 **15 Hours**

Matrices and Linear System of Equations: LU decomposition method, Gauss elimination, Gauss serial and Gauss Jordan for solving system of equations

Interpolation: Polynomial interpolation, Newton-Gregory forward and backward interpolation, Newton's divided differences interpolation formulae.

Unit - 3 **15 Hours**

Numerical Integration: Trapezoidal rule, Simpson's 1/3rd and 3/8th rule,

Numerical Differentiation: Euler's, modified Euler's and Runge-Kutta (RK) 2nd order and 4th order.

Unit - 4 **15 Hours**

Statistics: Definition, Importance, Functions and Limitations of statistics.

Graphic presentation: Frequency distribution, Histogram, Frequency polygon, frequency curve and O gives Measures of central tendency: (Mean, Median, Mode) Dispersion, Correlation, Regression.

Reference Books:

1. K.E. Atkinson, W. Han, Elementary Numerical Analysis, 3rd Ed., Wiley, 2003.
2. C. Xavier, S.S. Iyengar, Introduction to Parallel Algorithms, Wiley-Interscience, 1998.
3. A. Kharab, R.B. Guenther, An Introduction to Numerical Methods: A MATLAB Approach, 1st Chapman and Hall/CRC, 2001.
4. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, 2007.
5. S.R. Otto and J.P. Denier, An Introduction to Programming and Numerical Methods in MATLAB, Springer, 2005.
6. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 7th Ed., New Age International Publishers, 2007.
7. Computer oriented numerical methods by V Rajaraman
8. Statistics Theory and Practice by R S N Pillai, Bagavathi
9. Practical statistics by S P Gupta

ECD21101

IV SEMESTER

DSC 10A: Numerical Analysis and Statistics Lab

Credit (L: T: P = 0: 0: 2)

Software lab based on numerical techniques and statistics

1. Brute force method
2. Bisection method
3. regula –falsi method
4. NewtonRaphson
5. Secant
6. LU decomposition
7. Gauss elimination
8. GaussJordan
9. Gauss seidal
10. Euler's
11. modified Euler's
12. Runge Kutta ii order
13. Runge Kutta iv order
14. Trapezoidal
15. Simpson's 1/3 rd Rule
16. Simpson's 3/8 th Rule
17. Finding the mean, median and mode of a set of data
18. Finding the range of a set of data
19. Finding the standard deviation of a set of data
20. Newton's forward and backward interpolation
21. Newton's divided difference

ECD22001

IV SEMESTER
DSC 11A: J2EE
Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO 1. Learn the details of Basic elements of J2EE

CO 2. Deliberate the details of Concepts of Multi-Tier Architectures

CO 3. Understand the characteristics of Enterprise Application Strategy

CO 4. Write down in depth Basic Concepts of JDBC

CO 5. Identify in details with examples implementation of SQL Commands Using JDBC objects

CO 6. Learn in details with examples Basic Concepts of Servlets

CO 7. Learn in details with examples Basic Concepts of JSP

Unit - 1 15 Hours

Introduction: The ABC of Programming Languages, taking programming languages up a notch, the beginning of java, java byte-code, the advantages of Java, J2EE and J2SE.

J2EE Multi-Tier Architecture: Distributive systems, the Tier, J2EE Multi-Tier Architecture, Client Tier Implementation, Web Tier Implementation, Enterprise JavaBeans Tier Implementation, Enterprise Information Systems Tier Implementation, Challenges.

J2EE Nest Practices: Enterprise Application Strategy, The enterprise application, clients, Sessions Management, Web Tier and Java Server pages, Enterprise Java Beans Tier, The Myth of using inheritance, Maintainable classes, Performance Enhancements, The power of Interfaces, The power of threads, The power of Notification.

Unit - 2 15 Hours

J2EE Database Concepts: Data, Database, Database Schema, the Art of Indexing.

JDBC Objects: The concept of JDBC, JDBC Driver Types, JDBC packages, A Brief overview of the JDBC Process, Database Connection, Associating the JDBC / ODBC Bridge with the database, Statement Objects, Result Set, Transaction Processing, and Metadata.

Unit - 3 15 Hours

JDBC and Embedded SQL: Model Programs: Model A Program, Model B Program, Tables: Creating a Table, Dropping a Table, Indexing: Creating an Index, Dropping an Index, Inserting Data into tables: Inserting a Row, Inserting the systems date into a column, Inserting the system Time into a column, Inserting a Timestamp into a column, Selecting Data from a Table: Selecting all data from a Table, Requesting one column, Requesting Multiple column, Requesting rows, Requesting rows and columns, AND, OR, and NOT clauses, Joining multiple compound expressions, equal & not equal operators, Less than & greater than operators, Less than equal to & greater than equal to, BETWEEN, LIKE, IS NULL Operator, DISTINCT Modifier, IN modifier.

Unit - 4 **15 Hours**

Metadata: Number of columns in result set, Data type of a column, Name of a column, Column Size, updating Tables: Updating a row and column, updating multiple rows, Deleting Data from a table: Deleting a Row from a table, Joining tables, Calculating Data, Grouping and ordering data, sub queries, view.

Java Servlets: Java Servlets and common gateway interface programming: Benefits of using a Java servlet, A simple Java Servlets, Anatomy of a java Servlets: Development Descriptor, Reading Data from a client, Reading HTTP request Headers, Sending Data to a Client, writing the HTTP response Header, Working with cookies, Tracking Sessions, Quick reference guide.

JAVA Server Pages: JSP installation, JSP Tags: Variables & objects, Methods, Control Statements, Loops, Tomcat, Request string: Parsing other information, User sessions, cookies, Session objects, Quick reference guide.

Reference Books:

1. The complete reference J2EE seventh edition - Java 2 Enterprise edition overview
2. J2EE: The complete Reference - McGraw-Hill Education

ECD22101

IV SEMESTER
DSC 11A: J2EE Lab
Credit (L: T: P = 0: 0: 2)

1. Program to Create Jdbc Connection
2. Application to access the database using the Java Database Connectivity (JDBC).
3. Perform a Database Query and View Results.
4. Write a program to display a day of a given date
5. Write a program to Display request header information.
6. Write a program to calculate income tax of a customer using database
7. Write a program to display cookie value, cookie age and cookie path.
8. Write a program in JSP file to set and then display the cookie.
9. Write a program for Java script validation.
10. Write a JAVA Servlets Program to implement a dynamic HTML using Servlets (user name and password should be accepted using HTML and displayed using a Servlets).
11. Write a JAVA Servlets Program to Download a file and display it on the screen (A link has to be provided in HTML, when the link is clicked corresponding file has to be displayed on Screen)
12. Write a JAVA Servlets Program to implement Request Dispatcher object (use include () and forward () methods)
13. Write a JAVA Servlets Program to implement and demonstrate get() and Post methods(Using HTTP Servlets Class).
14. Write a JAVA Servlets Program to implement send Redirect () method (using HTTP Servlets Class).
15. Write a JAVA Servlets Program to implement sessions (Using HTTP Session Interface).
16. Write a JAVA JSP Program to print 10 even and 10 odd numbers.
17. Write a JAVA JSP Program to implement verification of a particular user login and display a welcome page.
18. Write a JAVA JSP Program to get student information through a HTML and create a JAVA Bean Class, populate Bean and display the same information through another JSP.
19. Write a JAVA JSP Program which uses <jsp:plugin> tag to run a applet
20. Write a JAVA JSP Program which implements nested tags and also use TagSupport Class.

ECD23001

IV SEMESTER

DSC 12A: Software Engineering and Software Testing

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO 1. Understand in details with examples Concepts of Software process
CO 2. Specify the details of Software requirements and analysis
CO 3. Learn in depth Design concepts and principles of software engineering
CO 4. Understand in depth software Configuration Management and Project Managemen
CO 5. Learn in details with examples Software Tastings
CO 6. Specify in depth trends in software engineering

Unit - 1 15 Hou

Software Process: Introduction, S/W Engineering Paradigm, life cycle models (water fa incremental, spiral, evolutionary, prototyping, object oriented), System engineeri computer based system, verification, validation, life cycle process, development proc system engineering hierarchy.

Software requirements: Functional and non-functional, user, system, requireme engineering process, feasibility studies, requirements, elicitation, validation and manageme software prototyping, prototyping in the software process, rapid prototyping techniqu user interface prototyping, S/W document.

Unit - 2 15 Hou

Software Analysis: Analysis and modeling, data, functional and behavioral mode structured analysis and data dictionary.

Design Concepts and Principles: Design process and concepts, modular design, des heuristic, design model and document, Architectural design, software architecture, d design, architectural design, transform and transaction mapping, user interface design, u interface design principles. Real time systems, Real time software design, system design, r time executives, data acquisition system, monitoring and control system.

Unit - 3 15 Hou

Software Configuration Management: The SCM process, Version control, Change cont Configuration audit, SCM standards.

Software Project Management: Measures and measurements, S/W complexity and scie measure, size measure, data and logic structure measure, information flow meas Estimations for Software Projects, Empirical Estimation Models, Project Scheduling.

Unit - 4 **15 Hours**

Testing: Taxonomy of software testing, levels, test activities, types of s/w test, black box testing, and testing boundary conditions, structural testing, test coverage criteria based on data flow, mechanisms, regression testing, testing in the large. S/W testing strategies, strategic approach and issues, unit testing, integration testing, validation testing, system testing and debugging.

Trends in Software Engineering: Reverse Engineering and Re-engineering – wrappers – Case Study of CASE tools.

Reference Books:

1. Roger S. Pressman, Software engineering- A practitioner's Approach, McGraw-Hill
2. Ian Sommerville, Software engineering, Pearson education Asia, 6th edition, 2000.
3. PankajJalote- An Integrated Approach to Software Engineering, Springer Verlag, 1997.
4. James F Peters and WitoldPedryez, "Software Engineering – An Engineering Approach", John Wiley and Sons, New Delhi, 2000.
5. Ali Behforooz and Frederick J Hudson, "Software Engineering Fundamentals", Oxfor University Press, New Delhi, 1996.
6. Pfleeger," Software Engineering", Pearson Education India, New Delhi, 1999.
7. Carlo Ghezzi, Mehdi Jazayari and Dino Mandrioli, "Fundamentals of Software Engineering", Prentice Hall of India, New Delhi, 1991.

ECD23101

IV SEMESTER

DSC 12A: Software Engineering and Software Testing Lab

Credit (L: T: P = 0: 0: 2)

Lab based on Software Engineering

1. Practical Title
   - Problem Statement,
   - Process Model
2. Requirement Analysis
   - Creating a Data Flow
   - Data Dictionary,
   - Use Cases
3. Project Management
   - Computing FP
   - Effort
   - Schedule, Risk Table, Timeline chart
4. Design Engineering
   - Architectural Design
   - Data Design, Component Level Design
5. Testing
   - Basis Path Testing. Sample Projects like
   - DTC Route Information: Online information about the bus routes and their fre and fares
   - Car Pooling: To maintain a web based intranet application that enables the emp
   - Employees within an organization to avail the facility of carpooling effectively
   - Patient Appointment and Prescription Management System
   - Organized Retail Shopping Management Software
   - Parking Allocation System
   - Wholesale Management System

ECE21001

V SEMESTER

DSE 1A: Elective: Data Communication and Computer Networks

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn in depth Elements of Data Communications and network Systems

CO2. Learn in depth Transmission Media

CO3. Understanding the various classifications and characteristics of Signals

CO4. Understand in details with examples Network Models

CO5. Learn in depth Error Detection and Corrections Algorithms

CO6. Deliberate in details with examples Switching Concepts

CO7. Deliberate the classification and characteristics of networking and internetworking Devices

Unit - 1 — 15 Hours

Data Communications: Components, Data Representation, Dataflow
Networks: Network criteria, Physical Structures, Topology (Mesh, Star, Tree, Bus, Ring, Hybrid)
Categories of Network: LAN, MAN, WAN
History of Network: Protocols and Standards: Protocols (Standards organization),
Addressing: Physical, Logical, Port Specific.

Unit - 2 — 15 Hours

Transmission Media: Guided Media – Twisted pair cable, co-axial cable, optical fibre, Unguided Media – Radio waves, microwaves, Infrared.
Signals: Analog and Digital Data, Analog and Digital Signals, periodic and non periodic signals. Analog Signals – Sine wave, Peak Amplitude, Period and frequency, Phase, wave length, composite signals. Digital Signals – Band width, Bit length, Bit rate, base band transmission, Digital v/s Analog, Transmission Impairment, Data rate limits (Noisy and noiseless channel)

Unit - 3 — 15 Hours

Network Models: Layered tasks, OSI model (peer – to – peer), Layered Architecture. Functions of Layers (OSI), TCP / IP Protocol suite
Multiplexing: FDM (MUX and DEMUX process, Application of FDM), WDM, TDM (Interleaving, synchronizing, bit padding)
Switching Concept: Working principle of circuit switching and packet switching. Circuit switched networks, three phases' efficiency, delay, Data grams network, routing table, delay efficiency, virtual.

Error Detection and Correction: Types of Errors, Redundancy, Error detection vir Correction.

Error Detection: Parity check, Cyclic Redundancy Check (CRC), Check Sum, Correction - Retransmission, Forward Error Correction, Burst error Correction.

Unit - 4 15 H

Networking And Internetworking Devices: Connecting Devices - Hubs, Rep Amplifiers, Bridges – LAN bridges, transparent bridges, Source-route bridges, Ro Gateways, 2 layer and 3 layers switches.

Routing Concepts: Types, Shortest path, flooding.

Wireless Lan's: Blue tooth - Architecture, Blue tooth layers.

Network Layer: IPV4, IPV6 addresses

Transport Layer: UDP – user datagram, operations, Application. TCP - Services segment, SCTP - Services, packet format.

Application Layer: - SMTP, SNMP, HTTP, FTP

Reference Books:

1. Data Communication and Networking – Forouzan
2. Computer Network – Tanenbaurn – 3rd Editions
3. Computer Network – Larry L. Peterson & Bruce S. Davie

ECE21101

V SEMESTER

DSE 1A: Elective: Data Communication and Computer Networks L Credit (L: T: P = 0: 0: 2)

1. Program for Identifying well known Ports
2. Program for Data Retrieval from Remote Database.
3. Program for Simulating SMTP Client.
4. Program for Simulating Telnet Client
5. Program for Simple file transfer between two systems, (without using Protoco
6. Program for implementing HTTP.
7. Program for Downloading Image files.
8. Simulate Checksum Algorithm.
9. Simulate Stop & Wait Protocol.
10. Simulate Go-Back-N Protocol.
11. Simulate Selective Repeat Protocol.
12. Take an example subnet of hosts. Obtain broaECAst tree for it.
13. Network address with automatic subnet address generation:

ECE22001

V SEMESTER

DSE 1B: Elective: Computer Graphics

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn the classification and characteristics of Elements of Graphics Systems
CO2. Learn in depth Graphics Algorithms
CO3. Deliberate the classification and characteristics of 2D Graphics
CO4. Understand the characteristics of 3D Graphics
CO5. Deliberate the details of Transformation and Viewing Techniques
CO6. Learn the details of Illumination and Color Models

Unit - 1 15 Hours

INTRODUCTION: Survey of computer graphics, Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software: Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

Unit - 2 15 Hours

TWO-DIMENSIONAL GRAPHICS: Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two-dimensional viewing – viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.

Unit - 3 15 Hours

THREE-DIMENSIONAL GRAPHICS: Three dimensional concepts; Three-dimensional object representations – Polygon surfaces Polygon tables- Plane equations – Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces.

TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

Unit - 4 15 Hours

ILLUMINATION AND COLOUR MODELS: Light sources – basic illumination models – halftone patterns and dithering techniques; Properties of light – Standard primaries and chromaticity diagram; Intuitive color concepts – RGB color model – YIQ color model – CMY colour model – HSV color model – HLS color model; Color selection.

Reference Books:

1. Computer Graphics C Version by Donald Hearn & M. Pauline Baker Pearson Educati Delhi, 2004
2. Procedural Elements for Computer Graphics by David F. Rogers, Tata McGraw H Company, New Delhi, 2003
3. Computer Graphics: Principles & Practice in C by J. D. Foley, S. K Feiner, A Van Dam F. Pearson Education, 2004
4. Computer Graphics using Open GL by Franscis S Hill Jr Pearson Education, 2004.

ECE22101

V SEMESTER

DSE 1B: Elective: Computer Graphics Lab
Credit (L: T: P = 0: 0: 2)

1. Implementation of Bresenham's Algorithm – Line, Circle, Ellipse.
2. Implementation of Line, Circle and ellipse attributes
3. Two Dimensional transformations - Translation, Rotation, Scaling, Reflection, Shear.
4. Composite 2D Transformations
5. Cohen Sutherland 2D line clipping and Windowing
6. Sutherland – Hodgeman Polygon clipping Algorithm
7. Three dimensional transformations - Translation, Rotation, Scaling
8. Composite 3D transformations
9. Drawing three dimensional objects and Scenes
10. Generating Fractal images

ECE23001

V SEMESTER

DSE 1C: Elective: Multimedia Systems and Applications

Credit (L: T: P = 4: 0:0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Understand the details of Components of Multimedia with applications

CO2. Identify in details with examples Text, Images, Sound and Videos

CO3. Learn in depth Animation Techniques

CO4. Understand the details of Multimedia in internet

CO5. Deliberate the characteristics of Making Multimedia

CO6. Deliberate in depth Multimedia Making Tools

Unit - 1 — 15 Hours

Multimedia: Introduction to multimedia, components, uses of multimedia, multimedia applications, virtual reality.

Text: Fonts & Faces, Using Text in Multimedia, Font Editing & Design Tools, Hypermedia & Hypertext.

Images: Still Images – bitmaps, vector drawing, 3D drawing & rendering, natural light &colours, computerized colours, colour palettes, image file formats.

Unit - 2 — 15 Hours

Sound: Digital Audio, MIDI Audio, MIDI vs Digital Audio, Audio File Formats.

Video: How video works, analog video, digital video, video file formats, video shooting and editing.

Unit - 3 — 15 Hours

Animation: Principle of animations, animation techniques, animation file formats.

Internet and Multimedia: www and HTML, multimedia on the web – web servers, web browsers, web page makers and site builders.

Unit - 4 — 15 Hours

Making Multimedia: Stages of a multimedia project, Requirements to make good multimedia, Multimedia Hardware - Macintosh and Windows production Platforms, Hardware peripherals - Connections, Memory and storage devices, Multimedia software and Authoring tools.

Reference Books:

1. Tay Vaughan, "Multimedia: Making it work", TMH, Eighth edition.
2. Ralf Steinmetz and KlaraNaharstedt, "Multimedia: Computing, Communications Applications", Pearson.
3. Keyes, "Multimedia Handbook", TMH.
4. K. Andleigh and K. Thakkar, "Multimedia System Design", PHI.

ECE23101

V SEMESTER

DSE 1C: Elective: Multimedia Systems and Applications Lab

Credit (L: T: P = 0: 0: 2)

Practical exercises based on concepts listed in theory using Presentation tools in offic automation tool/ GIMP/Blender / Audacity/ Animation Tools/ Image Editors/ Video Edit

Implement the followings using Blender -

1. Create an animation using the tools panel and the properties panel to draw the follo – Line, pie, oval, circle, rectangle, square, pencil, brush and lasso tool
2. Create an animation using text tool to set the font, size, colour etc.
3. Create an animation using free transform tool that should use followings-
   - Move Objects
   - Skew Objects
   - Stretch Objects
   - Rotate Objects
   - Stretch Objects while maintaining proportion
   - Rotate Objects after relocating the centre dot
4. Create an animation using layers having following features- Insert layer, Delete l guide layer, Mask layer.
5. Modify the document (changing background color etc.) using the following tools
   - Eraser tool
   - Hand tool
   - Ink bottle tool
   - Zoom tool
   - Paint Bucket tool
   - Eyedropper tool
6. Create an animation for bus car race in which both starts from the same point and wins the race.
7. Create an animation in which text Hello gets converted into Good Bye (u motion/shape tweening).
8. Create an animation having five images having fade-in fade-out effect.
9. Create an scene to show the sunrise (using multiple layers and motion tweening)
10. Create an animation to show the ripple effect.
11. Create an animation (using Shape tweening and shape hints) for transforming one s into another.
12. Create an animation for bouncing ball (you may use motion guide layer).

OR

Project:

Design a minimum 10-pages interactive website using Joomla or WordPress.

ECE24001

V SEMESTER

DSE 2A: Elective: ASP.Net

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO 1. Learn the details of ASP.NET Framework
CO 2. Learn the details of ASP.NET working Environment
CO 3. Deliberate in details with examples Standard Control of ASP.NET
CO 4. Understand the details of Developing Simple Websites Using ASP.NET Controls
CO 5. Deliberate in depth Developing Simple Web Application Using ASP.NET Controls
CO 6. Learn the details of Database Access Controls
CO 7. Identify in details with examples Database Access Controls

Unit - 1 15 Hours

Overview of the ASP.NET: Introduction of different Web Technology, What is Asp.Net, How Asp.Net Works, Use of visual studio, Different Languages used in ASP.Net, Summary.
Framework: Common Language Runtime (CLR), .NET Framework Class Library, Summary

Unit - 2 15 Hours

Setting up and Installing ASP.NET: Installing Internet Information Server, Installation of Asp.Net, virtual directory, Application Setting in IIS, Summary.

Unit - 3 15 Hours

Asp.Net Standard Controls, Displaying information, Label Controls, Literal Controls, Bulleted List, Accepting User Input, Textbox controls, Radio Button and Radio Button List Controls, Checkbox and Checkbox List Controls, Button controls, Link Button Control, Image Button Control, Using Hyperlink Control, Dropdown List, List Box, Displaying Images, Image Control, Image Map Control, Using Panel Control, Using Hyperlink Control, Asp.Net, Page & State Management, Overview of events in page, Summary.

Unit - 4 15 Hours

Designing Websites with master pages, creating master pages, Creating default contents, nesting master pages, registering master pages in web configuration, Summary.
ASP.Net Theme: ASP.NET Website Theme, Named Skin and Default Skin in ASP.NET Theme, Style Sheet Theme and Theme Attributes of a Page Directive
Using the Rich Controls: Accepting File Uploads, Saving files to file system, Calendar Control, Displaying advertisements, Displaying Different Page view, Displaying a Tabbed Page View, Wizard Control, Summary.

Reference Books:

1. Mathew Mac Donald, ASP. Net The Complete Reference, McGraw –Hill, 2002.

ECE24101

V SEMESTER

DSE 2A: Elective: ASP.Net Lab
Credit (L: T: P = 0: 0: 2)

LAB MANUAL:

1. Write a Program to generate the factorial operation.
2. Write a Program to perform Money Conversion.
3. Write a Program to generate the Quadratic Equation.
4. Write a Program to generate the Login control.
5. Write a Program to perform Asp.Net state.
6. Write a Program to perform validation operation.
7. Write a Program to perform Tree view operation.
8. Write a Program to display the phone no of an author using database.
9. Write a Program to insert the data in to database using Execute-Non Query.
10. Write a Program to bind data using template in data list.
11. Write a Program to bind data using Hyperlink column in data grid.

ECE25001

V SEMESTER

DSE 2B: Elective: Visual Programming
Credit (L: T: P = 4: 0:0)

[Note: Use any open-source alternative such as Tkinter with Python SharpDevelop GAMBAS OPENXAVA with JAVA]

Course Outcome:

After successful completion of the course, the student is able to
CO 1. Learn in details with examples Basic concept Of GUI Environment
CO 2. Deliberate the details of GUI Controls
CO 3. Learn in details with examples Data types and Operations in Visual Programming
CO 4. Learn in details with examples Control statements in Visual Programming
CO 5. Write down in details with examples Modular Programming
CO 6. Learn the details of Forms Handling in Visual Programming
CO 7. Understand in depth Database Connectivity in Visual Programming

Unit - 1 15 Hours

GUI Environment: Introduction to graphical user interface (GUI), programming language (procedural, object oriented, event driven), the GUI environment, compiling, debugging, and running the programs.
Controls: Introduction to controls textboxes, frames, check boxes, option buttons, images, setting borders and styles, the shape control, the line control, working with multiple controls and their properties, designing the user interface, keyboard access, tab controls, default & cancel property, coding for controls.
Operations: Data types, constants, named & intrinsic, declaring variables, scope of variables, val function, arithmetic operations, formatting data.

Unit - 2 15 Hours

Decision Making: If statement, comparing strings, compound conditions (and, or, not), nested if statements, case structure, using if statements with option buttons & check boxes, displaying message in message box, testing whether input is valid or not.

Modular programming: Menus, sub-procedures and sub-functions defining / creating and modifying a menu, using common dialog box, creating a new sub-procedure, passing variables to procedures, passing argument by value or by reference, writing a function/ procedure.

Unit - 3 15 Hours

Forms Handling: Multiple forms creating, adding, removing forms in project, hide, show method, load, unload statement, me keyword, referring to objects on a different forms
Iteration Handling: Do loops, for next loops, using msg box function, using string function
Arrays and Grouped Data Control: Arrays - 1-dimension arrays, initializing an array using for each, user-defined data types, accessing information with user-defined data types, using list boxes with array, two dimensional arrays.

Unit - 4 **15 H**

lists, loops and printing list boxes & combo boxes, filling the list using property wind add item method, clear method, list box properties, removing an item from a list, list combo box operations.

Database Connectivity: Database connectivity of forms with back end tool like mysql, populating data in text boxes, list boxes etc. searching of data in database using forms. Updating/ editing data based on a criterion.

Reference Books:

1. Reference: Programming in Visual Basic 6.0 by Julia Case Bradley, Anita C. Millispangh (Tata Mcgraw Hill Edition 2000 (Fourteenth Reprint 2004))

ECE25101

V SEMESTER

DSE 2B: Elective: Visual ProgrammingLab
Credit (L: T: P = 0: 0: 2)

1. Print a table of numbers from 5 to 15 and their squares and Cubes.
2. Print the largest of three numbers.
3. Find the factional of a number n.
4. Enter a list of positive numbers terminated by zero. Find the sum and average of these numbers.
5. A person deposits Rs. 1000 in a fixed account yielding 5% interest. Complete the amount in the account at the end of each year for n years.
6. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list.
7. Read n numbers. Count the number of negative numbers, positive numbers and zeros in the list. Use of arrays.
8. Read a single dimension array. Find the sum and average of these numbers.
9. Read a two dimension array. Find the sum of two 2D Array.
10. Create a database Employee and Make a form to allow data entry to Employee Form with the following command buttons:

ECE26001

V SEMESTER

DSE2C: PHP Programming with MySQL
Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn in depth Elements of PHP
CO2. Learn in depth Interaction Methods Between HTML and PHP
CO3. Understand in depth PHP function
CO4. Understand in depth String Manipulation
CO5. Learn the characteristics of Regular Expression
CO6. Learn the details of Developing PHP Web Application

Unit - 1 15 Hours

Introduction Basic PHP Development Control Structure: Introduction to www, History, understanding client/server roles Apache, PHP, MySQL, XAMPP Installation PHP Basic syntax, PHP data Types, PHP Variables PHP Constants, PHP Expressions, PHP Operators Control Structures & Loop

Unit - 2 15 Hours

Working With the File System Working With Regular Expressions, Opening a File, Reading from a File, Writing to a File, File Locking, Uploading Files via an HTML Form, Getting File Information, Directory Functions, Getting a Directory Listing, The basic regular expressions, Matching patterns, Finding matches, Replace patterns

WORKING WITH FORMS: PHP Form handling, PHP GET/POST, PHP Form Validation, Accessing user input, Combine HTML and PHP code using hidden fields, Redirecting the user, File upload

Unit - 3 15 Hours

CLASSES AND OBJECTS: Object oriented concepts, define a class, attributes, Object, Object properties, methods, constructors and destructors, Class constants, Static method, Class inheritance, Abstract classes, Final keyword, Implementing Interface, Object serialization

Using Cookies: What are Cookies? – Setting Cookies – Using Cookie variables – Session Basics: What's a session? – Understanding Session variables – Managing User preferences with Sessions – Graphics: Drawing functions.

Unit - 4

15 H

INTRODUCTION TO DATABASE: What is RDBMS technology, Introduction to connecting to the MYSQL, selecting a database, adding data to a table, displaying re data on Web pages, Finding the number of rows, Inserting, Deleting, Entering and upd data, Executing multiple queries, Understanding Primary and Foreign Key, Underst Database Normalization, Dealing with Dates and Times

Reference Books:

1. Complete Beginner's Guide to PHP: Programming & Web Development by Palmer (22 February 2014)
2. PHP and MySQL Web Development *by Laura Thomson and Luke Welling*
3. PHP Reference: Beginner to Intermediate PHP5 *by Mario Lurig*
4. PHP 4: A Beginner's Guide *by William Mccarty*
5. *Julie Meloni and Matt Telles, PHP 6, Course Technology, CENGAGE Learning, India Ed 2008.*
6. *Kevin Tatroe, Peter Macintyre and RasmusLerdorf, Programming PHP, O'REILLY media edition, 2013.*

ECE26101

V SEMESTER

DSE2C: PHP Programming with MySQL Lab
Credit (L: T: P = 0: 0: 2)

1. Write a PHP program to find the factorial of a number.
2. Write a PHP program using Conditional Statements.
3. Write a PHP program to find the maximum value in a given multi-dimensional array.
4. Write a PHP program to find the GCD of two numbers using user-defined functions.
5. Design a simple web page to generate multiplication table for a given number using PHP.
6. Design a web page that should compute one's age on a given date using PHP.
7. Write a PHP program to download a file from the server.
8. Write a PHP program to store the current date and time in a COOKIE and display the Visited' date and time on the web page.
9. Write a PHP program to store page views count in SESSION, to increment the count on refresh and to show the count on web page.
10. Write a PHP program to draw the human face.
11. Write a PHP program to design a simple calculator.
12. Design an authentication web page in PHP with MySQL to check username and password

ECE27001

V SEMESTER

DSE 3A: Elective: Analysis and Design of Algorithms

(Credit L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn the details of Types of notion of Algorithm

CO2. Learn in details with examples Algorithm Design Techniques

CO3. Deliberate in depth Sorting Techniques

CO4. Deliberate in depth of Searching Techniques

CO5. Identify in details with examples Analysis of Graph Algorithms

CO6. Learn the details of Dynamic Programming Methods

Unit - 1 **15 Hours**

Introduction: Notion of Algorithm, Review of Asymptotic Notations, Mathematical Analysis of Non-Recursive and Recursive Algorithms Correctness of Algorithm

Algorithm Design Techniques: Iterative techniques Divide and conquer greedy algorithms.

Sorting Techniques: Selection sort, bubble sort, insertion sort, more sorting techniques-quick sort, merge sort. Radix sort,

Unit - 2 **15 Hours**

The Greedy Method: General Method - Container Loading - Knapsack Problem - Tree

Searching Techniques: Linear and Binary search, Complexity Analysis.

Graphs: Analysis of Graph algorithms -Depth-First Search Breadth-First Search and its applications, minimum Spanning Trees and Shortest Paths -PRIM 'S, KRUSKAL, Dijkstra's algorithm. Branching-Hamiltonian Circuit problem.

Unit - 3 **15 Hours**

Dynamic Programming: The General Method, Warshall's Algorithm, Floyd's Algorithm for the All-Pairs Shortest Paths, Single-Source Shortest Paths: The Travelling Salesperson problem.

Unit - 4 **15 Hours**

Vertex Splitting – Job Sequencing With Deadlines - Minimum Cost Spanning Trees – Optimal Storage on Tapes – Optimal Merge Patterns - #Single Source Shortest Paths#.

Backtracking: The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Knapsack Problem Branch and Bound: The Method - 0/1 Knapsack Problem.

Reference Books:

1. Analysis & design of Algorithm-Padma Reddy
2. A.V. Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Ed, 2006.
3. J. Kleinberg and E. Tardos, Algorithms Design, Pearson Education, 2006.
4. Ellis Horowitz, SatrajSahni and SanguthevarRajasekaran, Fundamentals of Comp Algorithms,Universities Press, Second Edition, Reprint 2009.
5. A.A.Puntambekar, Analysis and Design Of Algorithms, Technical Publications, 2

ECE27101

V SEMESTER

DSE 3A: Elective: Analysis and Design of Algorithms Lab

(Credit L: T: P = 0: 0: 2)

1. Implement Insertion Sort.
2. Implement Merge Sort.
3. Implement recursive algorithm
4. Implement Randomized Quick sort.
5. Implement Radix Sort.
6. Implement Searching Techniques (linear & Binary)
7. Implement selection sort
8. Implement Bubble sort
9. Implement Prim's Algorithm
10. Implement Dijkstra's Algorithm
11. Implement Krushkal's Algorithm
12. Implement Travelling Salesperson problem
13. Implement Floyd's Algorithm
14. Implement Depth First Search
15. Implement Binary Search tree.

ECE28001

V SEMESTER

DSE 3B: Elective: Mobile Applications

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate the details of Concepts of Event Driven Programming
CO2. Learn in details with examples issues of Mobile applications
CO3. Specify the details of Mobile applications Development tools and Frameworks
CO4. Deliberate in details with examples common Mobile device UI's
CO5. Write down in depth Data persistence Remote data storage and communication
CO6. Learn in details with examples Code signing

Unit - 1 **15 Hours**

Event Driven Programming: UI event loop, Threading for background tasks, Outlets / actions, delegation, notification, Model View Controller (MVC) design pattern.
Mobile application issues: limited resources (memory, display, network, file system), input / output (multi-touch and gestures), sensors (camera, compass, accelerometer, GPS)

Unit - 2 **15 Hours**

Development tools: Apple iOS toolchain: Objective-C, Xcode IDE, Interface Builder, Device simulator.
Frameworks: Objective-C and Foundation Frameworks, Cocoa Touch, UI Kit, Others: Core Graphics, Core Animation, Core Location and Maps, Basic Interaction.

Unit - 3 **15 Hours**

Common UI's for mobile devices: Navigation Controllers, Tab Bars, Table Views, Modal Views, UI Layout.
Data Persistence: Maintaining state between application invocations, File system, Property Lists, SQLite, Core Data.

Unit - 4 **15 Hours**

Remote Data-Storage and Communication: "Back End" / server side of application, RESTful programming, HTTP get, post, put, delete, database design, server side JavaScript / JSON.
Code signing: security, Keychain, Developers and App Store License Agreement

Reference:

1. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley, 2011.
2. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, D and Development, Prentice Hall, 2004.
3. Brian Fling, Mobile Design and Development, O'Reilly Media, 2009. Maximiliano
4. Firtman, Programming the Mobile Web, O'Reilly Media, 2010.
5. Christian Crumlish and Erin Malone, Designing Social Interfaces, O'Reilly Media, 2009.
6. James E Smith, Ravi Nair, "Virtual Machines", Morgan Kaufmann Publishers, 2006.

ECE28101

V SEMESTER

DSE 3B: Elective: Mobile Applications Lab

Credit (L: T: P = 0: 0: 2)

Software Lab based on Mobile Applications:

1. Installing Android Environment
2. Create Hello World Application
3. Sample Application about Android Resources
4. Sample Application about Layouts
5. Sample Application about Intents
6. Sample Application I about user interfaces
7. Sample Application about Animations
8. Make a Project based on above labs
9. Sample Application about Android Data
10. Sample Application about SQLite I
11. Sample Application about SQLite II
12. Project Presentation

ECE29001

V SEMESTER

DSE 3C: Elective: Machine Learning

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate the details of Concepts of Machine Learning
CO2. Learn in details with examples for Machine Learning Software
CO3. Specify the details of Linear Algebra
CO4. Deliberate in details with examples Linear & Logistic Regression
CO5. Write down in depth Regularization and its utility
CO6. Learn in details with methods of Neural Networks

Unit - 1 **15 Hours**

Introduction: Concept of Machine Learning, Applications of Machine Learning, Key elements of Machine Learning, Supervised vs. Unsupervised Learning, Statistical Learning: Bayesian Method, The Naive Bayes Classifier

Unit - 2 **15 Hours**

Software's for Machine Learning and Linear Algebra Overview: Plotting of Data, Vectorization, Matrices and Vectors: Addition, Multiplication, Transpose and Inverse using available tool such as MATLAB.

Unit - 3 **15 Hours**

Linear Regression: Prediction using Linear Regression, Gradient Descent, Linear Regression with one variable, Linear Regression with multiple variables, Polynomial Regression, Feature Scaling/Selection.

Logistic Regression: Classification using Logistic Regression, Logistic Regression vs. Linear Regression, Logistic Regression with one variable and with multiple variables.

Unit - 4 **15 Hours**

Regularization: Regularization and its utility: The problem of Overfitting, Application of Regularization in Linear and Logistic Regression, Regularization and Bias/Variance.

Neural Networks: Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multilayer Perceptrons, Multiclass Representation, Backpropagation Algorithm.

Readings

1. Ethem Alpaydin, "Introduction to Machine Learning" 2nd Edition, The MIT Press, 2009.
2. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" by Springer, 2007.
4. Mevin P. Murphy, "Machine Learning: A Probabilistic Perspective" by The MIT Press, 2012.

ECE29101

V SEMESTER

DSE 3C: Elective: Machine Learning Lab

Credit (L: T: P = 0: 0: 2)

For practical Labs for Machine Learning, students may use software like MABLAB/Octave or Python. For later exercises, students can create use their own datasets or utilize datasets from online repositories like UCI Machine Learning Repository (http: archive.ics.uci.edu ml).

1. Perform elementary mathematical operations in Octave MATLAB like addition, multiplication, division and exponentiation.
2. Perform elementary logical operations in Octave MATLAB (like OR, AND, Checking for Equality, NOT, XOR).
3. Create, initialize and display simple variables and simple strings and use simple formatting for variable.
4. Create Define single dimension multi-dimension arrays, and arrays with specific values like array of all ones, all zeros, array with random values within a range, a diagonal matrix.
5. Use command to compute the size of a matrix, size/length of a particular row/column, load data from a text file, store matrix data to a text file, finding out variables and features in the current scope.
6. Perform basic operations on matrices (like addition, subtraction, multiplication) display specific rows or columns of the matrix.
7. Perform other matrix operations like converting matrix data to absolute values, taking the negative of matrix values, additing removing rows columns from a matrix, finding the maximum or minimum values in a matrix or in a row column, and finding the sum of some all elements in a matrix.
8. Create various type of plots charts like histograms, plot based on sine/cosine function based on data from a matrix. Further label different axes in a plot and data in a plot.
9. Generate different subplots from a given plot and color plot data.
10. Use conditional statements and different type of loops based on simple examples.
11. Perform vectorized implementation of simple matrix operation like finding the transpose of a matrix, adding, subtracting or multiplying two matrices.
12. Implement Linear Regression problem. For example, based on a dataset comprising existing set of prices and area size of the houses, predict the estimated price of a given house.
13. Based on multiple features variables perform Linear Regression. For example, based on a number of additional features like number of bedrooms, servant room, number of balconies, number of houses of years a house has been built – predict the price of a house.
14. Implement a classification/ logistic regression problem. For example based on different features of students' data, classify, whether a student is suitable for a particular activity. Based on the available dataset, a student can also implement another classification problem like checking whether an email is spam or not.
15. Use some function for regularization of dataset based on problem 14.
16. Use some function for neural networks, like Stochastic Gradient Descent or backpropagation - algorithm to predict the value of a variable based on the dataset of problem 14.

ECE30001

V SEMESTER

(Shifted from II Semester)

SEC 1A: Elective: Mathematics
Credit (L: T: P = 2: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to
CO 1. Understand in details with examples trigonometry
CO 2. Understand the classification and characteristics of Analytic geometry
CO 3. Deliberate in details with examples straight lines
CO 4. Specify in details with examples pair of lines
CO 5. Specify the classification and characteristics of conics

Unit - 1 **15 Hours**

TRIGONOMETRY:
Radians-Trigonometric functions and identities-Allied angles-Trigonometric functions of compound angles and multiple angles-Transformation formulae.

Unit - 2 **15 Hours**

ANALYTICAL GEOMETRY
Co-ordinates-distance formula –section formula-area of a triangle.
Equation of lines-Equation of circles-conic section.

Reference Books:

1. Theory and Problems in Mathematics – I by BOSCO Publications 2004.
2. Theory and Problems in Mathematics – II by BOSCO Publications 2005.
3. Engineering Mathematics, Volumes I–IV by S Chandrasekhar.

ECE30201

V SEMESTER

(Shifted from II Semester)

SEC 1B: Elective: Business Mathematics

Credit (L: T: P = 2: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO 1. Specify the characteristics of matrices and determinants

CO 2. Write down in details with examples matrices and determinants

CO 3. Deliberate the characteristics of algebra

CO 4. Learn the classification and characteristics of permutation and combination

CO 5. Deliberate in details with examples mathematical induction

Unit - 1 15 H

Matrices and Determinants- Order-Types of matrices-Addition and subtraction of ma and multiplication of a matrix by a scalar-Product of matrices. Evaluation of determin order two and three-Properties of determinants (Statements only)-Cramer's rule-Singu non-singular matrices-Inverse of a non-singular matrices-Product of two determinants.

Unit - 2 15 H

Algebra- Partial fraction- Proper and improper fractions-Permutation-Circular Perm Combination-Standard derivation. Mathematic induction-Summation of series using $\sum n^2$ and $\sum n^3$.Binomial theorem for a positive integral index-Binomial coefficients.

Reference Books:

1. Mathematics for Economics and Business by R.S. Bhardwaj .
2. Business Mathematics by PadmalochanHazarika.
3. Business Mathematics by D.C. Sancheti and V.K. Kapoor.
4. Mathematical Economics by Dowling, T. Edword.
5. Mathematical Analysis for Economics by Allen, RGD.
6. Algebra by Natarajan, Manicavasagam Pillay and Ganapathy

ECE30401

V SEMESTER
(Shifted from II Semester)

SEC 1C: Elective: Accountancy & Financial Management

Credit (L: T: P = 2: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to
CO 1. Deliberate the details of Basic Accounting Concepts
CO 2. Specify in depth Examples of Accounting
CO 3. Understand the detail Concepts of Costing
CO 4. Learn in details with examples Budgetary Control

Unit - 1 15 Hours
ACCOUNTING:

Introduction: Principles, concepts and conventions, double entry system of accounting, ledger keeping.
Subsidiary books with special reference to simple cash book and three columns cash book.
Trial balance and final accounts of sole trader: Preparation trial balance, adjusting entries, including revenue for bad debts, revenue for discount on debtors and creditors, preparation of final accounts.

Unit - 2 15 Hours
COSTING & BUDGETARY CONTROL:

Funds flow statement: Meaning and concepts of funds, preparation of fund flow statement.
Unit costing: Preparation of cost sheet and tender price statement.
Marginal costing: Concepts, Marginal cost equations, P/V ratio, B.E.P., Margin of safety, Sales to earn a desired profit, Problems on the above.

Reference Books:

1. Accountancy Vol. 1 by B.S. Raman.
2. Accountancy Vol. 2 by B.S. Raman.
3. Management Accounting by R.K. Sharma and Gupta.
4. Financial Management by I.M. Pandey.

ECE30601

V SEMESTER
(Shifted from II Semester)
SEC 1D: Elective: Entrepreneurship Development
Credit (L: T: P = 2: 0: 0)

Course Outcome

After successful completion of the course, the student is able to

CO1. Specify the characteristics of Entrepreneurship
CO2. Deliberate the details of identification of opportunities
CO3. Understand in depth Feasibility and financial management of the Project
CO4. Write down the details of Project Report
CO5. Learn the characteristics of SWOT Techniques
CO6. Learn the details of Enterprise Rules and regulations

Unit - 1 15

Need - scope and characteristics of entrepreneurships special schemes for a [illegible] entrepreneur STED.

Identification of opportunities: Exposure to Demand based, Resource based, Serv[illegible] important substitutes and expert promotion industries. Market surveys techniques. Need scope and approaches for the project formulation. Criteria for the principles of p[illegible] selection and development. Structure of the project report, Choice of technology, [illegible] equipment. Institutions financing procedure and financial incentives. Financial [illegible] their significance.

Unit - 2 15

Books of accounts, financial statements and funds flow analysis. Resource management machine and material. Planning tools for establishing SSI

a. CREATIVITY AND INNOVATION
B. ROBLEMSOLVING APPROACH
c. STRENGTH AND WEAKNESS OPPORTUNITY AND THREAT (S[illegible] TECHNIQUES.

Techno economics feasibility of the project. Plan layout and process planning for the p[illegible] Quality control / quality assurances and testing of the products. Costing and p[illegible] Management of self and understanding human behavior.Sickness in small-scale in[illegible] and their remedial measures.

Reference Books:

1. Entrepreneurship Development – Kanaka
2. Entrepreneurship Development – VasanthDesa

ECE30701

V SEMESTER

SEC 2A: Elective: Object Oriented Modelling& Design with UML
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate in details with examples Object Oriented Development
CO2. Write down the details of OO Modeling Concepts
CO3. Learn the details of OO process Overview
CO4. Identify in depth Design of System Using OO Model
CO5. Specify the details of Steps for Implementation of OO Modeling
CO6. Learn the details of Design a System Using UML Tool

Object Oriented Modeling& Design with UML Lab

Term Work / Assignment

Each candidate will submit an approximately10-page written report on a case study or mini project. Students have to do OO analysis & design for the project problem, and develop use case model, analysis model and design model for it, using UML.

Practical assignment

Nine assignments, one on each of the diagrams learnt in UML.

Reference Books:

1. Object –oriented modeling and design- Michael R Blaha and James R Rumbaugh
2. Object Technology- David A.Taylor
3. Designing Flexible Object Oriented systems with UML – Charles Ritcher
4. Object Oriented Analysis & Design, Sat/.inger. Jackson, BurdThomson
5. Object Oriented Modeling and Design - James Rumbaugh
6. Teach Yourself UML in 24 Hours - Joseph Schmuilers

ECE30801

V SEMESTER

SEC 2B: Elective: JQuery
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate in details with examples JQuery
CO2. Learn the details of JQuery Overview
CO3. Specify the details of Steps for Implementation of JQuery
CO4. Learn the details of Design and use of JQuery

JQuery Lab

a. Test if jQuery is loaded.
b. Scroll to the top of the page with jQuery.
c. Disable right click menu in html page using jquery.
d. Blink text using jQuery.
e. Create a Zebra Stripes table effect.
f. Print a page using jQuery.
g. Limit character input in the text area including count.
h. Create a div using jQuery with style tag.
i. Move one DIV element inside another using jQuery.
j. Add a list element within an unordered list element.
k. Remove all the options of a select box and then add one option and select it.
l. How to get the value of a textbox using jQuery?
m. Remove style added with .css() function using jQuery.
n. Distinguish between left and right mouse click with jQuery.
o. Check if an object is a jQuery object.
p. How to detect whether the user has pressed 'Enter Key' using jQuery.
q. How to get textarea text using jQuery.
r. Access form input fields using jQuery.
s. Convert a jQuery object into a string.
t. How to detect a textbox's content has changed using jQuery?
u. Remove a specific value from an array using jQuery.
v. Add options to a drop-down list using jQuery.
w. Delete all table rows except first one using jQuery.
x. Count Child elements using jQuery.
y. Restrict "number"-only input for textboxes including decimal points.
z. Set value in input text using jQuery.
aa. Set a value in a span using jQuery.
bb. Find the class of the clicked element.
cc. Set href attribute at runtime using jquery.
dd. Find the total width of an element (including width, padding, and border) in jQuery
ee. Change options of select using jQuery.
ff. Access HTML form data using jQuery.

ECE30901

V SEMESTER

SEC 2B: Elective: MongoDB
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to
CO1. Deliberate in details with examples MongoDB
CO2. Learn the details of MongoDB Overview
CO3. Specify the details of Steps for Implementation of MongoDB
CO4. Learn the details of Design and use of MongoDB

MongoDB Lab

a. Write a MongoDB query to display all the documents in the collection restaurants.
b. Write a MongoDB query to display the fields restaurant_id, name, borough and cuisine for all the documents in the collection restaurant.
c. Write a MongoDB query to display the fields restaurant_id, name, borough and cuisine, but exclude the field _id for all the documents in the collection restaurant.
d. Write a MongoDB query to display the fields restaurant_id, name, borough and zip code, but exclude the field _id for all the documents in the collection restaurant.
e. Write a MongoDB query to display all the restaurant which is in the borough Bronx.
f. Write a MongoDB query to display the first 5 restaurant which is in the borough Bronx.
g. Write a MongoDB query to display the next 5 restaurants after skipping first 5 which are in the borough Bronx.
h. Write a MongoDB query to find the restaurants who achieved a score more than 90.
i. Write a MongoDB query to find the restaurants that achieved a score, more than 80 but less than 100.
j. Write a MongoDB query to find the restaurants which locate in latitude value less than -95.754168.
k. Write a MongoDB query to find the restaurants that do not prepare any cuisine of 'American' and their grade score more than 70 and latitude less than -65.754168.
l. Write a MongoDB query to find the restaurants which do not prepare any cuisine of 'American' and achieved a score more than 70 and located in the longitude less than -65.754168.
Note: Do this query without using $ and operator.
m. Write a MongoDB query to find the restaurants which do not prepare any cuisine of 'American ' and achieved a grade point 'A' not belongs to the borough Brooklyn. The document must be displayed according to the cuisine in descending order.
n. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which contain 'Wil' as first three letters for its name.
o. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which contain 'ces' as last three letters for its name.
p. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which contain 'Reg' as three letters somewhere in its name.
q. Write a MongoDB query to find the restaurants which belong to the borough Bronx and prepared either American or Chinese dish.

r. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which belong to the borough Staten Island or Queens or Bronxor Brooklyn.

s. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which are not belonging to the borough Staten Island or Queens or Bronxor Brooklyn.

t. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which achieved a score which is not more than 10.

u. Write a MongoDB query to find the restaurant Id, name, borough and cuisine for those restaurants which prepared dish except 'American' and 'Chinees' or restaurant's name begins with letter 'Wil'.

v. Write a MongoDB query to find the restaurant Id, name, and grades for those restaurants which achieved a grade of "A" and scored 11 on an ISO Date "2014-08-11T00:00:00Z" among many of survey dates.

w. Write a MongoDB query to find the restaurant Id, name and grades for those restaurants where the 2nd element of grades array contains a grade of "A" and score 9 on an ISO Date "2014-08-11T00:00:00Z".

x. Write a MongoDB query to find the restaurant Id, name, address and geographical location for those restaurants where 2nd element of coord array contains a value which is more than 42 and upto 52.

y. Write a MongoDB query to arrange the name of the restaurants in ascending order along with all the columns.

z. Write a MongoDB query to arrange the name of the restaurants in descending along with all the columns.

aa. Write a MongoDB query to arrange the name of the cuisine in ascending order and for that same cuisine borough should be in descending order.

bb. Write a MongoDB query to know whether all the addresses contains the street or not.

cc. Write a MongoDB query which will select all documents in the restaurants collection where the coord field value is Double

dd. Write a MongoDB query which will select the restaurant Id, name and grades for those restaurants which returns 0 as a remainder after dividing the score by 7

ee. Write a MongoDB query to find the restaurant name, borough, longitude and attitude and cuisine for those restaurants which contains 'mon' as three letters somewhere in its name.

ff. Write a MongoDB query to find the restaurant name, borough, longitude and latitude and cuisine for those restaurants which contain 'Mad' as first three letters of its name.

ECF21001

VI SEMESTER

DSE 4A: Elective: Operation Research
Credit (L: T: P = 4: 0: 0)

Course Outcome

After successful completion of the course, the student is able to
CO1. Write down the details of Origin and Development of Operation Research
CO2. Understand the characteristics of Linear Programming Problems and Methods
CO3. Deliberate in depth Transportation Problems
CO4. Deliberate in depth Assignment Problem
CO5. Identify in details with examples Network Analysis
CO6. Learn in depth Application of Operation Research

Unit - 1 **15 Hours**

Linear Programming Problems: Origin and development of operations research, formulation of Linear Programming problem, Graphical solution.
Theory of simplex method, Use of artificial variables and their solution.

Unit - 2 **15 Hours**

Transportation Problem: Mathematical formulation of transportation problem, Initial basic Feasible solution, North West corner rule, Matrix minima method, Vogel's approximation method, MODI method to find optimal solution.

Unit - 3 **15 Hours**

Assignment Problem: Mathematical formulation of an Assignment problem, Assignment algorithm, Hungarian Method to solve Assignment Problem.

Unit - 4 **15 Hours**

Network Analysis: Basic components of Network, Rules for drawing Network diagram Time calculation in Networks. Critical Path Method and PROJECT Evaluation and Review Techniques. Algorithm and flow chart for CPM and PERT.

Reference Books:

1. Taha, "Operations Research", 7th edition, Pearson Education, 2007.
2. Billey E. Gillett, "Introduction to Operations Research", Himalaya Publishing House, Delhi,1979.
3. HamadyA.Taha "Operations Research" , Collin Mac Millan, 1982

ECF21101

VI SEMESTER

DSE 4A: Elective: Operation Research Lab
Credit (L: T: P = 0: 0:2)

Lab based on Operation Research

1. LPP
2. Simplex
3. Dual Simplex
4. Big – M
5. Vogel's
6. Maxima and Minima
7. North West corner
8. Sequencing Problems
9. Modi Method
10. Hugarian Method
11. Assignment Problem

ECE22001

VI SEMESTER

DSE 4B: Elective: Enterprise Resource Planning

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate the details of ERP

CO2. Learn in depth Models of ERP

CO3. Write down in depth Business Process Mapping for ERP

CO4. Understand in details with applications of ERP and Related Technologies

CO5. Deliberate the details of ERP Modules

CO6. Specify in details with examples SAP

Unit - 1 15 Hours

Introduction to ERP, Evolution of ERP, What is ERP? Reasons for the growth of ERP, Scenario and Justification of ERP in India, Evaluation of ERP, Various Modules of ERP, Advantage of ERP and Disadvantage of ERP.

Unit - 2 15 Hours

An overview of Enterprise, Integrated Management Information, Business Modeling, ERP for Small Business, ERP for make to order companies, Business Process Mapping for ERP Module Design, Hardware Environment and its Selection for ERP Implementation.

Unit - 3 15 Hours

ERP and Related Technologies, Business Process Reengineering (BPR), Management Information System (MIS), Executive Information System (EIS), Decision support System (DSS), Supply Chain Management (SCM) (With Example)

Unit - 4 15 Hours

ERP Modules, Introduction to Finance, Plant Maintenance, Quality Management, Materials Management, ERP Market, Introduction, SAP AG, Baan Company, Oracle Corporation, People Soft, JD Edwards World Solutions Company, System Software Associates.

Reference Books:

1. C.S. V Murthy Enterprise Resource Planning
2. R.G. Saha – Enterprise Resource Planning - HPH
3. Alexis Leon, Leon Publishers: Enterprise Resource Planning
4. Ravi Anupindi, Sunil Chopra, Pearson Education". "Managing Business Process Flows
5. Altekar, PHI. Enterprise Resource Planning
6. Srivatsava, I.K. International Publishers, Enterprise Resource Planning
7. P. DiwanVinod Kumar Garg and N.K. Venkitakrishnan, PHI, Enterprise Resource Planning
8. Introduction to SAP, an Overview of SD: MM, PP, FI/CO Modules of SAP. 10. ZaveriJyotindra Enterprise Resource Planning

ECE22101

VI SEMESTER

DSE 4B: Elective: Enterprise Resource Planning Lab
Credit (L: T: P = 0: 0: 2)

Students should be Prepare ERP Solution Report for his / her Case Study under the supervision of Teacher/ Lecturer

ECF23001

VI SEMESTER

DSE 4C: Elective: E-Commerce Technologies

Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to
CO1. Understand the details of E-Commerce
CO2. Learn the details of Basic Concepts Of Internet and WWW
CO3. Identify in depth Internet Security Methods
CO4. Learn in details with examples Concepts of Electronic Data Exchange and applications
CO5. Learn in details with examples Planning For E-Commerce
CO6. Understand in depth Features of Internet Marketing

Unit - 1 15 Hours

An introduction to electronic commerce: What is E-Commerce (Introduction and Definition), Main activities E-Commerce, Goals of E-Commerce, Technical Components of E-Commerce, Functions of E-Commerce, Advantages and disadvantages of E-Commerce, Scope of E-Commerce, Electronic Commerce Applications, 9 Electronic Commerce and Electronic Business(C2C) (C2G, G2G, B2G, B2P, B2A, P2P, B2A, C2A, B2B, B2C)

The Internet and WWW: Evolution of Internet, Domain Names and Internet Organization (.edu, .com, .mil, .gov, .net etc.) , Types of Network, Internet Service Provider, World Wide Web, Internet & Extranet, Role of Internet in B2B Application, building own website, Cost, Time, Reach, Registering a Domain Name, Web promotion, Target email, Banner, Exchange, Shopping Bots.

Unit - 2 15 Hours

Internet Security: Internet Security Issues Overview –Computer Security Classifications- Intellectual Property threats- Threats to the security of client computers-Threats to the security of communication channels- Threats to the security of Server computers- digital Certificates

Secure Transaction, Computer Monitoring, Privacy on Internet, Corporate Email privacy, Computer Crime (Laws, Types of Crimes), Threats, Attack on Computer System, Software Packages for privacy, Hacking, Computer Virus (How it spreads, Virus problem, virus protection, Encryption and Decryption, Secret key Cryptography, DES, Public Key Encryption, RSA, Authorization and Authentication, Firewall, Digital Signature (How it Works)

Unit - 3 15 Hours

Electronic Data Exchange: Introduction, Concepts of EDI and Limitation, Applications of EDI, Disadvantages of EDI, EDI model, Electronic Payment System: Introduction, Types of Electronic Payment System, Payment Types, Value Exchange System, Credit Card System, Electronic Fund Transfer, Paperless bill, Modern Payment Cash, Electronic Cash.

Online payment basics- Payment cards-E-cash-Holding Electronic cash: online and offline Cash-Advantages and disadvantages of electronic cash system-electronic wallets-Microsoft.NET passport-yahoo Wallet-EGML standard-stored value cards-magnetic strip Cards-smart cards.

Unit - 4 15 Hours

Planning for Electronic Commerce: Planning Electronic Commerce initiates, linking objectives to business strategies, measuring cost objectives, comparing benefits to Costs, Strategies for developing electronic commerce web sites.

Internet Marketing: The PROS and CONS of online shopping, the cons of online shopping, Justify an Internet business, Internet marketing techniques, The E-cycle of Internet marketing, Personalization e-commerce.

Technologies for Electronic Commerce: Web Server Hardware and Software- Web server Basics- Types of web sites- web clients and web servers-Software for Web servers-website and utility programs-Web server hardware-Web Hosting Choices.

Reference Books:

1. G.S.V.Murthy, E-Commerce Concepts, Models, Strategies- :- Himalaya Publishing House, 2011.
2. Kamlesh K Bajaj and DebjaniNag , E- Commerce , 2005.
3. Gray P. Schneider, Electronic commerce, International Student Edition, 2011,
4. HENRY CHAN, RAYMOND LEE, THARAM DILLON, ELIZABETH CHANG E COMMERCE, FUNDAMENTALS AND APPLICATIONS, Wiely Student Edition, 2011

ECF23101

VI SEMESTER
DSE 4C: Elective: E-Commerce Technologies Lab
Credit (L: T: P = 0: 0: 2)

Software Lab based on E-Commerce Technologies

E-commerce concepts are to be implemented in developing a website using a combination of following technologies:

1. HyperText Markup Language (HTML)
2. Cascading Style Sheets (CSS)
3. JavaScript
4. ASP
5. PHP
6. XML
7. Joomla

ECF24001

VI SEMESTER

DSE 5A: Cloud Computing
Credit (L: T: P = 4: 0: 0)

Course Outcome

After successful completion of the course, the student is able to

CO1. Learn in depth Fundamentals of Cloud Computing
CO2. Understand the details of Cloud Services and File System
CO3. Learn in depth Concept of Collaborating with Cloud
CO4. Understand the details of Virtualization in cloud
CO5. Learn the classification and characteristics of Security challenges in Cloud Computing
CO6. Specify the classification and characteristics of Security challenges in Cloud Computing
CO7. Understand the details of Security challenges in Cloud Computing
CO8. Understand the Common standards of Cloud Computing
CO9. Deliberate in details with examples Various Application of Cloud Computing

Unit - 1 15 Hours

Cloud Introduction: Cloud Computing Fundamentals: Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing, usage scenarios and Applications, Business models around Cloud– Major Players in Cloud Computing - Issues in Cloud - Eucalyptus - Nimbus - Open Nebula, CloudSim.
Cloud Services and File System: Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service - Monitoring as a Service – Communication as services.

Unit - 2 15 Hours

Service providers- Google App Engine, Amazon EC2, Microsoft Azure, Sales force.
Collaborating With Cloud: Collaborating on Calendars, Schedules and Task Management – Collaborating on Event Management, Contact Management, Project Management – Collaborating on Word Processing, Databases – Storing and Sharing Files- Collaborating via Web-Based Communication Tools – Evaluating Web Mail Services – Collaborating via Social Networks – Collaborating via Blogs and Wikis.

Unit - 3 15 Hours

Virtualization For Cloud: Need for Virtualization – Pros and cons of Virtualization – Types of Virtualizations – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM, VMWare, Virtual Box, Hyper-V.

Unit - 4 15 Hours

Security, Standards, And Applications: Security in Clouds: Cloud security challenges - Software as a Service Security, Common Standards: The Open Cloud Consortium –The Distributed management Task Force – Standards for application Developers – Standards for Messaging - Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

Reference Books:

1. Bloor R., Kanfman M., Halper F. Judith Hurwitz "Cloud Computing" Wiley India Edition,2010
2. John Rittinghouse& James Ransome, "Cloud Computing Implementation Management and Strategy", CRC Press, 2010
3. Antohy T Velte,Cloud Computing: "A Practical Approach", McGraw Hill,2009
4. Michael Miller, Cloud Computing: "Web-Based Applications That Change the Way You Work and Collaborate Online", Que Publishing, August 2008.
5. James E Smith, Ravi Nair, "Virtual Machines", Morgan Kaufmann Publishers, 2006.

Online Reading/Supporting Material

1. Haley Beard, "Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing", Applications and Data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008
2. Webpages.iust.ac.ir/hsalimi/.../89.../Cloud%20Common%20standards.pptop ennebula.org,
3. www.cloudbus.org/cloudsim/, http://www.eucalyptus.com/
4. hadoop.apache.org
5. *http://hadoop.apache.org/docs/stable/hdfs_design.html*
6. http://static.googleusercontent.com/external_content/untrusted_dlcp/research.google.com/en//archive /mapreduce-osdi04.pdf

ECF24101

VI SEMESTER

DSE 5A: Cloud Computing Lab
Credit (L: T: P = 0: 0: 2)

Software Lab based on Cloud Computing:

1. Create virtual machines that access different programs on same platform.
2. Create virtual machines that access different programs on different platforms.
3. Exploring Google cloud for the following
   a) Storage
   b) Sharing of data
   c) Manage your calendar, to-do lists,
   d) A document editing tool
4. Exploring Open source cloud (Any two)

ECF25001

VI SEMESTER

DSE 5B: Elective: Data Mining and Data Warehousing
Credit (L: T: P = 4: 0: 0)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Understand the characteristics of Data Warehousing
CO2. Understand the details of Data Warehousing Architecture
CO3. Deliberate in depth Data Mining
CO4. Learn in details with examples Association Rule Mining
CO5. Specify the details of Classification and Prediction Techniques
CO6. Learn in depth Clustering Methods
CO7. Write down in depth Application of Data Mining

Unit - 1 **15 Hours**

Data Warehousing: Introduction- Definition and description need for data ware housing need for strategic information, failures of past decision support systems, OLTP v/s DWH-DWH requirements-trends in DWH-Application of DWH.

Data Warehousing Architecture: Reference architecture- Components of reference architecture - Data warehouse building blocks, implementation, physical design process and DWH deployment process.

Unit - 2 **15 Hours**

A Multidimensional Data, Model Data Warehouse Architecture.

Data Mining: Data mining tasks-Data mining vs KDD- Issues in data mining, Data Mining metrics, Data mining architecture - Data cleaning- Data transformation- Data reduction - Data mining primitives.

Unit - 3 **15 Hours**

Association Rule Mining: Introduction - Mining single dimensional Boolean association rules from transactional databases - Mining multi-dimensional association rules.

Classification and Prediction: Classification Techniques - Issues regarding classification and prediction - decision tree - Bayesian classification –Classifier accuracy.

Unit - 4 **15 Hours**

Clustering: Clustering Methods - Outlier analysis.

Applications and Other Data Mining Methods: Distributed and parallel Data Mining Algorithms, Text mining- Web mining.

Reference Books:

1. Jiawei Han and MichelineKamber," Data Mining Concepts and Techniques", Morgan Kaufmann Publishers, USA, 2006.
2. Berson,"DataWarehousing, Data Mining and OLAP", Tata McGraw Hill Ltd, New Delhi, 2004.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, , Pearson Education.
4. Arun K Pujari,"Data mining techniques", Oxford University Press, London, 2003.
5. Dunham M H,"Data mining: Introductory and Advanced Topics". Pearson Education, New Delhi, 2003.
6. MehmedKantardzic," Data Mining Concepts, Methods and Algorithms", John Wiley and Sons, USA, 2003.
7. Soman K. P., DiwakarShyam, Ajay V., Insight into Data mining: Theory and Practice, PHI 2006

ECF25101

VI SEMESTER

DSE 5B: Elective: Data Mining and Data Warehousing Lab
Credit (L: T: P = 0: 0: 2)

Software Lab based on Data Mining:

Practical List: Practical are to be done using Weka, and a report prepared as per the format*. The operations are to be performed on built-in dummy data sets of weka and/or the downloadable datasets mentioned in references below. Also wherever applicable, the parameter values are to be varied (upto 3 distinct values). The 'Visualize' tab is to be explored with each operation.

1. Pre-processing: Apply the following filters –
   a. weka>filter>supervised>attributed> AddClassification, AttributeSelection, Discretize, NominalToBinary
   b. weka>filter>supervised>instance: StratifiedRemoveFolds, Resample
   c. weka>filter>unsupervised>attribute>Add, AddExpression, AddNoise, Center, Discretize, MathExpression ,MergeTwoValues , NominalToBinary , NominalToString, NormalizeNumericToBinary ,NumericToNominal , NumericTransform , PrincipalComponent, RandomSubset , Remove , RemoveType , ReplaceMissingValues , Standardize
   d. weka>filter>unsupervised>instance>Normalize , Randomize , Standardize, RemoveFrequentValues, RemoveWithValues , Resample , SubsetByExpression
2. Explore the 'select attribute' as follows
   weka>attributeSelection> , FilteredSubsetEval , WrapperSubsetEval
3. Association mining
   weka>associations> , Apriori, FPGrowth
4. Classification**
   weka>classifiers>bayes> , NaïveBayes , weka>classifiers>lazy> : IB1, IBkweka>classifiers>trees , SimpleCart , RandomTree , ID3
5. Clustering**
   weka>clusters> , SimpleKMeans , FarthestFirst algorithm, DBSCAN, hierarchicalClusterer

ECF26001

VI SEMESTER

DSE 5C: Elective: Artificial Intelligence and Expert Systems
Credit (L: T: P = 4: 0: 0)

Course Outcome

After successful completion of the course, the student is able to

CO1. Deliberate in details with examples Artificial intelligence system
CO2. Learn the characteristics of Concepts of Representation of knowledge
CO3. Understand in details with examples Concepts of Representation of knowledge
CO4. Understand the details of knowledge inference methods
CO5. Understand in details with examples Concepts of Machine Learning Techniques
CO6. Learn the details of Expert System

Unit - 1 15 Hours

INTRODUCTION TO AI AND PRODUCTION SYSTEMS: Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system-Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

REPRESENTATION OF KNOWLEDGE: Game playing - Knowledge representation, Knowledge representation using Predicate logic

Unit - 2 15 Hours

Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

KNOWLEDGE INFERENCE: Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster -Shafer theory.

Unit - 3 15 Hours

PLANNING AND MACHINE LEARNING: Basic plan generation systems - Strips - Advanced plan generation systems - Kstrips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

Unit - 4 15 Hours

EXPERT SYSTEMS: Expert systems - Architecture of expert systems, Roles of expert systems -Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

Reference Books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill- 2008. (Unit-1,2,4,5)
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III)
3. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
4. Stuart Russel, Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.

ECF26101

VI SEMESTER

DSE 5C: Elective: Artificial Intelligence and Expert Systems Lab
Credit (L: T: P = 0: 0: 2)

1. Implement Breadth First Search (for 8 puzzle problem or Water Jug problem or any AI search problem)
2. Implement Depth First Search (for 8 puzzle problem or Water Jug problem or any AI search problem)
3. Implement Best First Search (for 8 puzzle problem or Water Jug problem or any AI search problem)
4. Implement Single Player Game (Using Heuristic Function)
5. Implement Two Player Game (Using Heuristic Function)
6. Implement A* Algorithm
7. Implement Propositional calculus related problem
8. Implement First order propositional calculus related problem
9. Implement Certainty Factor problem
10. Implement Syntax Checking of English sentences-English Grammar
11. Develop an Expert system for Medical diagnosis.
12. Develop any Rule based system for an application of your choice.

ECF27001

VI SEMESTER

DSE 6: Elective: Dissertation / Project
Credit (L: T: P = 0: 0: 6) 12 Hours/Week

Course Outcome:

After successful completion of the course, the student is able to

CO1. Identify in details with examples Problem identification
CO2. Write down in depth System Analysis
CO3. Understand and Develop SRS for selected System Problem
CO4. Understand and Develop System Design for selected System Problem
CO5. Learn in details and Develop a Code and Test the System
CO6. Understand the details of Presentation and Demo of Project Work

- ✓ This option is to be offered only in 6th Semester.
- ✓ The students will be allowed to work on any project based on the concepts studied in
- ✓ Core/elective or skill based elective courses.
- ✓ The group size should be maximum of THREE (03) students.
- ✓ Each group will be assigned a teacher as a supervisor who will handle both their theory as Well as lab classes.
- ✓ A maximum of Four (04) projects would be assigned to one teacher.

ECF30001

VI SEMESTER

SEC 3A: Elective: AJAX
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate in details with examples AJAX
CO2. Learn the details of AJAX Overview
CO3. Specify the details of Steps for Implementation of AJAX
CO4. Learn the details of Design and use of AJAX

Term work: Design& Develop Small web application using AJAX

Reference Books:

1. Steven Holzner, "Ajax A Beginner's Guide", The McGraw-Hill Companies.
2. Edmond Woychowsky,"Ajax: Creating Web Pages with AsynchronousJavaScript and XML", Pearson Education, Inc.
3. Thomas A. Powell, "Ajax: The Complete Reference", McGraw-Hill Companies.

ECF30101

VI SEMESTER

SEC 3B: Elective: Angular JS
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO5. Deliberate in details with examples Angular JS
CO6. Learn the details of Angular JS Overview
CO7. Specify the details of Steps for Implementation of Angular JS
CO8. Learn the details of Design and use of Angular JS

Term work: Design & Develop Small web application using AngularJS

Reference Books:

1. Valeri Karpov, Diego Netto, "Professional AngularJS", WROX
2. *Sheppard, Miller, Liptak*, "Sams Teach Yourself-AngularJS for .NET Developer in 24 Hours", Pearson Education India; First edition

ECF30301

VI SEMESTER

SEC 3C: Elective: Wordpress

Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate in details with examples Word press

CO2. Learn the details of Word press Overview

CO3. Specify the details of Steps for Implementation of Word press

CO4. Learn the details of Design and use of Word press

Term work: Design & Develop Small Web Site using Word press

Reference Books:

1. Lisa Sabin-Wilson, Cory Miller, Kevin Palmer, Andrea Rennick, and Michael Torbert, " WordPress® All-in-One For Dummies®", Wiley Publishing, Inc.
2. Tris Hussey, "WordPress Absolute Beginner's Guide", Que Publishing

ECF30501

VI SEMESTER

SEC 4A: Elective: Python Programming
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn the details of Python Programming Structure
CO2. Deliberate the characteristics of Python Programming
CO3. Understand in details with examples - Python Programming Languages
CO4. Specify in depth OOPs, Event Driven and GUI features in Python

Software Lab using Python

Section: A (Simple programs)

1. Write a menu driven program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. WAP to calculate total marks, percentage and grade of a student. Marks obtained in each of the three subjects are to be input by the user. Assign grades according to the following criteria
   Grade A: Percentage >=80
   Grade B: Percentage>=70 and <80
   Grade C: Percentage>=60 and <70
   Grade D: Percentage>=40 and <60
   Grade E: Percentage<40
3. Write a menu-driven program, using user-defined functions to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
4. WAP to display the first n terms of Fibonacci series.
5. WAP to find factorial of the given number
6. WAP to find sum of the following series for n terms: 1 – 2/2! : 3/3! - - - - - n/n!
7. WAP to calculate the sum and product of two compatible matrices.

Section: B (Visual Python)

All the programs should be written using user defined functions, wherever possible.

1. Write a menu-driven program to create mathematical 3D objects
   I. Curve
   II. Sphere
   III. Cone
   IV. Arrow
   V. Ring
   VI. Cylinder.
2. WAP to read n integers and display them as a histogram.

WAP to display sine, cosine, polynomial and exponential curves.

WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.

WAP to calculate the mass m in a chemical reaction. The mass m (in gms) disintegrates according to the formula m=60/(t+2), where t is the time in hours. Sketch a graph for t vs. m, where t>=0.

A population of 1000 bacteria is introduced into a nutrient medium. The population p grows as follows:

P(t) = (15000(1+t))/(15+ e^t)

Where the time t is measured in hours. WAP to determine the size of the population at given time t and plot a graph for P vs t for the specified time interval.

Input initial velocity and acceleration, and plot the following graphs depicting equations of motion:

I. Velocity wrt time (v=u+at)

II. Distance wrt time (s=u*t+0.5*a*t*t)

III. Distance wrt velocity (s=(v*v-u*u)/2*a)

Reference Books:

1. P. K. Sinha&PritiSinha , "Computer Fundamentals", BPB Publications, 2007
2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.
3. T. Budd, Exploring Python, TMH, 1st Ed, 2011
4. Python Tutorial/Documentation www.python.or 2010
5. Allen Downey , Jeffrey Elkner, Chris Meyers , How to think like a computer scientist : learning with Python . Freely available online.2012

ECF30701

VI SEMESTER

SEC 4B: Elective: R Programming
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn the details of R Programming Structure
CO2. Deliberate the characteristics of R Programming
CO3. Understand in details with examples - R Programming Languages

Software Lab Based on R Programming

1. Write a program that prints 'Hello World' to the screen.
2. Write a program that asks the user for a number n and prints the sum of the numbers 1 to n 3. Write a program that prints a multiplication table for numbers up to 12.
4. Write a function that returns the largest element in a list.
5. Write a function that computes the running total of a list.
6. Write a function that tests whether a string is a palindrome.
7. Implement the following sorting algorithms: Selection sort, Insertion sort, Bubble Sort
8. Implement linear search.
9. Implement binary search.
10. Implement matrices addition, subtraction and Multiplication

Reference Books:

1. William N. Venables and David M. Smith, An Introduction to R. 2nd Edition. Network Theory Limited.2009
2. Norman Matloff, the Art of R Programming - A Tour of Statistical Software Design, No Starch Press.2011

ECF30901

VI SEMESTER

SEC 4C: Elective: CodeIgniter
Credit (L: T: P = 0: 0: 2)

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn the details of CodeIgniter - Application Development Framework
CO2. Deliberate the Features of CodeIgniter

Term work: Design & Develop Small web application using CodeIgniter framework

Reference Books:

https://www.guru99.com/codeigniter-tutorial.html
https://www.javatpoint.com/codeigniter-preventing-enabling-from-csrf

NEP2020 Model Course Content for BCA, Semesters I and II

Semester: I

Course Code: **CAC01 [FAA410]**	Course Title: **Fundamentals of Computers**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

- Introduction to computers, classification of computers, anatomy of computer, constituents and architecture, microcontrollers
- Operating systems, functions of operating systems, classification of operating systems, kernel, shell, basics of Unix, shell programming, booting
- Databases, why databases are used, users, SQL, data types in SQL, introduction of queries - select, alter, update, delete, truncate, using where, and or in not in
- Internet basics, features, applications, services, internet service providers, domain name system, browsing, email, searching
- Web Programming basics, introduction of HTML and CSS programming
- Introduction of computers, classification of computers, anatomy of computer, constituents and architecture, microcontrollers.

Course Content	Hours
Unit - 1	
Fundamentals of Computers: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution and History of Computers, Types of Computers, Basic Organisation of a Digital Computer; Number Systems – different types, conversion from one number system to another; Computer Codes – BCD, Gray Code, ASCII and Unicode; Boolean Algebra – Boolean Operators with Truth Tables; Types of Software – System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program - Algorithm, Flowchart and Pseudo code with Examples. **Introduction to computers:** Characteristics of computers, Classification of Digital Computer Systems: Microcomputers, Minicomputers, Mainframes, Super computers.	14
Unit-2	
Anatomy of Computer: Introduction, Functions & Components of a Computer, Central Processing Unit, Microprocessor, Storage units, Input and output Devices. How CPU and memory works. Program execution with illustrative examples. Introduction to microcontrollers. **Operating System Fundamentals:** Operating Systems: Introduction, Functions of an operating System, Classification of Operating Systems, System programs, Application programs, Utilities, The Unix Operating System, Basic Unix commands, Microkernel Based Operating System, Booting.	14
Unit-3	
Introduction to Database Management Systems: Database, DBMS, Why Database -File system vs DBMS, Database applications, Database users, Introduction to SQL, Data types, Classification of SQL-DDL with constraints, DML, DCL, TCL **Internet Basics:** Introduction, Features of Internet, Internet application, Services of Internet, Logical and physical addresses, Internet Service Providers, Domain Name System. **Web Basics:** Introduction to web, web browsers, http/https, URL, HTML5, CSS	14

Text Books:
1. Pradeep K. Sinha and Priti Sinha: Computer Fundamentals (Sixth Edition), BPB Publication
2. David Riley and Kenny Hunt, Computational thinking for modern solver, Chapman & Hall/CRC,

Reference:
1. J. Glenn Brook shear," Computer Science: An Overview", Addision-Wesley, Twelfth Edition,
2. R.G. Dromey, "How to solve it by Computer", PHI,

Course Code: **CAC01P [FAA410]**	Course Title: **Information Technology Lab**
Course Credits: **02**	Hours/Week: **04 Hours**
Formative Assessment Marks**: 25**	Total Contact Hours: **52 Hours**
Exam Marks: **25**	Exam Duration: **03 Hours**

Part A: Hardware

1. Identification of the peripherals of a computer, components in a CPU and their functions.
2. Assembling and disassembling the system hardware components of personal computer.
3. Basic Computer Hardware Trouble shooting.
4. LAN and WiFi Basics.
5. Operating System Installation – Windows OS, UNIX/LINUX, Dual Booting.
6. Installation and Uninstallation of Software – Office Tools, Utility Software (like Anti-Virus, System Maintenance tools); Application Software - Like Photo/Image Editors, Audio Recorders/Editors, Video Editors …); Freeware, Shareware, Payware and Trialware; Internet Browsers, Programming IDEs,
7. System Configuration – BIOS Settings, Registry Editor, MS Config, Task Manager, System Maintenance, Third-party System Maintenance Tools (Similar to CCleaner and Jv16 PowerTools …)

Part B: Software

1. Activities using Word Processor Software
2. Activities using Spreadsheets Software
3. Activities using Presentation Software
4. Activities involving Multimedia Editing (Images, Video, Audio …)
5. Tasks involving Internet Browsing
6. Flow charts: Installation and using of flowgarithms software for different arithmetic tasks like sum, average, product, difference, quotient and remainder of given numbers, calculate area of Shapes (Square, Rectangle, Circle and Triangle), arrays and recursion.

NOTE: In addition to the ones listed above, universities can include other activities so as for the student to become proficient in using personal computers for multiple purposes for which modern computers can be put to use.

Reference:
1. Computational Thinking for the Modern Problem Solver, By Riley DD, Hunt K.A CRC press, 2014
2. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer

Web References:
http://www.flowgorithm.org/documentation/

Evaluation Scheme for Lab Examination

Assessment Criteria		**Marks**
Activity – 1 from Part A	Write up on the activity/ task	5
	Demonstration of the activity/ task	5
Activity-2 from Part B	Write up on the activity/ task	5
	Demonstration of the activity/ task	5
Viva Voice based on Lab Activities		05
Total		**25**

Course Code: **CAC02 [FAA420]**	Course Title: **Programming in C**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- Confidently operate Desktop Computers to carry out computational tasks
- Understand working of Hardware and Software and the importance of operating systems
- Understand programming languages, number systems, peripheral devices, networking, multimedia and internet concepts
- Read, understand and trace the execution of programs written in C language
- Write the C code for a given problem
- Perform input and output operations using programs in C
- Write programs that perform operations on arrays

Course Content	Hours
Unit - 1	
Introduction to C Programming: Overview of C; History and Features of C; Structure of a C Program with Examples; Creating and Executing a C Program; Compilation process in C. **C Programming Basic Concepts:** C Character Set; C tokens - keywords, identifiers, constants, and variables; Data types; Declaration & initialization of variables; Symbolic constants. **Input and output with C:** Formatted I/O functions - *printf* and *scanf,* control stings and escape sequences, output specifications with *printf* functions; Unformatted I/O functions to read and display single character and a string - *getchar, putchar, gets* and *puts* functions. **C Operators & Expressions:** Arithmetic operators; Relational operators; Logical operators; Assignment operators; Increment & Decrement operators; Bitwise operators; Conditional operator; Special operators; Operator Precedence and Associatively; Evaluation of arithmetic expressions; Type conversion.	14
Unit - 2	
Control Structures: Decision making Statements - S*imple if, if_else*, *nested if_else, else_if ladder, Switch Case*, *goto, break* & *continue* statements; Looping Statements - Entry controlled and exit controlled statements, *while, do-while, for* loops, Nested loops. **Derived data types in C:** Arrays: One Dimensional arrays - Declaration, Initialization and Memory representation; Two Dimensional arrays - Declaration, Initialization and Memory representation. **Strings:** Declaring & Initializing string variables; String handling functions - *strlen, strcmp, strcpy and strcat;* Character handling functions - *toascii, toupper, tolower, isalpha, isnumeric* etc.	14
Unit - 3	
Pointers in C: Understanding pointers - Declaring and initializing pointers, accessing address and value of variables using pointers; Pointers and Arrays; Pointer Arithmetic; Advantages and disadvantages of using pointers; **User Defined Functions:** Need for user defined functions; Format of C user defined functions; Components of user defined functions - return type, name, parameter list, function body, return statement and function call; Categories of user defined functions - With and without parameters and return type. **User defined data types:** Structures - Structure Definition, Advantages of Structure, declaring structure variables, accessing structure members, Structure members initialization, comparing structure variables, Array of Structures; Unions - Union definition; difference between Structures and Unions.	14

Text Books:

1. C: The Complete Reference, By Herbert Schildt.
2. C Programming Language, By Brain W. Kernighan
3. Kernighan & Ritchie: The C Programming Language (PHI)

Reference Books:

1. P. K. Sinha & Priti Sinha: Computer Fundamentals (BPB)
2. E. Balaguruswamy: Programming in ANSI C (TMH)
3. Kamthane: Programming with ANSI and TURBO C (Pearson Education)
4. V. Rajaraman: Programming in C (PHI – EEE)
5. S. Byron Gottfried: Programming with C (TMH)
6. Yashwant Kanitkar: Let us C
7. P.B. Kottur: Programming in C (Sapna Book House)

Course Code: **CAC02P [FAA420]**	Course Title: **C Programming Lab**
Course Credits: **02**	Hour of Teaching / Week: **04 Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52 Hours**
Exam Marks: **25**	Exam Duration: **03 Hours**

Programming Lab

Part A:

1. Program to read radius of a circle and to find area and circumference
2. Program to read three numbers and find the biggest of three
3. Program to demonstrate library functions in math.h
4. Program to check for prime
5. Program to generate n primes
6. Program to read a number, find the sum of the digits, reverse the number and check it for palindrome
7. Program to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers
8. Program to read percentage of marks and to display appropriate message (Demonstration of else-if ladder)
9. Program to find the roots of quadratic equation (demonstration of switch Case statement)
10. Program to read marks scored by n students and find the average of marks (Demonstration of single dimensional array)
11. Program to remove Duplicate Element in a single dimensional Array
12. Program to perform addition and subtraction of Matrices

Part B:

1. Program to find the length of a string without using built in function
2. Program to demonstrate string functions.
3. Program to demonstrate pointers in C
4. Program to check a number for prime by defining isprime() function
5. Program to read, display and to find the trace of a square matrix
6. Program to read, display and add two m x n matrices using functions
7. Program to read, display and multiply two m x n matrices using functions
8. Program to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters.
9. Program to Reverse a String using Pointer
10. Program to Swap Two Numbers using Pointers
11. Program to demonstrate student structure to read & display records of n students.
12. Program to demonstrate the difference between structure & union.

Note: Student has to execute a minimum of 10 programs in each part to complete the Lab course

Evaluation Scheme for Lab Examination

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on Lab Activities		05
Total		**25**

Course Code: **CAC03(A) [FAA430]**	Course Title: **Mathematical Foundation**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

• Study and solve problems related to connectives, predicates and quantifiers under different situations.
• Develop basic knowledge of matrices and to solve equations using Cramer's rule.
• Know the concept of Eigen values.
• To develop the knowledge about derivatives and know various applications of differentiation.
• Understand the basic concepts of Mathematical reasoning, set and functions

Course Content	Hours
Unit - 1	
Basic concepts of set theory: Mathematical logic introduction-statements Connectives-negation, conjunction, disjunction- statement formulas and truth tables- conditional and bi Conditional statements- tautology contradiction-equivalence of formulas-duality law-Predicates and Quantifiers, Arguments.	14
Unit - 2	
Operations on sets: power set- Venn diagram Cartesian product-relations - functions- types of functions - composition of functions. **Matrix algebra:** Introduction-Types of matrices-matrix operations- transpose of a matrix -determinant of matrix - inverse of a matrix- Cramer's rule	14
Unit - 3	
Matrix: finding rank of a matrix - normal form-echelon form cayley Hamilton theorem-Eigen values **Differential calculus:** Functions and limits - Simple Differentiation of Algebraic Functions – Evaluation of First and Second Order Derivatives – Maxima and Minima	14

Text Books:

- P. R. Vittal-Business Mathematics and Statistics, Margham Publications, Chennai,

Reference Books:

- B. S. Vatsa-Discrete Mathematics –New Age International Limited Publishers, New Delhi

Course Code: **CAC03(B) [FAA440]**	Course Title: **Accountancy**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

- Study and understand Accounting, systems of Book, Branches of accounting advantage and limitations
- Know the concept of accounting, financial accounting process and Journalization
- Maintenance different account book and reconciliations
- Preparations of different bills, and trial balance.
- Understand the basic concepts of Mathematical reasoning, set and functions

Course Content	Hours
Unit - 1	
Introduction: History and Development of Accounting, Meaning, Objectives and functions of Accounting, Book keeping V/s Accounting, Users of accounting data, systems of book keeping and accounting, branches of accounting, advantages and limitations of accounting **Accounting Concepts and Convention:** Meaning, need and classification, accounting standards meaning, need and classification of Indian accounting standards. Accounting principles V/s accounting standard	14
Unit - 2	
Financial Accounting Process: Classification of accounting transactions and accounts, rules of debit and credit as per Double Entry System. Journalization and Ledger posting. **Preparation of Different Subsidiary Books:** Purchase Day book Sales Day Book, Purchase Returns Day Book, Sales Returns Day Book, Cash Book. Bank Reconciliation Statement: Meaning, Causes of Difference, Advantages, Preparation of Bank Reconciliation Statements.	14
Unit - 3	
Account Procedure: Honor of the Bill, Dishonor of the Dill, Endorsement, Discounting, Renewal, Bill for collection, Retirement of the Bill, Accommodation Bills, Bill Receivable Book and Payable Book. Preparation of Trial Balance: Rectification of errors and Journal Proper **Preparation of Final Accounts:** Meaning, need and classification, Preparation of Manufacturing, Trading, Profit and loss account and Balance – Sheet of sale-traders and partnership firms.	14

Text Books:

1. S. Ramesh, B.S. Chandrashekar, A Text Book of Accountancy.
2. V.A. Patil and J.S. Korihalli, Book – keeping and accounting, (R. Chand and Co. Delhi).
3. R. S. Singhal, Principles of Accountancy, (Nageen Prakash pvt. Lit. Meerut).
4. M. B. Kadkol, Book – Keeping and Accountancy, (Renuka Prakashan, Hubil)
5. Vithal, Sharma:Accounting for Management, Macmillan Publishers, Mumbai.

Reference Books:

1. B.S. Raman, Accountancy, (United Publishers, Mangalore).
2. Tulsian, Accouning and Finacial Management – I: Financial Accounting – Person Education.

Semester: II

Course Code: **CAC04 [FAB410]**	Course Title: **Data Structures using C**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
- Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
- Demonstrate different methods for traversing trees
- Compare alternative implementations of data structures with respect to performance
- Describe the concept of recursion, give examples of its use
- Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

Course Content	Hours
Unit - 1	
Introduction to data structures: Definition; Types of data structures - Primitive & Non-primitive, Linear and Non-linear; Operations on data structures. Dynamic memory allocation: Static & Dynamic memory allocation; Memory allocation and de-allocation functions - *malloc*, *calloc*, *realloc* and *free.* Algorithm Specification, Performance Analysis, Performance Measurement Recursion: Definition; Types of recursions; Recursion Technique Examples - GCD, Binomial coefficient nCr, Towers of Hanoi; Comparison between iterative and recursive functions. **Arrays:** Basic Concepts – Definition, Declaration, Initialisation, Operations on arrays; Types of arrays; Arrays as abstract data types (ADT); Representation of Linear Arrays in memory;	14
Unit - 2	
Traversing linear arrays; Inserting and deleting elements; Sorting – Selection sort, Bubble sort, Quick sort, Selection sort, Insertion sort; Searching - Sequential Search, Binary search; Iterative and Recursive searching; Multidimensional arrays; Representation of multidimensional arrays; Sparse matrices. **Linked list**: Basic Concepts – Definition and Representation of linked list, Types of linked lists - Singly linked list, Doubly liked list, Header liked list, Circular linked list; Representation of Linked list in Memory; Operations on Singly linked lists – Traversing, Searching, Insertion, Deletion; Memory allocation; Garbage collection,	14
Unit - 3	
Stacks: Basic Concepts – Definition and Representation of stacks; Operations on stacks; Applications of stacks; Infix, postfix and prefix notations; Conversion from infix to postfix using stack; Evaluation of postfix expression using stack; Application of stack in function calls. **Queues**: Basic Concepts – Definition and Representation of queues; Types of queues - Simple queues, Circular queues, Double ended queues, Priority queues; Operations on Simple queues; **Trees:** Definition; Tree terminologies –node, root node, parent node, ancestors of a node, siblings, terminal & non-terminal nodes, degree of a node, level, edge, path, depth; **Binary tree:** Type of binary trees - strict binary tree, complete binary tree, binary search	14

tree and heap tree; Array representation of binary tree. Traversal of binary tree; preorder, inorder and postorder traversal;	

Text Books

1. Ellis Horowitz and Sartaj Sahni: Fundamentals of Data Structures

References

1. Tanenbaum: Data structures using C (Pearson Education)
2. Kamathane: Introduction to Data structures (Pearson Education)
3. Y. Kanitkar: Data Structures Using C (BPB)
4. Kottur: Data Structure Using C
5. Padma Reddy: Data Structure Using C
6. Sudipa Mukherjee: Data Structures using C – 1000 Problems and Solutions (McGraw Hill Education, 2007)

Course Code: **CAC04P [FAB410]**	Course Title: **Data Structures Lab**
Course Credits: **02**	Hour of Teaching / Week: **04 Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52 Hours**
Exam Marks: **25**	Exam Duration: **03 Hours**

Programming Lab

Part A:

1. Program to find GCD using recursive function
2. Program to display Pascal Triangle using binomial function
3. Program to generate n Fibonacci numbers using recursive function.
4. Program to implement Towers of Hanoi.
5. Program to implement dynamic array, find smallest and largest element of the array.
6. Program to create two files to store even and odd numbers.
7. Program to create a file to store student records.
8. Program to read the names of cities and arrange them alphabetically.
9. Program to sort the given list using selection sort technique.
10. Program to sort the given list using bubble sort technique.

Part B:

1. Program to sort the given list using insertion sort technique.
2. Program to sort the given list using quick sort technique.
3. Program to sort the given list using merge sort technique.
4. Program to search an element using linear search technique.
5. Program to search an element using recursive binary search technique.
6. Program to implement Stack.
7. Program to convert an infix expression to postfix.
8. Program to implement simple queue.
9. Program to implement linear linked list.
10. Program to display traversal of a tree.

Evaluation Scheme for Lab Examination

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on C Programming		05
Total		**25**

Course Code: **CAC05 [FAB420]**	Course Title: **Object Oriented Concepts using JAVA**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- Understand the features of Java and the architecture of JVM
- Write, compile, and execute Java programs that may include basic data types and control flow constructs and how type casting is done
- Identify classes, objects, members of a class and relationships among them needed for a specific problem and demonstrate the concepts of polymorphism and inheritance
- The students will be able to demonstrate programs based on interfaces and threads and explain the benefits of JAVA's Exceptional handling mechanism compared to other Programming Language
- Write, compile, execute Java programs that include GUIs and event driven programming and also programs based on files

Course Content	Hours
Unit - 1	
Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java. **Objects and Classes:** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, String Buffer, File, this reference.	14
Unit - 2	
Inheritance and Polymorphism: Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package. **Event and GUI programming:** Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing, Exceptional handling mechanism.	14
Unit - 3	
I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. **Multithreading in java:** Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try catch-finally, Collections in java, Introduction to JavaBeans and Network Programming.	14

Text Books

1. Programming with Java, By E Balagurusamy – A Primer, Fourth Edition, Tata McGraw Hill Education Private Limited.
2. Core Java Volume I – Fundamentals, By Cay S. Horstmann, Prentice Hall
3. Object Oriented Programming with Java: Somashekara, M.T., Guru, D.S., Manjunatha, K.S

Reference Books:

1. Java 2 - The Complete Reference – McGraw Hill publication.
2. Java - The Complete Reference, 7th Edition, By Herbert Schildt– McGraw Hill publication.

Course Code: **CAC05P [FAB410]**	Course Title: **JAVA Lab**
Course Credits: **02**	Hour of Teaching / Week: **04 Hours**
Formative Assessment Marks: **25**	Total Contact Hours: **52 Hours**
Exam Marks: **25**	Exam Duration: **03 Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

• Implement Object Oriented programming concept using basic syntaxes of control Structures

• Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem

• Demonstrates how to achieve reusability using inheritance

• Demonstrate understanding and use of interfaces, packages, different exception handling mechanisms and concept of multithreading for robust faster and efficient application development.

• Identify and describe common user interface components to design GUI in Java using Applet & AWT along with response to events

Practice Lab

1. Program to print the following triangle of numbers

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
```

2. Program to simple java application, to print the message, "Welcome to java"

3. Program to display the month of a year. Months of the year should be held in an array.

4. Program to find the area of rectangle.

5. program to demonstrate a division by zero exception

6. Program to create a user defined exception say Pay Out of Bounds.

Programming Lab

PART A: Java Fundamentals OOPs in Java

1. Program to assign two integer values to X and Y. Using the 'if' statement the output of the program should display a message whether X is greater than Y.

2. Program to list the factorial of the numbers 1 to 10. To calculate the factorial value, use while loop. (Hint Fact of 4 = 4*3*2*1)

3. Program to add two integers and two float numbers. When no arguments are supplied, give a default value to calculate the sum. Use function overloading.

4. Program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations.

5. Program with class variable that is available for all instances of a class. Use static variable declaration. Observe the changes that occur in the object's member variable values.

6. Program

a. To find the area and circumference of the circle by accepting the radius from the user.

b. To accept a number and find whether the number is Prime or not

7. Program to create a student class with following attributes;

Enrollment No: Name, Mark of sub1, Mark of sub2, mark of sub3, Total Marks. Total of the three marks must be calculated only when the student passes in all three subjects. The

pass mark for each subject is 50. If a candidate fails in any one of the subjects his total mark must be declared as zero. Using this condition write a constructor for this class. Write separate functions for accepting and displaying student details. In the main method create an array of three student objects and display the details.
8. In a college first year class are having the following attributes Name of the class (BCA, BCom, BSc), Name of the staff No of the students in the class, Array of students in the class
9. Define a class called first year with above attributes and define a suitable constructor. Also write a method called best Student () which process a first-year object and return the student with the highest total mark. In the main method define a first-year object and find the best student of this class
10. Program to define a class called employee with the name and date of appointment. Create ten employee objects as an array and sort them as per their date of appointment. ie, print them as per their seniority.
11. Create a package 'student. Fulltime. BCA 'in your current working directory
a. Create a default class student in the above package with the following attributes: Name, age, sex.
b. Have methods for storing as well as displaying

PART B: Exception Handling & GUI Programming
1. Program to catch Negative Array Size Exception. This exception is caused when the array is initialized to negative values.
2. Program to handle Null Pointer Exception and use the "finally" method to display a message to the user.
3. Program which create and displays a message on the window
4. Program to draw several shapes in the created window
5. Program to create an applet and draw grid lines
6. Program which creates a frame with two buttons father and mother. When we click the father button the name of the father, his age and designation must appear. When we click mother similar details of mother also appear.
7. Create a frame which displays your personal details with respect to a button click
8. Create a simple applet which reveals the personal information of yours.
9. Program to move different shapes according to the arrow key pressed.
10. Program to create a window when we press M or m the window displays Good Morning, A or the window displays Good After Noon E or e the window displays Good Evening, N or n the window displays Good Night
11. Demonstrate the various mouse handling events using suitable example.
12. Program to create menu bar and pull-down menus.

Note: Student has to execute a minimum of 10 programs in each part to complete the Lab course

Evaluation Scheme for Lab Examination

Assessment Criteria		**Marks**
Program – 1 from Part A	Flowchart / Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Program -2 from Part B	Flowchart/Algorithm	02
	Writing the Program	05
	Execution and Formatting	03
Viva Voice based on **Object Oriented Programming with JAVA**		05
Total		**25**

Course Code: **CAC06 [FAA430]**	Course Title: **Discrete Mathematical Structures**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course Outcomes (COs):

After completing this course satisfactorily, a student will be able to:

- To understand the basic concepts of Mathematical reasoning, set and functions.
- To understand various counting techniques and principle of inclusion and exclusions.
- Understand the concepts of various types of relations, partial ordering and
- equivalence relations.
- Apply the concepts of generating functions to solve the recurrence relations.
- Familiarize the fundamental concepts of graph theory and shortest path algorithm

Course Content	Hours
Unit - 1	
The Foundations: Logic and proofs: Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy. **Basic Structures**: Sets, Functions, Sequences, Sums, and Matrices: Sets, set operations, Functions, Sequences and Summations, matrices.	14
Unit - 2	
Counting: Basics of counting, Pigeonhole principle, Permutation and combination, Binomial Coefficient and Combination, Generating Permutation and Combination. **Advanced Counting Techniques**: Applications of Recurrence Relations, Solving Linear Recurrence, Relations, Divide and Conquer Algorithms and Recurrence Relations, Generating functions, Inclusion-Exclusion, Applications of Inclusion-exclusion. **Induction and Recursion**: Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms, Program Corrections.	14
Unit - 3	
Relation: Properties of relation, Composition of relation, Closer operation on relation, Equivalence relation and partition. Operation on relation, Representing relation. **Graphs**: Graphs and Graph models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.	14

Text Book:

1. Discrete Mathematics and Its Applications, Kenneth H. Rosen: Seventh Edition, 2012.

References:

2. Discrete Mathematical Structure, Bernard Kolman, Robert C, Busby, Sharon Ross, 2003.
3. Graph Theory with Applications to Engg and Comp. Sci: Narsingh Deo-PHI 1986.
4. Discrete and Combinatorial Mathematics Ralph P. Grimaldi, B. V. Ramatta, Pearson, Education, 5 Edition.
5. Discrete Mathematical Structures, Trembley and Manobar.

Course Code: **OE01**	Course Title: **Business Intelligence**
Course Credits: **03**	Hour of Teaching / Week: **03 Hours**
Formative Assessment Marks: **40**	Total Contact Hours: **42 Hours**
Exam Marks: **60**	Exam Duration: **2½ Hours**

Course outcomes:

- gain knowledge of Business Intelligence
- build business projects
- generate and manage BI reports
- do BI Deployment, Administration & Security.

Course Content	Hours
Unit - 1	
Introduction to Business Intelligence: Understanding the scope of today's BI solutions and how they fit into existing infrastructure Assessing new options such as SaaS and cloud-based technology. Describe BI, its components & architecture, previewing the future of BI Crafting a better experience for all business users, End User Assumptions, setting up Data for BI, The Functional Area of BI Tools, Query Tools and Reporting, OLAP and Advanced Analytics, Supporting the requirements of senior executives, including performance management.	14
Unit - 2	
Elements of Business Intelligence Solutions: Reports & ad hoc queries; Analyze OLAP data; Dashboards & Scorecards development, Metadata Models; Automated tasks & events; Mobile & disconnected BI; Collaboration capabilities; Real time monitoring capabilities; Software development kit; Consume BI through portals, web applications, Desktop applications. **Building the BI Project:** Planning the BI project, Project Resources; Project Tasks, Risk Management and Mitigation, Cost-justifying BI solutions and measuring success, Collecting User Requirements, Requirements-Gathering Techniques; Prioritizing & Validating BI Requirements, Changing Requirements; BI Design and Development, Best Practices for BI Design; Post-Implementation Evaluations, Maintaining Your BI Environment.	14
Unit - 3	
Reporting authoring: Building reports with relational vs Multidimensional data models; Types of Reports Data Grouping & Sorting, Filtering Reports, Adding Calculations to Reports, Conditional formatting, Adding Summary Lines to Reports. Drill up, drill- down, drill-through capabilities. Run or schedule report, different output forms. **BI Deployment, Administration & Security:** Centralized Versus Decentralized Architecture, BI Architecture Alternatives, phased & incremental BI roadmap, System Sizing, Measurements and Dependencies, System Sizing, Measurements, and Dependencies. Setting Early Expectations and Measuring the Results. End-User Provisos. OLAP Implementations. Expanding BI Authentication Authorization, Access Permissions, Groups and Roles, Single-sign on Server Administration, Manage Status & Monitoring, Audit, Mail server & Portal integration, Back Up and Restore.	14

TEXT BOOKS

1. Business Intelligence (IBM ICE Publication).

REFERENCE BOOKS

1. http://en.wikipedia.org/wiki/Business_intelligence.
2. http://www.webopedia.com/TERM/B/Business_Intelligence.html.
3. Http://www.cio.com/article/40296/Business_Intelligence_Definition_and_Solutions.

SEMESTER V

Course code: DME25002

DSE 6A: Elective: Computer Science – V

Database Management Systems

Credits: Theory – 04 **60 Hours**

Course Outcome:

After successful completion of the course, the student is able to

CO1. Understand the characteristics of DBMS with examples
CO2. Deliberate the details of types of database languages with examples
CO3. Learn the details of ER- Diagrams and Relationship
CO4. Understand in depth Basic concepts of Relational Model
CO5. Learn in details with examples MYSQL Commands
CO6. Learn in details with examples in PL-SQL

Unit - 1 15 Hours

Introduction to Database Management Systems: Definition of Data, Information, DBMS, Data base system application, Purpose of database systems, Characteristics of DB – Self describing nature, Insulation between programs, data and data Abstraction (data Independence), support of multiple views of the data, sharing of data and multiples transaction processing, Storage management, Database language – DDL, DML, DCL.
File processing system v/s DBMS, Data models, Levels of Abstraction in a DBMS, Three Schema architecture, Characteristics of database approach, data models, DBMS architecture and data independence.

Unit - 2 15 Hours

Entity Relationship and Enhanced ER Modeling: Entity types, Entity Sets, Attributes, and Keys, Relationships, Relationship Types, Roles, and Structural Constraints, Weak Entity Types, ER Diagrams, Naming Conventions, SQL99: Schema Definition, constraints, and object modeling

Unit - 3 15 Hours

Relational Data Model: Basic concepts, Relational Constraints and Relational Database Schemas, Update Operations and Dealing with Constraint Violations, Basic Relational Algebra Operations.
Database design: ER and EER to relational mapping, functional dependencies, normal forms-first normal form, second normal forms, third normal form BCNF

Unit - 4 15 Hours

MYSQL (SQL/PL-SQL): SQL VS. SQL * PLUS: SQL COMMANDS ANDDATA TYPES OPERATORS AND EXPRESSIONS, INTRODUCTION TO SQL * PLUS.

MANAGING TABLES AND DATA:

- CREATING AND ALTERING TABLES (INCLUDING CONSTRAINTS)
- DATA MANIPULATION COMMAND LIKE INSERT, UPDATE, DELETE
- SELECT STATEMENT WITH WHERE, GROUP BY AND HAVING, ORDER BY, DISTINCT, SPECIAL OPERATOR LIKE IN, ANY, ALL BETWEEN, EXISTS, LIKE
- JOIN, BUILT IN FUNCTIONS OTHER DATABASE OBJECTS
- VIEW • SYNONYMS, INDEX TRANSACTION CONTROL STATEMENTS
- COMMIT, ROLLBACK, SAVEPOINT INTRODUCTION TO PL/SQL
- SQL V/S PL/SQL • PL/SQL BLOCK STRUCTURE
- LANGUAGE CONSTRUCT OF PL/SQL (VARIABLES, BASIC AND COMPOSITE DATA TYPE, CONDITIONS LOOPING ETC.)
- % TYPE AND % ROWTYPE
- USING CURSOR (IMPLICIT, EXPLICIT)

Reference:

1. R. Elmasri, S.B. Navathe, Fundamentals of Database Systems 6th Edition, Pearson Education, 2010.
2. R. Ramakrishanan, J. Gehrke, Database Management Systems 3rd Edition, McGraw-Hill, 2002.
3. A. Silberschatz, H.F. Korth, S. Sudarshan, Database System Concepts 6th Edition, McGraw Hill, 2010.
4. R. Elmasri, S.B. Navathe Database Systems Models, Languages, Design and application Programming, 6th Edition, Pearson Education,2013.

SEMESTER V

Course code: DME25102

DSE 6A: Elective: Computer Science – V

Database Management Systems Lab

Credits: Practical – 02 **60 Hours**

Software Lab based on Database Management Systems

The following concepts must be introduced to the students:

Note: MS Access/MySQL may be used.

DDL Commands

- Create table, alter table, drop table

DML Commands

- Select, update, delete, and insert statements
- Condition specification using Boolean and comparison operators (and, or, not,=,<>,>,<,>=,<=)
- Arithmetic operators and aggregate functions(Count, sum, avg, Min, Max)
- Multiple table queries (join on different and same tables) • Nested select statements

1. Create tables with relevant foreign key constraints
2. Populate the tables with data
3. Perform the following queries on the database
   a. Display all the details of all employees working in the company
   b. Display ssn, lname, fname, address of employees who work in department no 7
   c. Retrieve the birthdate and address of the employee whose name is 'Franklin T. Wong'
4. Retrieve the name and salary of every employee
5. Retrieve all distinct salary values
6. Retrieve all employee names whose address is in 'Bellaire'
7. Retrieve all employees who were born during the 1950s
8. Retrieve all employees in department 5 whose salary is between 50,000 and 60,000 (inclusive)
9. Retrieve the names of all employees who do not have supervisors
10. Retrieve SSN and department name for all employees
11. Retrieve the name and address of all employees who work for the 'Research' department
12. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate
13. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor
14. [illegible] and Department Name
15. [illegible] an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project

16. Increase the salary of all employees working on the 'ProductX' project by 15%. Retrieve employee name and increased salary of these employees.
17. Retrieve a list of employees and the project name each works in, ordered by the employee's department, and within each department ordered alphabetically by employee first name.
18. Select the names of employees whose salary does not match with salary of any employee in department.
19. Retrieve the name of each employee who has a dependent with the same first name and same sex as the employee.
20. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford.
21. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings.
22. Find the sum of the salaries and number of employees of all employees of the 'Marketing' department, as well as the maximum salary, the minimum salary, and the average salary in this department
23. Select the names of employees whose salary is greater than the average salary of all employees in department 10.
24. For each department, retrieve the department number, the number of employees in the department, and their average salary.
25. For each project, retrieve the project number, the project name, and the number of employees who work on that project.
26. Change the location and controlling department number for all projects having more than 5 employees to 'Bellaire' and 6 respectively.
27. For each department having more than 10 employees, retrieve the department no, no of employees drawing more than 40,000 as salary.
28. Insert a record in Project table which violates referential integrity constraint with respect to Department number. Now remove the violation by making necessary insertion in the Department table.
29. Delete all dependents of employee whose ssn is '123456789'.
30. Delete an employee from Employee table with ssn = '12345'(make sure that this employee has some dependents, is working on some project, is a manager of some department and is supervising some employees). Check and display the cascading effect on Dependent and Works on table. In Department table MGRSSN should be set to default value and in Employee table SUPERSSN should be set to NULL
31. Perform a query using alter command to drop/add field and a constraint in Employee table.

SEMESTER V

Course code: DME25202

DSE6B: Elective: Computer Science - V
Computer Networks

Credits: Theory – 04 **60 Hours**

Course Outcome:

After successful completion of the course, the student is able to

- CO1. Understand the Elements of Data Communications and network Systems
- CO2. Learn in depth Transmission Media
- CO3. Understand in details with examples Network Models
- CO4. Understanding the various classifications and characteristics of Protocols
- CO5. Learn in depth Error Detection and Corrections Algorithms
- CO6. Learn in detail of Network Security

Unit - 1 15 Hours

Basic concepts: Components of data communication, standards and organizations, Network Classification, Network Topologies; network protocol; layered network architecture; overview of OSI reference model; overview of TCP/IP protocol suite.

Unit - 2 15 Hours

Physical Layer: Cabling, Network Interface Card, Transmission Media Devices- Repeater, Hub, Bridge, Switch, Router, Gateway.

Data Link Layer: Framing techniques; Error Control; Flow Control Protocols; shared media protocols - CSMA/CD and CSMA/CA.

Unit - 3 15 Hours

Network Layer: Virtual Circuits and Datagram approach, IP addressing methods – Sub netting; Routing Algorithms (adaptive and non-adaptive)

Transport Layer: Transport services, Transport Layer protocol of TCP and UDP

Unit - 4 15 Hours

Application Layer: Application layer protocols and services – Domain name system, HTTP, WWW, telnet, FTP, SMTP

Network Security: Common Terms, Firewalls, Virtual Private Networks.

Reference:

1. B.A. Forouzan: Data Communication and Networking, 4th Edition, Tata McGraw Hill, 2007.
2. D.E. Comer, Internetworking with TCP/IP, Vol. I, Prentice Hall of India, 1998.
3. W. Stalling, Data & Computer Communication, 8th edition, Prentice Hall of India, 2006.
4. D. Bertsekas, R. Gallager, Data Networks, 2nd edition, Prentice Hall of India, 1992.

SEMESTER V

Course code: DME25302

DSE6B: Elective: Computer Science - V
Computer Networks

Credits: Practicals – 02 **60 Hours**

Software Lab based on Computer Networks:

Implement the concepts of Computer Networks such as:
1. Simulate Checksum Algorithm.
2. Simulate CRC Algorithm
3. Simulate Stop & Wait Protocol.
4. Simulate Go-Back-N Protocol.
5. Simulate Selective Repeat Protocol.

and so on….

SEMESTER VI

Course code: DMF25002

DSE6A: Elective: Computer Science - VI
Programming in JAVA

Credits: Theory – 04, 60 Hours

Course Outcome:

After successful completion of the course, the student is able to

CO1. Deliberate in depth java programming fundamental
CO2. Specify in details with examples Basic java OOPs Concepts
CO3. Understand in depth OOPs Concepts
CO4. Understand in depth java Interface and packages
CO5. Deliberate the details of Exception handling in java
CO6. Deliberate the details of Multithreading & I/O operations in java
CO7. Identify the classification and characteristics of File handling in java
CO8. Learn the details of File handling in java
CO9. Learn the characteristics of Applet Programming

Unit - 1 15 Hours

Introduction to Java: Features of Java, JDK Environment, Object Oriented Programming Concept Overview of Programming, Paradigm, Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Difference between C++ and JAVA, JDK Environment
Java Programming Fundamental: Structure of java program, Data types, Declaration of Variables, scope of variables, Keywords, operators, separators, literals, Machine neutral, JVM, Command line arguments, Decision Making statements, iterative statements, jumping statement, type conversion and casting

Unit - 2 15 Hours

Classes and Objects: Defining a Class, Field Declaration, Methods Declarations, Creating an Object, Accessing class members, Assigning Object Reference Variables, Access specifies, Constructor, Type of Contractors, this keyword instance variable hiding, Garbage Collection, Finalize method, method overloading, overloading Constructor, Understanding Static, Introducing final, Recursion.
Inheritance: Definition, Types of Inheritance, Member Access, Uses of Super, Method Overriding, Dynamic Method Dispatch, Abstract class and Methods, Uses final, Object Class, Nested and Inner classes
Arrays and Strings: Arrays, Creating an array, Types of Arrays, arrays accessing methods/operations String class Methods, String Buffer methods.

Unit - 3 15 Hours

Abstract Class, Interface and Packages: Modifiers and Access Control, Abstract classes and methods, Interfaces, Packages Concept- definition, JAVA API packages, naming conventions, creating packages, Accessing Packages using packages, adding a class to a package, hiding class static import

Interface: Introduction, Defining Interfaces, implementing Interfaces, Nested Interfaces Extending Interfaces, accessing interface variables

Exception handling: Introduction, Types of Errors, Exception, Syntax of Exception handling try and catch statement, multiple catch Statements, Nested try Statements, throws, throwing our own exception, finally statement, java built in exception classes

Unit - 4 **15 Hours**

Multithreading: Introduction, Creating Threads, Extending the thread Classes, implementing runnable interface, Declaring the Class, implementing the run () Method, starting new thread stopping and blocking thread, thread life cycle, thread Priority

Input and Output: Concept of Streams, Stream Classes, Byte Stream classes, Character Stream classes, reading Console input, Writing Console Output, wrapper Classes.

Applet Programming: Introduction, Types of Applet, How applets differ from applications Applet Life cycle, Creating Applet, Applet tag

Reference Books:

1. Ivan Bayross, Web Enabled Commercial Application Development Using Html Dhtml,javascript, Perl Cgi , BPB Publications, 2009.
2. Cay Horstmann, BIG Java, Wiley Publication , 3rd Edition., 2009
3. Herbert Schildt , Java 7, The Complete Reference, , 8th Edition, 2009.
4. E Balagurusamy , Programming with JAVA, TMH, 2007

SEMESTER VI

Course code: DMF25102

DSE6A: Elective: Computer Science - VI
Programming in JAVA Lab

Credits: Practical – 02 **60 Hours**

Software Lab based on Java

PART A

1.Write a java program to find whether given number is positive, negative or zero
2.Write a java program to find the largest of three number using ternary operator
3.Write a java program to find out roots of the quadratic Equation
4.Write a java program to check whether given date is valid or not
5.Write a java program to implement ATM Transaction Using Switch statement

6.Write a java program to generate the following pattern

```
         A
      A  B  A
   A  B  C  B  A
A  B  C  D  C  B  A..
```

7.Write a java program to find sum of all digits of a given number until given number become a single digit

8.Write a program to create an array of 10 integers. Accept values from the user in that array. Input another number from the user and find out how many numbers are equal to the number passed, how many are greater and how many are less than the number passed.

9.Write a java program to sort the given element using selection sort

10. Write a java program to find the trace and norm of the given square matrices

PART B

1. Write a java program to Generate Employee Salary slip Using Class and Object
2. Write a java program to check whether entered character is a vowel or consonant using Constructor
3. Write a java program to Demonstrate Method Overloading
4. Write java program to generate Student marks card Using Inheritance
5. Write a java program to calculate bonus for different departments using abstract class
6. Write a java program to Demonstrate Method Overriding
7. Write a java program to that reads two integer numbers for the variables a and b. If any other character except number (0-9) is entered then the error is caught by NumberFormatException object. After that ex.getMessage () prints the information about the error occurring causes
8. Write a java program to Demonstrate multiple Inheritance using Interface
9. Write a java program to Demonstrate multithreading
10. Write a applet program to generate the following pattern

SEMESTER IV / V / VI

Course code: DLD##### / DME##### / DMF#####

SEC 1A: Elective: Computer Application (Practical)
Office Automation

Credits: Practical – 02 **60 Hours**

Course Outcome:

After successful completion of the course, the student is able to

CO1. Understand the details of fundamentals Of Computer

CO2. Learn in depth Hardware and Software

CO3. Learn the details of Computer Peripherals

CO4. Understand the details of Programming Languages

CO5. Deliberate in details with examples office automation Tools

CO6. Deliberate in depth Operating System and the User Interface

CO7. Understand in details of Internet and its usages

Practical List for WORD:

1. Create a **telephone directory**.
   - The heading should be 16-point Arial Font in bold
   - The rest of the document should use 10-point font size
   - Other headings should use 10-point Courier New Font.
   - The footer should show the page number as well as the date last updated.
2. Design a time-table form for your college.
   - The first line should mention the name of the college in 16-point Arial Font and should be bold.
   - The second line should give the course name teacher's name and the department in 14-point Arial.
   - Leave a gap of 12-points.
   - The rest of the document should use 10-point Times New Roman font.
   - The footer should contain your specifications as the designer and date of creation.
3. Create the following document: A newsletter with a headline and 2 columns in portrait orientation, including at least one image surrounded by text.

Practical List for EXCEL:

1. Create a student worksheet containing roll numbers, names and total marks. Open a document in Word and insert the excel worksheet using:-

i) Copy Paste
ii) Embedding
iii) Linking

2. The term wise marks for APS class of 20 students are stored in 3 separate sheets named term1, term2 and term3. Create 4th worksheet that contains student names and their total and average marks for the entire year. Give proper headings using headers. Make the column headings bold and italic. The 4th worksheet should contain college name as the first line. Make it bold, italic and center it.

3. Consider the following employee worksheet:

Full (First	Name Last)	Grade 1/2/3	Basic Salary	HRA	PF	Gross	Net	(VA)VehicleAllowance

HRA is calculated as follows

Grade	HRA %(of Basic)
1	40%
2	35%
3	30%

Gross = Basic + HRA + VA
Net = Gross – PF
PF is 8% for all Grades
VA is 15000, 10000 and 7000 for Grades 1, 2 and 3

i) Find max, min and average salary of employees in respective Grade
ii) Count no. of people where VA>HRA
iii) Find out most frequently occurring grade.
iv) Extract records where employee name starts with "A" has HRA>10000
v) Print Grade wise report of all employees with subtotals of net salary and also grand totals. Use subtotal command.
vi) Extract records where Grade is 1 or 2 and salary is between 10000 and 20000 both inclusive.

4. In a meeting of a marketing department of an organization it has been decided that price of selling an item is fixed at Rs40. It was resolved to increases the sell of more of more items and getting the profit of Rs40,000. Use Goal Seek of find out how many items you will have to sell to meet your profit figure.

5. Consider the following worksheet for APS 1st year students:-

S.No.	Name	PH	CH	BY	MT	CS	Total Marks	%	Grade
1									
2									

Grade is calculated as follows:-

If % >=90 Grade A

If % >=80 & <90 Grade B
If % >=70 & <80 Grade C
If % >=60 & <70 Grade D
Otherwise students will be declared fail

i) Calculate Grade using if function
ii) Sort the data according to total marks
iii) Apply filter to display the marks of the students having more than 65% marks.
iv) Draw a pie chart showing % marks scored in each subject by the topper of the class.
v) Draw the doughnut chart of the data as in (iv)
vi) Enter the S.No. of a student and find out the Grade of the student using VLOOKUP
vii) Extract all records where name
a) Begins with "A"
b) Contains "A"
c) Ends with "A"

Practical List for Power Point:

a. Create five Power point slides. Each slide should support different format. In these slides

Explain areas of applications of IT. Make slide transition time as 10 seconds.

b. Create five Power Point slides to give advantages/disadvantages of computer, application

of computers and logical structure of computer.

c. Create five Power Point slides detailing the process of internal assessment. It should be a self-running demo.

SEMESTER IV / V /VI

Course code: DLD##### / DME##### / DMF#####

SEC 1B: Elective: Computer Application (Practical)

Elective: XML Programming

Credits: Practical – 02 60 Hou

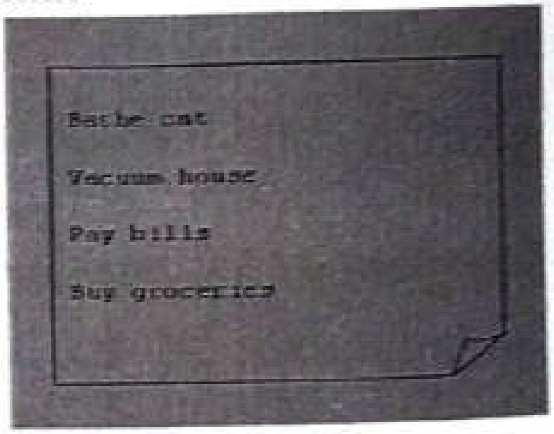
Course Outcome:

After successful completion of the course, the student is able to

CO1. Understand the details of Elements of XML Programming
CO2. Write down in details with examples DTD
CO3. Deliberate in details with examples XML Schemas
CO4. Deliberate the characteristics of CSS
CO5. Learn in details with application CSS
CO6. Deliberate in details with examples XSL
CO7. Learn the details of XML Security
CO8. Learn in details with examples XML and JAVA
CO9. Learn in details with examples XML and ASP.Net

Software Lab Based on XML:

Exercise #1 – Information Structure
In this exercise, student will practice identifying the structure of an information object.
For the sample document provided below:
Label the information structures you see, including containing structures.
12. Draw a tree representation of the structure.



Exercise 2# Deconstructing an XML Document
In this exercise, student will practice identifying the explicit structure within an XML docu
In a sense, this is the reverse of what you did in Exercise #1. For the sample XML ma
below, create a document-like representation (or a simple drawing) for the content con
within the XML tags:

```
<book>
<coverInfo>
<title>The XML Handbook</title>
<author>Charles F. Goldfarb</author>
<author>Paul Prescod</author>
<edition>Second</edition>
<description>The definitive XML resource: applications, products, and technologies. Revised
and expanded—over 600 new pages.
</description>
</coverInfo>
</book>
```

Exercise #3 – Creating XML Markup
In this exercise, create some XML markup based on the tree representation from Exercise #1 above, and the content from the original sample document.

Exercise #4 – Well-Formedness
This exercise checks your understanding of the constraints for well-formedness. Are the following document instances well-formed? Explain any NO answers.

```
<list><title>The first list</title><item>An item</list>
<item>An item</item><item>Another item</item>
<para>Bathing a cat is a <emph>relatively</emph> easy task as long as the cat is
willing.</para>
<bibl><title>How to Bathe a Cat<author></title>Merlin Bauer<author></bibl>
```

Exercise #5 - Well Formedness
This exercise is a bit more challenging than the previous example. Here is a fragment of an XML document instance. Identify all the places where it fails to match the constraints for well-formedness.

```
<PROCEDURE><TITLE>How to Bathe a Cat</TITLE>
<OVERVIEW>This procedure tells you how to bathe a cat. <WARNING></OVERVIEW>Cats
don't like to take baths. You could get hurt doing this. Be sure to obtain all the required
protective gear before you start. </WARNING><EQUIPEMENT><ITEM>Hockey Mask
<ITEM>Padded Full-body Kevlar Armor </ITEM><ITEM>Tub full of warm
water</ITEM><ITEM>Towels </ITEM> <ITEM>First Aid kit</ITEM><ITEM>Cat
Shampoo</ITEM><EQUIPMENT> <INSTRUCTIONS><STEP> Locate the cat, who by now is
hiding under the bed.</STEP> <STEP>Place the cat in the tub of water.</STEP><ITEM>Using
the First Aid kit, repair the damage to your head and arms.</STEP><STEP>Place the cat back in
the tub and hold it down.</STEP><STEP>Wash it really fast, then make an effort to dry it with
the towels.</STEP><STEP>Decide not to do this again. </STEP></INSTRUCTIONS>
```

Note: Cover more exercises based on XML Programming theory concepts.

SEMESTER VI

Course code: DM25202

SEC 4D (CA): Elective: Web Programming (Practical's)
Credits (L: T: P = 0: 0: 2)

Credits: Theory – 04 **60 Hours**

Course Outcome:

After successful completion of the course, the student is able to

CO 1. Learn the details of HTML tags
CO 2. Understand the details of Basic CSS and implements
CO 3. Understand the details of Basic Concepts of Java Scripts
CO 4. Write down in details with application and Usage of Java Scripts
CO 5. Understand in details with examples Document object Model
CO 6. Deliberate in depth Basic of XML

Web programming Lab

1. Program for formatting tags.
2. Creating a Webpage having Hyperlink.
3. Creating Types of Lists (Ordered, Unordered, Definition).
4. Creating a Nested List.
5. Creating a Time Table.
6. Creating a HTML document having vertical frames.
7. Creating Student Application Form.
8. Program to insert audio & video files
9. Creating Internal & External Style Sheets.
10. Program to Margin & Padding.
11. Program to create a Greeting card
12. Program to Image Transparency
13. Program to generate Fibonacci series in JavaScript.
14. Program to display Rainbow Colors in JavaScript.
15. Program to create Pop-Up Boxes.
16. Program to generate multiplication table.
17. Program to find even and odd numbers.
18. Program to add 2 numbers.
19. Program to find factorial of a numbers.
20. Program to generate 2 different patterns.
21. Program to change background color after 5 sec of page load.
22. Display reverse of a given number.
23. Program to generate random numbers.
24. Program to find the sum of individual numbers.
25. Program to display Book information in XML.

SEMESTER VI

Course code: CMF25702

SEC4B: Elective: Computer Science - VII
PHP Programming

Credits: Practical – 02 **60 Hours**

Course Outcome:

After successful completion of the course, the student is able to

CO1. Learn in depth Elements of PHP
CO2. Learn in depth Interaction Methods Between HTML and PHP
CO3. Understand in depth PHP function
CO4. Understand in depth String Manipulation
CO5. Learn the characteristics of Regular Expression
CO6. Learn the details of Developing PHP Web Application

PHP Programming Lab

Software Lab Based on PHP:

1. Create a PHP page using functions for comparing three integers and print the largest number.
2. Write a function to calculate the factorial of a number (non-negative integer). The function accepts the number as an argument.
3. WAP to check whether the given number is prime or not.
4. Create a PHP page which accepts string from user. After submission that page displays the reverse of provided string.
5. Write a PHP function that checks if a string is all lower case.
6. Write a PHP script that checks whether a passed string is palindrome or not? (A palindrome is word, phrase, or sequence that reads the same backward as forward, e.g., madam or nurses run)
7. WAP to sort an array.
8. Write a PHP script that removes the whitespaces from a string.
   Sample string: 'The quick " " brown fox'
   Expected Output: Thequick""brownfox
9. Write a PHP script that finds out the sum of first n odd numbers.
10. Create a login page having user name and password. On clicking submit, a welcome message should be displayed if the user is already registered (i.e.name is present in the database) otherwise error message should be displayed.
11. Write a PHP script that checks if a string contains another string.
12. Create a simple 'birthday countdown' script, the script will count the number of days between current day and birth day.
13. Create a script to construct the following pattern, using nested for loop.
    *

* *
* * *
* * * *
* * * * *

14. Write a simple PHP program to check that emails are valid.
15. WAP to print first n even numbers.
16. $color = array('white', 'green', 'red')
    Write a PHP script which will display the colors in the following way:
    Output:
    White, green, red,
    • Green
    • Red
    • White
17. Using switch case and dropdown list display a "Hello" message depending on the language selected in drop down list.
18. Write a PHP program to print Fibonacci series using recursion.
19. Write a PHP script to replace the first 'the' of the following string with 'That'.
    Sample: 'the quick brown fox jumps over the lazy dog.'
    Expected Result: That quick brown fox jumps over the lazy dog.

Reference:

1. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley, 2011.
2. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.
3. Brian Fling, Mobile Design and Development, O'Reilly Media, 2009. Maximiliano
4. Firtman, Programming the Mobile Web, O'Reilly Media, 2010.
5. Christian Crumlish and Erin Malone, Designing Social Interfaces, O'Reilly Media, 2009.

Semester:3
Code: ELC27025

Media Industry and Management

Course Out comes: On completion of the Course, students are able to:

CO: 1 Become an owner of the media

CO: 2 Become an Administrator or coordinator

CO: 3 Become TRP agent

CO: 4 Assistant for media managing Directors

CO: 5 to set up the newspaper indusay

Unit: I Concept of Management- Origin and growth of Media Management

Fundamentals of manager rent - Management School of Thought

Unit: 2 Media Industry & Challenges • Media industry as manufacturers- news and I!

content management.- Market Forces- performance evaluation TRP, BARC

and HITS - Changing Ownership patterns

Unit 3. Structure o 'media organizations — Role and responsibilities - Workflow & Shift Patterns- Gt idelines-

Qualities and Functions of media managers.

Unit 4. Media Economics- Strategic Management and Marketing - Capital inflow,-

Budgeting- Financial management-personnel Management- Strategic 1

Management,-Market forces

Reference

1. Indian Media Business by Vinita Kohli Khandeka,
2. Political Economy of Communications in India by Pradip Ninan Thomas,
3. Strategic management in media by Lucy Kung
4. Media Management in the age of Giant by Dennis F. Herrick

5. Media industries-History, Theory and Method , by Jennifer Holt and Alisa

Perron,, (Edited)

Semester: 6

Code: ELF 27025

Paper: I. Practice of Advertising and Public Relations

Course Out comes:

On completion of the Course, students are able to

CO: I set up advertising agency
CO: 2 prepare the advertising copy for print
CO: 3 become Script writer-marketing research
CO: 4 become PRO and event campaigner

Unit: 1- Introduction to Advertising, meaning, history and functions o Advertising-Theories, models-Apex bodies Like-AA-AI and ASCI

Unit: 2- Types of Advertising and new trends, ethics and tools for advertising, types of media for advertising, Advertising department and Ad agency structure.

Unit: 3- Introduction to PR, Definition, growth of PR, functions, principles and tools of PR, structure of PR department

Unit: 4- Types of PR, corporate communication, apex bodies like-IPRA, PRSI, PSPF and their codes.

References:

1. Advertising made simple- Frank Jefkins
2. Advertising Theory and Practices- Chunawalla •
3. Public Relations Techniques- Jefkins Frank Butterworth
4. Hand book of Public Relations- Heath Robert
5. Effective Public Relations- Cutlip S.M. and Center A.H.
6. Public Relations in India- Kaul El/ and Noya Prakash

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

B N ROAD, MYSURU- 570 025

DEPARTMENT OF ZOOLOGY

Syllabus

CHOICE BASED CREDIT SYSTEM

For B.Sc programmes

Chemistry, Botany, Zoology

Chemistry, Zoology, Biotechnology

V SEMESTER ZOOLOGY

PRACTICAL –V

APPLIED ZOOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense,* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*
5. Demonstration of Plastination techniques by using some dead insects.
6. Maintenance of freshwater aquarium.
7. Collection and mounting of Ants.
8. Animal associations: - Mutualism – Termites and Trichonympha.
9. Commensalism – Echenies and shark.
   Protocooperation – Hermit crab and Sea anemone.
10. Predation – Snake and Frog. Parasitism – Head louse, Bed bug, Mosquito, Ticks, Mites.
11. Identification of mulberry and non mulberry silkworms. Identification of different larvae of silk worm- Using specimens / pictures
12. Identification of food fishes of Karnataka.

Field visits to a Vermiculture / Sericulture / fisheries / apiculture / poultry / dairy farm- submission of any 1 Report.

V SEMESTER ZOOLOGY

PRACTICAL –V

INSECT VECTORS AND DISEASES

PRACTICAL (CREDITS 2)

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles*, *Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica,* through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors

Submission of a project report on any one of the insect vectors and disease transmitted

PRACTICAL VI

AQUATIC BIOLOGY

PRACTICAL **(Credits 2)**

1&2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem/ photographs.

3 Estimation of dissolved oxygen in different water samples.

4 Estimation of dissolved carbon dioxide in different water samples.

5 Estimation of chlorides in different water samples.

6 Estimation of hardness in different water samples.

7 Measurement of pH, using pH-meter, pH paper.

8 Study of pond ecosystem.

9 Study of aquarium ecosystem.

10 Morphometric measurement of locally available freshwater fish and marine water fish.

11 Identification of fish(any six).

12&13. Fish by products.

14 . Project Report on a visit to a Sewage treatment plant/Marine bioreserve/ Fisheries Institutes.

PRACTICAL VI

IMMUNOLOGY

PRACTICAL **(CREDITS 2)**

1 . Demonstration of lymphoid organs
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Cell counting and viability test from splenocytes of farm bred animals/cell lines.
7. Demonstration of
a) ELISA
b) Immunoelectrophoresis

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

B N ROAD, MYSURU- 570 025

DEPARTMENT OF ZOOLOGY

Syllabus

CHOICE BASED CREDIT SYSTEM

For B.Sc programmes

Chemistry, Botany, Zoology

Chemistry, Zoology, Biotechnology

V SEMESTER ZOOLOGY

PRACTICAL –V

APPLIED ZOOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense,* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla.
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*
5. Demonstration of Plastination techniques by using some dead insects.
6. Maintenance of freshwater aquarium.
7. Collection and mounting of Ants.
8. Animal associations: - Mutualism – Termites and Trichonympha.
9. Commensalism – Echenies and shark.
   Protocooperation – Hermit crab and Sea anemone.
10. Predation – Snake and Frog. Parasitism – Head louse, Bed bug, Mosquito, Ticks, Mites.
11. Identification of mulberry and non mulberry silkworms. Identification of different larvae of silk worm- Using specimens / pictures
12. Identification of food fishes of Karnataka.

Field visits to a Vermiculture / Sericulture / fisheries / apiculture / poultry / dairy farm- submission of any 1 Report.

V SEMESTER ZOOLOGY

PRACTICAL –V

INSECT VECTORS AND DISEASES

PRACTICAL (CREDITS 2)

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles*, *Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica,* through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors

Submission of a project report on any one of the insect vectors and disease transmitted

PRACTICAL VI

AQUATIC BIOLOGY

PRACTICAL **(Credits 2)**

1&2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem/ photographs.

3 Estimation of dissolved oxygen in different water samples.

4 Estimation of dissolved carbon dioxide in different water samples.

5 Estimation of chlorides in different water samples.

6 Estimation of hardness in different water samples.

7 Measurement of pH, using pH-meter, pH paper.

8 Study of pond ecosystem.

9 Study of aquarium ecosystem.

10 Morphometric measurement of locally available freshwater fish and marine water fish.

11 Identification of fish(any six).

12&13. Fish by products.

14 . Project Report on a visit to a Sewage treatment plant/Marine bioreserve/ Fisheries Institutes.

PRACTICAL VI

IMMUNOLOGY

PRACTICAL **(CREDITS 2)**

1 . Demonstration of lymphoid organs
2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells.
4. Ouchterlony's double immuno-diffusion method.
5. ABO blood group determination.
6. Cell counting and viability test from splenocytes of farm bred animals/cell
lines.
7. Demonstration of
a) ELISA
b) Immunoelectrophoresis

Content with a direct bearing on Employability

DME22005/DME22006

SEMESTER V

DSE: IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY (4 CREDITS)

Course Outcomes:

After completing the course students are able to:

CO1. Understand the role of different types of Cells in immune system .

CO2. Discuss the principles and applications of immunological techniques.

CO3. Understand to diagnose diseases.

CO4. Comprehend the knowledge of therapeutic applications of enzyme and hormone.

IMMUNOLOGY **NO. HOURS**

UNIT I **15**

Historical account and chronological events of EdwardJenner and Louis Pasture.

Antigens: Definition, chemical nature, hatpins, epitops, antigenicity, blood group antigens.

Antibodies: Definition, types, structure of IgG.

Types of immunity – Innate- mechanism of innate immunity. Adaptive immunity – active and passive and adoptive immunity.

Cells and organs involved in immune system – T- cells, B-cells, antigen presentation and macrophages, their role in antigen recognition, clonal selection, and immunological memory. Immunological aspects of viral (HIV), bacterial and parasitic infection (one example each)

UNIT II **15**

Immune disorders: Hypersensitivity, auto immune disorders- organ specific and systemic specific Grave's diseases, Hashimoto's disease , systemic lupus erythematosus.

Immuno techniques: Precipitation reaction, immuno diffusion-ODD and RID, RIA, Heamagglutination, ELISA, immunofluroscent, Western blotting. Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Vaccines& Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization.

MEDICAL BIOTECHNOLOGY

UNIT III **15**

Vaccine production: Introduction, new developments, types of vaccines – Inactivate, Attenuated and Recombinant Vaccines-Peptide and DNA, production of vaccines using genetically engineered microorganisms (Ex:HBV).

Enzymes in diagnosis: Enzymes used to detect and quantify blood glucose, cholesterol, triglycerides, urea and uric acid. Immobilized enzymes as diagnostic tools.

Nucleic acid analysis: Features of DNA probes and its applications in diagnosis, identification of *Mycobacterium tuberculosis* in clinical samples using PCR.

Enzymes in therapy: List of enzymes and their therapeutic applications.(Ex: DNase, debriding enzymes, asparginase, superoxide dismutase, rennin, streptokinase, urokinase ,lipase and adenosine deaminase)

UNIT IV **15**

Hormone therapy: List of hormones and their therapeutic applications (Ex: Insulin, human growth hormone, erythropoietin, calcitonin, lipocortin, somatotropin and alpha melanocyte stimulating hormone), production of humulin by recombinant DNA technology.

Therapeutic proteins: Cytokines as therapeutic proteins, production of interferon by recombinant DNA technology.

Human gene therapy: Definition, differences between somatic and germ line gene therapy, embryo, exvivo, in vivo and antisense gene therapy -one example each, principle and applications.

Transgenic plants for production of biopharmaceutical (tobacco, tomatoes, and potatoes)

Content with a direct bearing on Employability

DME22005/DME22006

SEMESTER V

DSE: IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY (4 CREDITS)

Course Outcomes:
After completing the course students are able to:
CO1. Understand the role of different types of Cells in immune system .
CO2. Discuss the principles and applications of immunological techniques.
CO3. Understand to diagnose diseases.
CO4. Comprehend the knowledge of therapeutic applications of enzyme and hormone.

IMMUNOLOGY **NO. HOURS**

UNIT I **15**

Historical account and chronological events of EdwardJenner and Louis Pasture.
Antigens: Definition, chemical nature, hatpins, epitops, antigenicity, blood group antigens.
Antibodies: Definition, types, structure of IgG.
Types of immunity – Innate- mechanism of innate immunity. Adaptive immunity – active and passive and adoptive immunity.
Cells and organs involved in immune system – T- cells, B-cells, antigen presentation and macrophages, their role in antigen recognition, clonal selection, and immunological memory. Immunological aspects of viral (HIV), bacterial and parasitic infection (one example each)

UNIT II **15**

Immune disorders: Hypersensitivity, auto immune disorders- organ specific and systemic specific Grave's diseases, Hashimoto's disease , systemic lupus erythematosus.
Immuno techniques: Precipitation reaction, immuno diffusion-ODD and RID, RIA, Heamagglutination, ELISA, immunofluroscent, Western blotting. Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Vaccines& Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization.

MEDICAL BIOTECHNOLOGY

UNIT III **15**

Vaccine production: Introduction, new developments, types of vaccines – Inactivate, Attenuated and Recombinant Vaccines-Peptide and DNA, production of vaccines using genetically engineered microorganisms (Ex:HBV).
Enzymes in diagnosis: Enzymes used to detect and quantify blood glucose, cholesterol, triglycerides, urea and uric acid. Immobilized enzymes as diagnostic tools.
Nucleic acid analysis: Features of DNA probes and its applications in diagnosis, identification of *Mycobacterium tuberculosis* in clinical samples using PCR.
Enzymes in therapy: List of enzymes and their therapeutic applications.(Ex: DNase, debriding enzymes, asparginase, superoxide dismutase, rennin, streptokinase, urokinase ,lipase and adenosine deaminase)

UNIT IV **15**

Hormone therapy: List of hormones and their therapeutic applications (Ex: Insulin, human growth hormone, erythropoietin, calcitonin, lipocortin, somatotropin and alpha melanocyte stimulating hormone), production of humulin by recombinant DNA technology.
Therapeutic proteins: Cytokines as therapeutic proteins, production of interferon by recombinant DNA technology.
Human gene therapy: Definition, differences between somatic and germ line gene therapy, embryo, exvivo, in vivo and antisense gene therapy -one example each, principle and applications.
Transgenic plants for production of biopharmaceutical (tobacco, tomatoes, and potatoes)

JSS MAHAVIDYAPEETHA

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

OOTY ROAD, MYSURU - 570025

Structure & Detailed Syllabus

Four years Multidisciplinary Undergraduate Programme with Multiple Exit options in

GEOGRAPHY

B.A. / B.Sc. Geography Degree (Basic/Honours)

Effective from 2021 - 2022

B.A/B.Sc Semester 1

Title of the Course: Principles of Geomorphology

Code: GEOGDSC T1.1

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	52 or 56	2	52 or 56
Course Outcomes: 1. After the completion of this course, students should be able to: 2. Define the field of Geomorphology and to explain the essential principles of it. 3. To outline the mechanism of dynamic nature of the Earth's surface and interior of theEarth. 4. To illustrate and explain the forces affecting the crust of the earth and its effect on it. 5. To understand the conceptual and dynamic aspects of landform development			
Course Objectives: This course aims to: 1. To define the concepts in Geomorphology and Physical Geography 2. To introduce various concept to understand cycles of the solid Earth surface 3. To understand the dynamic nature of the Earth's surface, various processes, and landforms. 4. To study the impact human on geomorphic system.			

Content of Theory Course 1	52/56Hrs
Unit – 1 Geomorphology	13/14
Introduction to geography: physical and human geography Introduction to Geomorphology: meaning, nature, development, and scopePrinciples of Geomorphology Geological Time Scale Distribution of continents and oceans	
Unit – 2 Systems and Cycles of the Solid Earth	13/14
Internal structure of the earth Alfred Wegener's continental drift Theory of Isostacy: Views of Pratt and Airy Convectional current theory and concept of sea floor spreading Theory of Plate Tectonics: plate boundaries, subduction, Case Studies: Volcano, Earthquake: reporting of latest incidents Case Studies: Volcano, Earthquake: reporting of latest incidents	
Unit – 3 The Dynamics of Earth	13/14
Earth's Movements: Endogenetic and Exogenetic forces, Sudden and Diastrophic movements- Epeirogenetic and Orogenetic Movements-Process of folding and faulting Vulcanicity and earthquake Rocks: Characteristics, types, importance, and rock cycle Weathering: meaning, types and controlling factors Mass Movement: meaning, controlling factors, types-landslides, rock-falls	

Unit – 4 Evolution of Landforms	13/14
Evolution of Landforms Landforms: meaning, types and factors controlling landforms developmentSlope development: concept and types Concept of Cycle of Erosion–W.M. Davis and W. Penck Agents of Denudation: river; drainage patterns, groundwater, Sea waves, Windand Glaciers and resultant landforms. Application of geomorphology: in India and Karnataka (Regional planning, Urban planning and transportation, Mining, Hazard management, Agriculture and Environmental management).	

References

1. Ahmed E. (1985) Geomorphology, Kalyani Publishers, New Delhi.
2. Bloom A.L. (1978) Geomorphology: A Systematic Analysis of Late CenozoicLandforms Prentice – Hall of India, New Delhi.
3. Brunsden D. (1985) Geomorphology in the Service of Man: The Future ofGeography, Methnen, U.K.
4. Chorley, R.J., Schumm, S. A. and Sugden, D.E. 1984: Geomorphology, Methuen,London
5. Cooke, R.U. and Warren, 1973: Geomorphology in Deserts, Batsford, London
6. Dayal, P. 1996: Textbook of Geomorphology, Shukla Book Depot, Patna.
7. Goudar M B, Physical Geography (Kannada Version)
8. Goudie Anrew et.al. (1981) Geomorphological Techniques, George Allen &Unwin,London.
9. Homes A. (1965) Principles of Physical Geology, 3rd Edition, ELBSS Edn.
10. Hugar M R Physical Geography part 1(Kannada Version)
11. Kolhapure and S S Nanjan, Physical Geography (Kannada Version)
12. Nanjannavar S S: Physical Geography (Kannada Version)
13. P Mallappa, Physical Geography (Kannada Version)
14. Ranganath Principles of Physical Geography (Kannada Version)
15. Strahler A.N. (1968) The Earth Sciences, Harper & Row Intl. Edn, New York
16. Thornberry W.D. (1969) Principles of Geomorphology 2nd Edition, Wiley Intl. Edn. &Wiley, 1984.
17. Verstappen H. (1983) Applied Geomorphology, Geomorphological Surveys forEnvironmental Develop- ment, Elsevier, Amsterdam

Reference Websites

1. http://www.solarviews.com/eng/earth.htm
2. http://www.moorlandschool.co.uk/earth/tectonic.htm
3. https://www.usgs.gov/
4. https://www.ksndmc.org/

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Case Studies	30%
Assignment	20%
CIA	50%
Total	100%

GEOGDSC P1.1 **Geomorphology Practical**

CREDIT:02

Content of Practical Course 1: List of Experiments to be conducted

Exercise-1: Identification of Rocks and Minerals. Mineral samples: Iron ore, Bauxite ore and Manganese. Rock Samples: Granite, Basalt, Lime Stones, Sandstone, quartzite, and marble.

Exercise-2: Extraction and interpretation of Geomorphic information from Topographicalmaps

Exercise-3: Preparation of contour map from toposheet, Construction of Relief Profiles-serial, Super imposed, Projected & Composite.

Exercise-4: Slope Analysis - Slope Maps (Wentworth method) Slope calculation and conversion (isotan and isosin) and aspect maps & Hypsometric curve and integral

Exercise-5: Drainage Morphometry: delineation of watershed, stream ordering and Morphometric analysis: mean stream length, drainage density and drainage frequency. **Field Work**: Measurement of channel cross-sections in the field, Geomorphic map of channel bed, Study of erosional and depositional features in the field.

Case Study: students must be taken to observe local land formation and degradation and write areport on their effectiveness.

B.A. / BSc Semester 2

Title of the Course: Introduction to Climatology

CODE: GEOGDSC T2.1

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	52 or 56	2	52 or 56

Course Outcomes:

After the completion of this course, students should be able to

1. define the field of climatology and to understand the atmospheric composition and structure.
2. to outline the mechanism and process of solar radiation transfer to earth surface and toex- plain the temperature distribution and variation according to time and space.
3. to illustrate and explain the air pressure system, wind regulating forces and the formationof the Atmospheric Disturbance.
4. to understand and compute the air humidity as well as to explain the process of Condensation and formation of precipitation and its types.

Course Objectives:

This course aims to:

1. to define the field of climatology and components of the climate system
2. to introduce various dimensions of climatology like structure and composition.
3. to understand the global atmospheric pressure, temperature, and wind system.
4. to study the concept of atmospheric moisture and its types

Content of Theory Course 1	**52/56Hrs**
Unit – 1 Composition and Structure of the Atmosphere	14
Nature and Scope of Climatology, Atmospheric Sciences; Climatology and Meteorology Origin and structure of the Atmosphere: Troposphere, Stratosphere, Mesosphere, Ionosphere, Exosphere and their characteristics. Composition of the atmosphere Weather and Climate	
Unit – 2 Atmospheric Temperature	14
Insolation: Definition, Mechanism, Solar Constant. Factors affecting the Insolation: Angle of incidence, length of the day, Sunspots,Distance between the earth and the sun, effect of the atmosphere. Heating and cooling process of the atmosphere-Radiation, Conduction,convection, and advection. Temperature: meaning and Influencing Factors on the Distribution ofTemperature Distribution of the temperature: Vertical, Horizontal, and Inversion of temperature. Global Energy Budget: Incoming shortwave solar radiation, Outgoing Longwave Terrestrial radiation, Albedo. Net Radiation and Latitudinal Heat Balances.	
Unit – 3 Atmospheric Pressure and Winds	14

Atmospheric Pressure: Influencing factors on atmospheric pressure.Vertical and Horizontal Distribution of the atmospheric pressure and Pressure Belts, Pressure Gradient. Tri-cellular-Hadley, Ferrel's and Polar Cells. Winds: influencing factors, Types - planetary, seasonal, local wind Variable winds-Cyclones and anti-cyclones. Air-Masses and Fronts: Definition, Nature, Source Regions, Classification.	
Unit – 4 Atmospheric Moisture	14
Humidity: Sources, influencing factors and types-Absolute, Relative and Specific. Hydrological cycle: process of evaporation, condensation. Clouds and its types Precipitation and its forms. Climate Change: Causes and consequences, recent issues-floods, drought,	

References

1. Lal, D. S. (1998). Climatology. Allahabad: Chaitanya Publishing House.
2. P Mallappa, Physical Geography (Kannada Version)
3. Ranganath Principles of Physical Geography (Kannada Version)
4. Nanjannavar S S: Physical Geography (Kannada Version)
5. Hugar M R Physical Geography part 1(Kannada Version)
6. Goudar M B, Physical Geography (Kannada Version)
7. Kolhapure and S S Nanjan, Physical Geography (Kannada Version)
8. Lutgens, Frederic K. & Tarbuck, Edward J. (2010). The Atmosphere: An Introductionto Meteorology. New Jersey: Pearson Prentice Hall.
9. Oliver, John E. & Hidore, John J. (2003). Climatology: An Atmospheric Science.Delhi: Pearson Education.
10. Singh, S. (2005). Climatology. Allahabad: Prayag Pustak Bhawan.
11. Barry, R.G. and Chorley, R.J. (2003): Atmosphere, Weather and Climate; Psychology Press, Hove; East Sussex.
12. Critchfield, H.J., (1975): general Climatology, Prentice Hall, New Jersey.
13. Mather,J.R.(1974): Climatology: Fundamentals and Applications; Mc Craw Hill BookCo., U.S.A.
14. Rumney, G.R. (1968): Climatology and the World Climates, Macmillan, London.
15. Trewartha, G.T. (1980): An Introduction to Climate; McGraw Hill, New York, 5thedition, (International Student Edition)

Reference Websites

1. https://earthobservatory.nasa.gov/
2. https://mausam.imd.gov.in/
3. https://www.weatheronline.in/
4. https://earthexplorer.usgs.gov/
5. https://www.nhc.noaa.gov/satellite.php

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Quiz	30%
Assignment	20%
CIA	50%
Total	100%

GEOGDSC P2.1- **Climatology Practical CREDITS: 2**

Content of Practical Course 1: List of Experiments to be conducted

Conduct all exercises with Goal, Procedure, devices, and findings.

Exercise 1: Understanding Structure and functions of the Indian Meteorological Department (IMD).

Exercise 2: Collection of climatic data from IMD website.

https://mausam.imd.gov.in/bengaluru/

Exercise 3: Plotting of downloaded climatic data using graphical methods-

Elementary Instrumental Observation:

Exercise 4: Centigrade and Fahrenheit thermometer for measuring temperature.

Exercise 5: Mercurial Barometer and Aneroid Barometer for measuring atmosphericpressure

Exercise 6: Wind Vane and cup-anemometer.

Exercise 7: Wet and Dry bulb thermometer for measuring humidity

Exercise 8: Rainguage- Dial type for measuring rainfall Exercise 3: Rainfall Trend Analysis.

Exercise 9: Interpretation of Indian Daily Weather charts.

Exercise 10: Deriving water balance chart, Actual and potential evapotranspiration

Note: Students are expected to download weather charts of the four seasons.

B.A. / BSc Semester 2

Title of the Course: 1 Introduction to Human Geography
CODE: GEOGOE T2.1.1

Number of Theory Credits	Number of lecture hours/ semester
3	42 - 45

Course Outcomes:

1. Students will learn how human, physical, and environmental components of theworld interact.
2. Students will be familiarized with economic processes such as globalization, tradeand their impacts on economic, cultural and social activities.
3. The student will describe what geography and human geography are.
4. Understand population dynamics and migration.

Course Objectives:

This course aims to

1. Understand the basics concepts of human geography
2. Study population attributes and dynamic nature of it
3. Introduce economic, cultural, and trade activities and their impact on thedevelopment of the region

Content of Theory Course 1	45Hrs
Unit – 1 Introduction to Human Geography	11
Nature and scope, Development Environmental Determinism and Possiblism, Neo determinism (stop and godeterminism) Approaches to human geography: Exploration and Descriptive approach, regionalanalysis Approach, Areal Differentiation Approach, Spatial organization Approach.Modern approaches: Welfare or Humanistic Approach, Radical Approach, Behavioral Approach, Post Modernism in geography Fields and sub fields in Human geography	
Unit – 2 Geographical Analysis of Population	11
Distribution and Growth of Population Density of population: meaning and Types: Arithmetic Density and PhysiologicalDensity. Regional distribution of Density of Population. Population Movement: Migration, Raventein's Law of Migration, Factors of population Migration, Economic Push and Pull factors, Cultural Push and Pull Factors, Environmental Push and Pull Factors. Migration Types: Immigration and Emigration, Internal and International Migration	
Unit – 3 Cultural Patterns and Processes	11
Concept of Culture, Material and Non material culture Cultural Regions, cultural Traits and Complexes, cultural Hearths, cultural Diffusion. Languages of the World: Types, Classification and Distribution. Religions: Types and Classification. Distribution. Universalizing Religions: Christianity, Islam, Buddhism. Ethnic Religions: Hinduism, the Chinese religion, Shintoism, Judaism. The Major tribal population of the world.	

Unit – 4 Human Economic Activities, Development and Settlements	12
Primary Economic Activities – Agriculture, Types: Primitive Subsistence, Intensive subsistence, Plantation Agriculture, Extensive Commercial grain cultivation, MixedFarming, Dairy Farming Secondary Activities: Manufacturing, classification – based on size – Small Scale and Large scale. Based on Raw material – Argo-based, Mineral based,Chemical Based and Forest based. Industrial Regions of the world. Tertiary Activities: Types: Trade and commerce, Retail Trading services, Wholesaletrading. Transport and communications: Factors, communication services – Telecommunication. Services: Informal and Non formal sector. Information technology and service. Human Settlements: Factors, Classification, Types and Patterns: Rural, Urban. Compact or Nucleated and Dispersed settlements. Rural settlement Patterns: linear,rectangular, circular, star shaped, T shaped.	

References

1. Hartshorne, T. A., & Alexander, J. W. (2010). Economic Geography. New Delhi: PHI Learning.
2. Knox, P., Agnew, J., & McCarthy, L. (2008). The Geography of the World Economy. London: Hodder Arnold.
3. Lloyd, P., & Dicken, B. (1972). Location in Space: A Theoretical Approach to Economic Geography. New York: Harper and Row.
4. Siddhartha, K. (2000). Economic Geography: Theories, Process and Patterns, NewDelhi: Kisalaya Publications.
5. Smith, D. M. (1971). Industrial Location: An Economic Geographical Analysis, NewYork: John Wiley and Sons.

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Quiz	30%
Assignment	20%
CIA	50%
Total	100%

B.A. / BSc Semester 2

Title of the Course: 2. Basics of Geographic Information Systems (GIS)
CODE: GEOGOE T2.1.2

Number of Theory Credits	Number of lecture hours/ semester
3	39 or 42

Course Outcomes:

1. Students are trained to adapt the theoretical concepts in a practical way through the mathematical models of geography.
2. Students will have the hands-on training on various modes of spatial and non-spatialdata collection, data storage, data analytics, data interpretation and data display through the thematic maps.
3. Students are exposed on spatial thinking to solve the geographical problems withrange of proven mathematical and statistical models.
4. Students can employ in various corporate and government organisation where theydeal to solve geographical problems.

Course Objectives:
This course aims to:

1. Understand the concept and techniques of the Geographic Information Systems.
2. Define the GIS data types and structures.
3. Study geo processing and visualization concepts and techniques in GIS.

Content of Theory Course 1	52/56Hrs
Unit – 1 Introduction	10
Emergence of GI Science, Milestone and Developmental stages in GIS, Definition, scope, role of GIS in digital world; Components, functionalities, merits and demerits, global market, interdisciplinary domains, and its integration with GIS.	
Unit – 2 Geodesy and Spatial Mathematics	10
Cartesian coordinates, latitude, longitudes, formats of angular units, geographical coordinates, Datum: WGS84, vs NAD32. UTM, Aerial Distance measurement using Geographic and projected coordinates, Area, Perimeter, length by coordinates andvarious international measures.	
Unit – 3 GIS Data and Scale	10
Spatial Data and its structures; sources and types of data collection; data errors, topology of data and relationship. Large Scale vs Small Scale, generalization; precision and accuracy of data-logical consistency and non-spatial data integration	
Unit – 4 Geoprocessing and Visualization	12
Spatial and Non-Spatial Queries, proximity analysis, Preparation of Terrain andSurface models. Hotspot and density mapping. Types of maps, thematic maps and Its types, relief maps, flow maps and cartograms. Tabulations: Graphs and Pivottables	

References

1. An Introduction to Geographical Information Systems - Ian Heywood (2011)
2. Geographic Information Systems and Cartographic Modelling - Tomlin, C.D. (1990)
3. Geographic Information Systems and Environmental Modelling - Clarke, C., K. (2002)
4. Geographic Information Systems and Science - Paul A. Longley, et. al. (2015)
5. Geographic Information Systems: A Management Perspective - Aronoff, S. (1989)
6. GIS - Fundamentals, Applications, and Implementations - Elangovan, K. (2006)
7. Introduction to Geographical Information Systems - Chang, Kang-Tsung (2015)
8. Mathematical Modeling in Geographical Information System, Global PositioningSystem and Digital Cartography - Sharma, H.S. (2006)
9. Remote Sensing and GIS - Bhatta, B. (2011)
10. Spatial analysis and Location-Allocation Models - Ghosh, A. and G. Rushton (1987)

Reference Websites

1. IIRS MOOC programme: https://isat.iirs.gov.in/mooc.php
2. ITC Netherlands, Principles of GIS https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesgis.pdf
3. Geographical Information Systems: Principles, Techniques, Management and Applications https://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Quiz	30%
Assignment	20%
CIA	50%
Total	100%

JSS MAHAVIDYAPEETHA

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

OOTY ROAD, MYSURU - 570025

Structure & Detailed Syllabus

Four years Multidisciplinary Undergraduate Programme with Multiple Exit options

in

GEOGRAPHY

B.A. / B.Sc. Geography Degree (Basic/Honours)

Effective from 2021 - 2022

B.A/B.Sc Semester 1

Title of the Course: Principles of Geomorphology

Code: GEOGDSC T1.1

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	52 or 56	2	52 or 56

Course Outcomes:

1. After the completion of this course, students should be able to:
2. Define the field of Geomorphology and to explain the essential principles of it.
3. To outline the mechanism of dynamic nature of the Earth's surface and interior of theEarth.
4. To illustrate and explain the forces affecting the crust of the earth and its effect on it.
5. To understand the conceptual and dynamic aspects of landform development

Course Objectives:

This course aims to:

1. To define the concepts in Geomorphology and Physical Geography
2. To introduce various concept to understand cycles of the solid Earth surface
3. To understand the dynamic nature of the Earth's surface, various processes, and landforms.
4. To study the impact human on geomorphic system.

Content of Theory Course 1	52/56Hrs
Unit – 1 Geomorphology	13/14
Introduction to geography: physical and human geography Introduction to Geomorphology: meaning, nature, development, and scopePrinciples of Geomorphology Geological Time Scale Distribution of continents and oceans	
Unit – 2 Systems and Cycles of the Solid Earth	13/14
Internal structure of the earth Alfred Wegener's continental drift Theory of Isostacy: Views of Pratt and Airy Convectional current theory and concept of sea floor spreading Theory of Plate Tectonics: plate boundaries, subduction, Case Studies: Volcano, Earthquake: reporting of latest incidents Case Studies: Volcano, Earthquake: reporting of latest incidents	
Unit – 3 The Dynamics of Earth	13/14
Earth's Movements: Endogenetic and Exogenetic forces, Sudden and Diastrophic movements- Epeirogenetic and Orogenetic Movements-Process of folding and faulting Vulcanicity and earthquake Rocks: Characteristics, types, importance, and rock cycle Weathering: meaning, types and controlling factors Mass Movement: meaning, controlling factors, types-landslides, rock-falls	

Unit – 4 Evolution of Landforms	13/14
Evolution of Landforms Landforms: meaning, types and factors controlling landforms developmentSlope development: concept and types Concept of Cycle of Erosion–W.M. Davis and W. Penck Agents of Denudation: river; drainage patterns, groundwater, Sea waves, Windand Glaciers and resultant landforms. Application of geomorphology: in India and Karnataka (Regional planning, Urban planning and transportation, Mining, Hazard management, Agriculture and Environmental management).	

References

1. Ahmed E. (1985) Geomorphology, Kalyani Publishers, New Delhi.
2. Bloom A.L. (1978) Geomorphology: A Systematic Analysis of Late CenozoicLandforms Prentice – Hall of India, New Delhi.
3. Brunsden D. (1985) Geomorphology in the Service of Man: The Future ofGeography, Methnen, U.K.
4. Chorley, R.J., Schumm, S. A. and Sugden, D.E. 1984: Geomorphology, Methuen,London
5. Cooke, R.U. and Warren, 1973: Geomorphology in Deserts, Batsford, London
6. Dayal, P. 1996: Textbook of Geomorphology, Shukla Book Depot, Patna.
7. Goudar M B, Physical Geography (Kannada Version)
8. Goudie Anrew et.al. (1981) Geomorphological Techniques, George Allen &Unwin,London.
9. Homes A. (1965) Principles of Physical Geology, 3rd Edition, ELBSS Edn.
10. Hugar M R Physical Geography part 1(Kannada Version)
11. Kolhapure and S S Nanjan, Physical Geography (Kannada Version)
12. Nanjannavar S S: Physical Geography (Kannada Version)
13. P Mallappa, Physical Geography (Kannada Version)
14. Ranganath Principles of Physical Geography (Kannada Version)
15. Strahler A.N. (1968) The Earth Sciences, Harper & Row Intl. Edn, New York
16. Thornberry W.D. (1969) Principles of Geomorphology 2nd Edition, Wiley Intl. Edn. &Wiley, 1984.
17. Verstappen H. (1983) Applied Geomorphology, Geomorphological Surveys forEnvironmental Develop- ment, Elsevier, Amsterdam

Reference Websites

1. http://www.solarviews.com/eng/earth.htm
2. http://www.moorlandschool.co.uk/earth/tectonic.htm
3. https://www.usgs.gov/
4. https://www.ksndmc.org/

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Case Studies	30%
Assignment	20%
CIA	50%
Total	100%

GEOGDSC P1.1 **Geomorphology Practical**

CREDIT:02

Content of Practical Course 1: List of Experiments to be conducted

Exercise-1: Identification of Rocks and Minerals. Mineral samples: Iron ore, Bauxite ore and Manganese. Rock Samples: Granite, Basalt, Lime Stones, Sandstone, quartzite, and marble.

Exercise-2: Extraction and interpretation of Geomorphic information from Topographicalmaps

Exercise-3: Preparation of contour map from toposheet, Construction of Relief Profiles-serial, Super imposed, Projected & Composite.

Exercise-4: Slope Analysis - Slope Maps (Wentworth method) Slope calculation and conversion (isotan and isosin) and aspect maps & Hypsometric curve and integral

Exercise-5: Drainage Morphometry: delineation of watershed, stream ordering and Morphometric analysis: mean stream length, drainage density and drainage frequency. **Field Work**: Measurement of channel cross-sections in the field, Geomorphic map of channel bed, Study of erosional and depositional features in the field.

Case Study: students must be taken to observe local land formation and degradation and write areport on their effectiveness.

B.A. / BSc Semester 2

Title of the Course: Introduction to Climatology

CODE: GEOGDSC T2.1

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	52 or 56	2	52 or 56

Course Outcomes:

After the completion of this course, students should be able to

1. define the field of climatology and to understand the atmospheric composition and structure.
2. to outline the mechanism and process of solar radiation transfer to earth surface and toex- plain the temperature distribution and variation according to time and space.
3. to illustrate and explain the air pressure system, wind regulating forces and the formationof the Atmospheric Disturbance.
4. to understand and compute the air humidity as well as to explain the process of Condensation and formation of precipitation and its types.

Course Objectives:

This course aims to:

1. to define the field of climatology and components of the climate system
2. to introduce various dimensions of climatology like structure and composition.
3. to understand the global atmospheric pressure, temperature, and wind system.
4. to study the concept of atmospheric moisture and its types

Content of Theory Course 1	52/56Hrs
Unit – 1 Composition and Structure of the Atmosphere	14
Nature and Scope of Climatology, Atmospheric Sciences; Climatology and Meteorology Origin and structure of the Atmosphere: Troposphere, Stratosphere, Mesosphere, Ionosphere, Exosphere and their characteristics. Composition of the atmosphere Weather and Climate	
Unit – 2 Atmospheric Temperature	14
Insolation: Definition, Mechanism, Solar Constant. Factors affecting the Insolation: Angle of incidence, length of the day, Sunspots,Distance between the earth and the sun, effect of the atmosphere. Heating and cooling process of the atmosphere-Radiation, Conduction,convection, and advection. Temperature: meaning and Influencing Factors on the Distribution ofTemperature Distribution of the temperature: Vertical, Horizontal, and Inversion of temperature. Global Energy Budget: Incoming shortwave solar radiation, Outgoing Longwave Terrestrial radiation, Albedo. Net Radiation and Latitudinal Heat Balances.	
Unit – 3 Atmospheric Pressure and Winds	14

Atmospheric Pressure: Influencing factors on atmospheric pressure.Vertical and Horizontal Distribution of the atmospheric pressure and Pressure Belts, Pressure Gradient. Tri-cellular-Hadley, Ferrel's and Polar Cells. Winds: influencing factors, Types - planetary, seasonal, local wind Variable winds-Cyclones and anti-cyclones. Air-Masses and Fronts: Definition, Nature, Source Regions, Classification.	
Unit – 4 Atmospheric Moisture	14
Humidity: Sources, influencing factors and types-Absolute, Relative and Specific. Hydrological cycle: process of evaporation, condensation. Clouds and its types Precipitation and its forms. Climate Change: Causes and consequences, recent issues-floods, drought,	

References

1. Lal, D. S. (1998). Climatology. Allahabad: Chaitanya Publishing House.
2. P Mallappa, Physical Geography (Kannada Version)
3. Ranganath Principles of Physical Geography (Kannada Version)
4. Nanjannavar S S: Physical Geography (Kannada Version)
5. Hugar M R Physical Geography part 1(Kannada Version)
6. Goudar M B, Physical Geography (Kannada Version)
7. Kolhapure and S S Nanjan, Physical Geography (Kannada Version)
8. Lutgens, Frederic K. & Tarbuck, Edward J. (2010). The Atmosphere: An Introductionto Meteorology. New Jersey: Pearson Prentice Hall.
9. Oliver, John E. & Hidore, John J. (2003). Climatology: An Atmospheric Science.Delhi: Pearson Education.
10. Singh, S. (2005). Climatology. Allahabad: Prayag Pustak Bhawan.
11. Barry, R.G. and Chorley, R.J. (2003): Atmosphere, Weather and Climate; Psychology Press, Hove; East Sussex.
12. Critchfield, H.J., (1975): general Climatology, Prentice Hall, New Jersey.
13. Mather,J.R.(1974): Climatology: Fundamentals and Applications; Mc Craw Hill BookCo., U.S.A.
14. Rumney, G.R. (1968): Climatology and the World Climates, Macmillan, London.
15. Trewartha, G.T. (1980): An Introduction to Climate; McGraw Hill, New York, 5thedition, (International Student Edition)

Reference Websites

1. https://earthobservatory.nasa.gov/
2. https://mausam.imd.gov.in/
3. https://www.weatheronline.in/
4. https://earthexplorer.usgs.gov/
5. https://www.nhc.noaa.gov/satellite.php

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Quiz	30%
Assignment	20%
CIA	50%
Total	100%

GEOGDSC P2.1- **Climatology Practical CREDITS: 2**

Content of Practical Course 1: List of Experiments to be conducted

Conduct all exercises with Goal, Procedure, devices, and findings.

Exercise 1: Understanding Structure and functions of the Indian Meteorological Department (IMD).

Exercise 2: Collection of climatic data from IMD website.

https://mausam.imd.gov.in/bengaluru/

Exercise 3: Plotting of downloaded climatic data using graphical methods-

Elementary Instrumental Observation:

Exercise 4: Centigrade and Fahrenheit thermometer for measuring temperature.

Exercise 5: Mercurial Barometer and Aneroid Barometer for measuring atmosphericpressure

Exercise 6: Wind Vane and cup-anemometer.

Exercise 7: Wet and Dry bulb thermometer for measuring humidity

Exercise 8: Rainguage- Dial type for measuring rainfall Exercise 3: Rainfall Trend Analysis.

Exercise 9: Interpretation of Indian Daily Weather charts.

Exercise 10: Deriving water balance chart, Actual and potential evapotranspiration

Note: Students are expected to download weather charts of the four seasons.

B.A. / BSc Semester 2

Title of the Course: 1 Introduction to Human Geography
CODE: GEOGOE T2.1.1

Number of Theory Credits	Number of lecture hours/ semester
3	42 - 45

Course Outcomes:

1. Students will learn how human, physical, and environmental components of theworld interact.
2. Students will be familiarized with economic processes such as globalization, tradeand their impacts on economic, cultural and social activities.
3. The student will describe what geography and human geography are.
4. Understand population dynamics and migration.

Course Objectives:

This course aims to

1. Understand the basics concepts of human geography
2. Study population attributes and dynamic nature of it
3. Introduce economic, cultural, and trade activities and their impact on thedevelopment of the region

Content of Theory Course 1	45Hrs
Unit – 1 Introduction to Human Geography	11
Nature and scope, Development Environmental Determinism and Possiblism, Neo determinism (stop and godeterminism) Approaches to human geography: Exploration and Descriptive approach, regionalanalysis Approach, Areal Differentiation Approach, Spatial organization Approach.Modern approaches: Welfare or Humanistic Approach, Radical Approach, Behavioral Approach, Post Modernism in geography Fields and sub fields in Human geography	
Unit – 2 Geographical Analysis of Population	11
Distribution and Growth of Population Density of population: meaning and Types: Arithmetic Density and PhysiologicalDensity. Regional distribution of Density of Population. Population Movement: Migration, Raventein's Law of Migration, Factors of population Migration, Economic Push and Pull factors, Cultural Push and Pull Factors, Environmental Push and Pull Factors. Migration Types: Immigration and Emigration, Internal and International Migration	
Unit – 3 Cultural Patterns and Processes	11
Concept of Culture, Material and Non material culture Cultural Regions, cultural Traits and Complexes, cultural Hearths, cultural Diffusion. Languages of the World: Types, Classification and Distribution. Religions: Types and Classification. Distribution. Universalizing Religions: Christianity, Islam, Buddhism. Ethnic Religions: Hinduism, the Chinese religion, Shintoism, Judaism. The Major tribal population of the world.	

Unit – 4 Human Economic Activities, Development and Settlements	12
Primary Economic Activities – Agriculture, Types: Primitive Subsistence, Intensive subsistence, Plantation Agriculture, Extensive Commercial grain cultivation, MixedFarming, Dairy Farming Secondary Activities: Manufacturing, classification – based on size – Small Scale and Large scale. Based on Raw material – Argo-based, Mineral based,Chemical Based and Forest based. Industrial Regions of the world. Tertiary Activities: Types: Trade and commerce, Retail Trading services, Wholesaletrading. Transport and communications: Factors, communication services – Telecommunication. Services: Informal and Non formal sector. Information technology and service. Human Settlements: Factors, Classification, Types and Patterns: Rural, Urban. Compact or Nucleated and Dispersed settlements. Rural settlement Patterns: linear,rectangular, circular, star shaped, T shaped.	

References

1. Hartshorne, T. A., & Alexander, J. W. (2010). Economic Geography. New Delhi: PHI Learning.
2. Knox, P., Agnew, J., & McCarthy, L. (2008). The Geography of the World Economy. London: Hodder Arnold.
3. Lloyd, P., & Dicken, B. (1972). Location in Space: A Theoretical Approach to Economic Geography. New York: Harper and Row.
4. Siddhartha, K. (2000). Economic Geography: Theories, Process and Patterns, NewDelhi: Kisalaya Publications.
5. Smith, D. M. (1971). Industrial Location: An Economic Geographical Analysis, NewYork: John Wiley and Sons.

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Quiz	30%
Assignment	20%
CIA	50%
Total	100%

B.A. / BSc Semester 2

Title of the Course: 2. Basics of Geographic Information Systems (GIS)
CODE: GEOGOE T2.1.2

Number of Theory Credits	Number of lecture hours/ semester
3	39 or 42

Course Outcomes:

1. Students are trained to adapt the theoretical concepts in a practical way through the mathematical models of geography.
2. Students will have the hands-on training on various modes of spatial and non-spatialdata collection, data storage, data analytics, data interpretation and data display through the thematic maps.
3. Students are exposed on spatial thinking to solve the geographical problems withrange of proven mathematical and statistical models.
4. Students can employ in various corporate and government organisation where theydeal to solve geographical problems.

Course Objectives:
This course aims to:

1. Understand the concept and techniques of the Geographic Information Systems.
2. Define the GIS data types and structures.
3. Study geo processing and visualization concepts and techniques in GIS.

Content of Theory Course 1	52/56Hrs
Unit – 1 Introduction	10
Emergence of GI Science, Milestone and Developmental stages in GIS, Definition, scope, role of GIS in digital world; Components, functionalities, merits and demerits, global market, interdisciplinary domains, and its integration with GIS.	
Unit – 2 Geodesy and Spatial Mathematics	10
Cartesian coordinates, latitude, longitudes, formats of angular units, geographical coordinates, Datum: WGS84, vs NAD32. UTM, Aerial Distance measurement using Geographic and projected coordinates, Area, Perimeter, length by coordinates andvarious international measures.	
Unit – 3 GIS Data and Scale	10
Spatial Data and its structures; sources and types of data collection; data errors, topology of data and relationship. Large Scale vs Small Scale, generalization; precision and accuracy of data-logical consistency and non-spatial data integration	
Unit – 4 Geoprocessing and Visualization	12
Spatial and Non-Spatial Queries, proximity analysis, Preparation of Terrain andSurface models. Hotspot and density mapping. Types of maps, thematic maps and Its types, relief maps, flow maps and cartograms. Tabulations: Graphs and Pivottables	

References

1. An Introduction to Geographical Information Systems - Ian Heywood (2011)
2. Geographic Information Systems and Cartographic Modelling - Tomlin, C.D. (1990)
3. Geographic Information Systems and Environmental Modelling - Clarke, C., K. (2002)
4. Geographic Information Systems and Science - Paul A. Longley, et. al. (2015)
5. Geographic Information Systems: A Management Perspective - Aronoff, S. (1989)
6. GIS - Fundamentals, Applications, and Implementations - Elangovan, K. (2006)
7. Introduction to Geographical Information Systems - Chang, Kang-Tsung (2015)
8. Mathematical Modeling in Geographical Information System, Global PositioningSystem and Digital Cartography - Sharma, H.S. (2006)
9. Remote Sensing and GIS - Bhatta, B. (2011)
10. Spatial analysis and Location-Allocation Models - Ghosh, A. and G. Rushton (1987)

Reference Websites

1. IIRS MOOC programme: https://isat.iirs.gov.in/mooc.php
2. ITC Netherlands, Principles of GIS https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesgis.pdf
3. Geographical Information Systems: Principles, Techniques, Management and Applications https://www.geos.ed.ac.uk/~gisteac/gis_book_abridged/

Pedagogy

Formative Assessment	
Assessment Occasion/type	**Weightage in Marks**
Quiz	30%
Assignment	20%
CIA	50%
Total	100%

DEPARTMENT OF MICROBIOLOGY
SEC
TITLE: MICROBIAL DIAGNOSIS IN HEALTH CLINICS
SEMESTER – V

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 2**

COURSE CODE-DME28406 / DME28407

Course outcome

CO1. Student will gain experience in health clinics such as examination, collection of clinical samples and diagnosis.

CO2.Demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs, and understand and use information from scientific papers.

UNIT: I **No of Hours: 5**

IMPORTANCE OF DIAGNOSIS OF DISEASES

Bacterial, viral, fungal and protozoan diseases of various human body systems. Disease associated clinical samples for diagnosis.

UNIT:II **No of Hours: 5**

COLLECTION OF CLINICAL SAMPLES

Collection of clinical samples (oral cavity/sputum, throat, skin, blood, CSF, urine and faeces) and handling clinical specimens. Method of transport of clinical samples to laboratory and storage.

UNIT :III **N o of Hours: 15**

DIRECT MICROSCOPIC EXAMINATION AND CULTURE

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained, Thin blood film for malaria, Preparation and use of culture media – Blood agar,Chocolate agar,Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Serological and Molecular Methods

Serological Methods – Agglutination, Precipitation, ELISA and PCR.

Test for Typhoid, Dengue ,HIV and Swine flu

Laboratory exposure to students: demonstration of staining.

UNIT: IV **No of Hours: 5**

TESTING FOR ANTIBIOTIC SENSITIVITY IN BACTERIA

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial dilution method

DSE
VI SEMESTER
TITLE: INDUSTRIAL AND FOOD MICROBIOLOGY
THEORY

TOTAL HOURS: 60hrs (4hrs/week) CREDITS: 4

COURSE CODE-DMF28006 / DMF28007

Course outcome

Enable the students to get sufficient knowledge about:

- **CO1**.Food related microorganisms, their contamination, spoilage and preservation
- **CO2.** Understand the beneficial role of microorganisms in fermented dairy products.
- **CO3.**Know the significance and activities of microorganisms in food
- **CO4.** Understand the food borne intoxication and infections.
- **CO5.** Learn about food safety and quality control.
- **CO6**. Know the principles involving various methods of food preservation.
- **CO7.** Understand how microbiology is applied in manufacture of industrial products
- **CO8.** Know about design of bioreactors , medium formulation & design for microbial fermentation, the different types of fermentation processes
- **CO9.** Identify techniques applicable for strain Improvement of microorganism
- **CO10**.The underlying principles in downstream processing

UNIT: I No of Hours: 15

INDUSTRIAL MICROBIOLOGY

A. Brief history and developments in industrial microbiology

B. Microorganisms of industrial importance; Isolation, Screening and Preservation of industrial important microbes..

C. Strain improvement of Microorganisms for industrial purposes.

D.A brief account of production medium, inoculum medium, raw materials-Molasses, corn steep liquor, sulphite waste liquor,yeast extract and whey. Buffers, Precursors, Inhibitors and Antifoam agents.

E. Fermenters and fermentation process: Design, types and basic function of fermenters, sterilization, devices for aeration and agitation (in brief).

Types of fermenters – laboratory, pilot-scale and production fermenters

Components of a typical continuously stirred tank bioreactor

Fermentation process – Surface, Submerged and Solid state fermentation. Types- Batch and Continuous fermentation.

Downstream processing: Steps in recovery and purification of fermented products – Precipitation, Filtration, Centrifugation, Distillation, Cell disruption, Solvent recovery, chromatography, Drying and crystallization.

UNIT: II No of Hours: 15

INDUSTRIAL PRODUCTION

A. a. Organic acids – Citric acid.

b. Antibiotics – Penicillin.

c. Enzymes –Pectinase and amylase.

d. Alcohol – Ethanol.

e. Amino acid –Glutamatic acid.

B. Mushroom cultivation – Oyster mushroom (bag method). Nutritional value.

C. Role of microorganisms in the production and recovery of minerals and petroleum.

D. Single cell protein: *Spirulina*.

Unit: III **No of Hours: 15**

FOOD MICROBIOLOGY

A. Introduction to Food Microbiology: Definition, Concept and Scope. Food as a substrate for microorganisms, Factors influencing microbial growth in foods (intrinsic and extrinsic factors)**.**

B. Sources of contamination, Microbial spoilage of foods – fruits, vegetables, meat, poultry, canned foods, cereals and cereal products.

C. Methods of food preservation: Physical method – high temperature, low temperature, canning. Drying – solar drying, drum drying, spray drying and Radiation.
Chemical methods – chemical preservatives – (propionates, benzoate, sorbates, nitrates and nitrites, sugar and salt)

D. Food borne intoxication and infection:
Bacterial intoxication- Staphylococcal intoxication and Botulism.
Bacterial infection- Salmonellosis.
Mycotoxin –Types and importance of toxins with special reference to Aflatoxins.

E. Food safety and quality control. –A brief account on FPO, HACCP, Food laws and Food standards (in brief)

UNIT:IV **No of Hours: 15**

DAIRY MICROBIOLOGY

A. Introduction to Dairy Microbiology: Source of milk contamination. Types of microorganisms in milk.

B. Methods to detect microbial spoilage by SPC, Reductase test.

C. Biochemical changes of milk - Souring, Gassy fermentation, Proteolysis, Lipolysis, and Ropiness.

D. Fermented dairy products (a brief account of characteristic and therapeutic value). Acidophilus milk, Yoghurt, Butter milk, Srikhand. Types of cheese. Probiotics and their benefits.

A. Preservation of milk and milk products – Pasteurization and Sterilization. Microbiological standard for milk and milk products (in brief).

DEPARTMENT OF MICROBIOLOGY
SEC
TITLE: MICROBIAL DIAGNOSIS IN HEALTH CLINICS
SEMESTER – V

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 2**

COURSE CODE-DME28406 / DME28407

Course outcome

CO1. Student will gain experience in health clinics such as examination, collection of clinical samples and diagnosis.

CO2.Demonstrate scientific quantitative skills, such as the ability to evaluate experimental design, read graphs, and understand and use information from scientific papers.

UNIT: I **No of Hours: 5**

IMPORTANCE OF DIAGNOSIS OF DISEASES

Bacterial, viral, fungal and protozoan diseases of various human body systems. Disease associated clinical samples for diagnosis.

UNIT:II **No of Hours: 5**

COLLECTION OF CLINICAL SAMPLES

Collection of clinical samples (oral cavity/sputum, throat, skin, blood, CSF, urine and faeces) and handling clinical specimens. Method of transport of clinical samples to laboratory and storage.

UNIT :III **N o of Hours: 15**

DIRECT MICROSCOPIC EXAMINATION AND CULTURE

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained, Thin blood film for malaria, Preparation and use of culture media – Blood agar,Chocolate agar,Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

Serological and Molecular Methods

Serological Methods – Agglutination, Precipitation, ELISA and PCR.

Test for Typhoid, Dengue ,HIV and Swine flu

Laboratory exposure to students: demonstration of staining.

UNIT: IV **No of Hours: 5**

TESTING FOR ANTIBIOTIC SENSITIVITY IN BACTERIA

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method,

Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial dilution method

DSE
VI SEMESTER
TITLE: INDUSTRIAL AND FOOD MICROBIOLOGY
THEORY

TOTAL HOURS: 60hrs (4hrs/week) **CREDITS: 4**

COURSE CODE-DMF28006 / DMF28007

Course outcome

Enable the students to get sufficient knowledge about:

CO1.Food related microorganisms, their contamination, spoilage and preservation
CO2. Understand the beneficial role of microorganisms in fermented dairy products.
CO3. Know the significance and activities of microorganisms in food
CO4. Understand the food borne intoxication and infections.
CO5. Learn about food safety and quality control.
CO6. Know the principles involving various methods of food preservation.
CO7. Understand how microbiology is applied in manufacture of industrial products
CO8. Know about design of bioreactors , medium formulation & design for microbial fermentation, the different types of fermentation processes
CO9. Identify techniques applicable for strain Improvement of microorganism
CO10.The underlying principles in downstream processing

UNIT: I **No of Hours: 15**

INDUSTRIAL MICROBIOLOGY

A. Brief history and developments in industrial microbiology

B. Microorganisms of industrial importance; Isolation, Screening and Preservation of industrial important microbes..

C. Strain improvement of Microorganisms for industrial purposes.

D.A brief account of production medium, inoculum medium, raw materials-Molasses, corn steep liquor, sulphite waste liquor,yeast extract and whey. Buffers, Precursors, Inhibitors and Antifoam agents.

E. Fermenters and fermentation process: Design, types and basic function of fermenters, sterilization, devices for aeration and agitation (in brief).
Types of fermenters – laboratory, pilot-scale and production fermenters
Components of a typical continuously stirred tank bioreactor
Fermentation process – Surface, Submerged and Solid state fermentation. Types- Batch and Continuous fermentation.
Downstream processing: Steps in recovery and purification of fermented products – Precipitation, Filtration, Centrifugation, Distillation, Cell disruption, Solvent recovery, chromatography, Drying and crystallization.

UNIT: II **No of Hours: 15**

INDUSTRIAL PRODUCTION

A. a. Organic acids – Citric acid.
b. Antibiotics – Penicillin.
c. Enzymes –Pectinase and amylase.
d. Alcohol – Ethanol.
e. Amino acid –Glutamatic acid.

B. Mushroom cultivation – Oyster mushroom (bag method). Nutritional value.

C. Role of microorganisms in the production and recovery of minerals and petroleum.

D. Single cell protein: *Spirulina*.

Unit: III **No of Hours: 15**

FOOD MICROBIOLOGY

A. Introduction to Food Microbiology: Definition, Concept and Scope. Food as a substrate for microorganisms, Factors influencing microbial growth in foods (intrinsic and extrinsic factors)**.**

B. Sources of contamination, Microbial spoilage of foods – fruits, vegetables, meat, poultry, canned foods, cereals and cereal products.

C. Methods of food preservation: Physical method – high temperature, low temperature, canning. Drying – solar drying, drum drying, spray drying and Radiation.
Chemical methods – chemical preservatives – (propionates, benzoate, sorbates, nitrates and nitrites, sugar and salt)

D. Food borne intoxication and infection:
Bacterial intoxication- Staphylococcal intoxication and Botulism.
Bacterial infection- Salmonellosis.
Mycotoxin –Types and importance of toxins with special reference to Aflatoxins.

E. Food safety and quality control. –A brief account on FPO, HACCP, Food laws and Food standards (in brief)

UNIT:IV **No of Hours: 15**

DAIRY MICROBIOLOGY

A. Introduction to Dairy Microbiology: Source of milk contamination. Types of microorganisms in milk.

B. Methods to detect microbial spoilage by SPC, Reductase test.

C. Biochemical changes of milk - Souring, Gassy fermentation, Proteolysis, Lipolysis, and Ropiness.

D. Fermented dairy products (a brief account of characteristic and therapeutic value). Acidophilus milk, Yoghurt, Butter milk, Srikhand. Types of cheese. Probiotics and their benefits.

A. Preservation of milk and milk products – Pasteurization and Sterilization. Microbiological standard for milk and milk products (in brief).

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF PHYSICS

Curriculum for I and II Semester BSc/BSc (Honours) Degree under NEP- from the Academic year 2021-22

PC, PM, PE, PCs

AND

Curriculum for Choice Based Credit System

PCM, PMCS, PME

2021-22

Course Content Semester – I

Mechanics and Properties of Matter

Course Title: Mechanics and Properties of Matter	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Programme Outcomes (POs)

PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO-4: Ethics: Apply the professional ethics and norms in respective discipline.

PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs) *(UGC guidelines)*	1	2	3	4	5	6
CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	x	x				x
CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures.	x	x				
CO-3: Will know how g can be determined experimentally and derive satisfaction.	x					
CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	x			x	x	x

CO-5: Will come to know how various elastic moduli can be determined.	**x**				x	**x**

CO-6: Will measure surface tension and viscosity and appreciate the methods adopted.	x	x				
CO-7: Will get hands on experience of different equipment.	x	x	x		x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Mechanics & Properties of Matter		Hrs
Credit : 4+2	**Unit – 1** **Theory : 4 hours /Week**	
Chapter No. 1	**Topics** to be covered/taught/learnt: **Units and measurements:** System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.	(13)
Chapter No. 2	**Momentum and Energy**: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets.	
Chapter No. 3	**Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	
Topics for self study(If any)	**Self Study** Chapter.4 Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass. Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 1	1. i). Students can measure diameters of small balls of different size and estimate their volumes. 2. ii). Students can measure lengths of nails of different size. iii). Students can measure volume of a liquid iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement. v). students can estimate standard deviations wherever possible.	
Activity No. 2	Students can try and understand conservation of energy in every day examples. For example: i) What happens in solar conservation panels ii) Pushing an object on the table it moves iii) Moving car hits a parked car causes parked car to move. In these cases, energy is conserved. How? Understand and verify if possible.	
Unit – 2		
Chapter No. 4.	**Laws of Motion:** Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.	(13)
Chapter No. 5.	**Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g.	
Chapter No. 6.	**Gravitation:** Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit.	

Topics for self study(If any)	**Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS). Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI α mr^2.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks in the class.	

Unit - 3		
Chapter No. 8	**Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method	(13)
	Suggested Activities	
Activity No. 5	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
Activity No.6	**Activity:** Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	

<table>
<tr><td colspan="2">Unit - 4</td><td></td></tr>
<tr><td>Chapter No. 9</td><td>Surface tension: Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact.</td><td rowspan="3">(13)</td></tr>
<tr><td>Chapter No. 11</td><td>Viscosity: Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems.</td></tr>
<tr><td>Topics for self study(If any)</td><td>Capillarity determination of surface tension by drop weight method.
Ref: 6,7,9,10</td></tr>
<tr><td></td><td>Suggested Activities</td><td></td></tr>
<tr><td>Activity No.7</td><td>1. Measure surface tension of water and other common liquids and compare and learn
i) Why water has high ST? think of reasons.
ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST.
iii) Plot ST versus T and learn how it behaves.

Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons.</td><td></td></tr>
<tr><td>Activity No. 8</td><td>Activity:
2. Collect a set of different liquids and measure their viscosity.
i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons.
ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non- sticky liquid concentration.
iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid.

List the applications where concept of Viscosity plays a dominant role</td><td></td></tr>
</table>

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, *et.al.*	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.		

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics. 9th Edn,	Resnick, Halliday & Walter,	Wiley	2010
2	Physics Vol-I	Halliday and Resnick,		

List of Experiments to be performed in the Laboratory:

1.	Determination of g using bar pendulum (L versus T and L versus LT^2 graphs).
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum.
4.	Modulus of rigidity of a rod – Static torsion method.
5.	Determination of elastic constants of a wire by Searle's method.
6.	Young's modulus by Koenig's method.
7.	Viscosity by Stoke's method.
8.	Verification of Hook's law.
9.	Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method.
10.	Study of motion of a spring and to calculate Spring constant, g and unknown mass.
11.	Determination of Young's modulus of a bar by the single cantilever method.
12.	Determination of Young's modulus of a bar by uniform bending method.
13.	Radius of capillary tube by mercury pellet method.
14	Verification of parallel and perpendicular axis theorems.

(Minimum EIGHT experiments have to be carried out)

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A lab manual of Physics for undergraduate classes, 1st Edition,		Vikas Publications.	
3	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	2002

SYLLABUS FOR OPEN ELECTIVE ENERGY SOURCES

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

		No. of lectures
Unit-I	**Non-Renewable energy sources**	
	Chapter-1: Introduction	
	Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources.	**04**
	Chapter-2: Conventional energy sources	
	Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology.	**09**
	Total	**13**
Unit-II	**Renewable energy sources**	
	Chapter-1: Introduction:	
	Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	**05**
	Chapter 2 : Solar energy:	
	Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**08**
	Total	**13**
Unit-III	**Chapter-3: Wind and Tidal Energy harvesting**:	
	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.	**08**
	Chapter-4 : Geothermal and hydro energy	
	Geothermal Resources, Geothermal Technologies.	**02**
	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**03**
	Carbon captured technologies, cell, batteries, power consumption	**01**
	Total	**13**

	Activity for tutorial classes 01 lectures/week 1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India 7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.	
	Reference Books: 1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy	

Climate Science

.

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Module 1:	**Atmosphere** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds.	(13 hours)
Module 2:	**Climate Science** Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more	(13 hours)
Module 3:	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering.	(13 hours)

	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200ºC. If you put your hands out of the window of the aircraft, you will not feel hot. (b) What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place.	

	4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).	
	References: 1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010. 2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.	

.

Astronomy

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Content		Hrs
Unit – 1 -History and Introduction		
Chapter 1	Ancient Astronomy Greek Observations, Sumerian Observations,Mayan Observations, Arabic Observations ,Chinese Observations	2
Chapter 2	Indian Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Astronomy in Indian Scriptures, Precession of the Equinox,Celebrations of Equinox	2
Chapter 3	Medieval & Modern Astronomy Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other,Modern Astronomy	2
Chapter 4	Optical tools for Astronomy Pin Hole, Binoculars, Telescopes & Imaging.	1
Chapter 5	Mathematical Methods of Observations Angular Measurement, Trigonometric functions, Stellar Parallax	1
Chapter 6	Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc.	2
Unit – 2: Unit 2: Observations of the Solar System		
Chapter 7.	The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots	1
Chapter 8	The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names	1
Chapter 9.	Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits.	2
Chapter 10	**Outer Planets** **Outer Planets: Mars, Jupiter & Saturn** Observational History.Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Moons Eclipses.Galilean Moons, Saturn's Rings	2

Unit III Major Astronomy Observations		
Chapter 11	March to June Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 12	June to September Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 13	September to December Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 14	December to March **Pr**ominent Stars and Constellations Visible during this period, Methods of Spotting.	2

Reference Books:

1. The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelrod

Text Books

1. P. N. SHANKAR A GUIDE TO THE NIGHT SKY
   https://www.arvindguptatoys.com/arvindgupta/nightskyshankar.pdf
2. BimanBasu , Joy of Star Watching , National Book Trust of India 2013

References Books

Christopher De Pree :The Complete Idiot's Guide to Astronomy, Penguin USA, 2008

Emily Winterburn ,The Stargazer's Guide: How to Read Our Night Sky, Constable and Robinson, 2008

Activities

Sl No	Experiment
1	Measuring Seasons using Sun's Position.
2	Measuring Distance using Parallax
3	Estimation of the Stellar Diameter using Pin Hole
4	Measuring Height of an Object Using Clinometer.
5	Star spotting using constellation maps
6	Constellation spotting using Skymaps
7	Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere.
8	Estimation of the Size of the Solar System in using Light Years.
9	Identification of Lunar Phases across a year.
10	Measuring Constellation of the Sun using Night Skymaps or Planispheres.

Medical Physics

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit I:	**Human Anatomy and Physiology** Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system	(13 hours)
Unit II:	**Physics of Medical Diagnostics** Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler.	(13 hours)
Unit III:	**Physics of Radiotherapy** Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques.	(13 hours)
	Class Room Activities Unit I: Students can demonstrate the shape, size, positions and functions of different organs in the body with the help of models. Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes. Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers. (ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines. **Other related activities/projects:** 1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines. 2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis. 3. Project on principle and use of X-ray films in imaging. 4. Visit to radiotherapy centers to study the modalities of radiotherapy.	

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.

2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.

3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.

4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.

5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.

6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.

2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.

3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.

4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.

5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.

6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.

7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.

8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.

9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.

10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.

11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.

12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.

13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.

14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.

15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.

16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.

	17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002. 18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005. 19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.	

.

Semester – II

Electricity & Magnetism

Course Title: Electricity and Magnetism	Course Credits: 4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Model Syllabus Authors:	Physics Expert Committee

Programme Outcomes

1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
2. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
3. Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. Ethics: Apply the professional ethics and norms in respective discipline.
5. Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	x	x				
ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
iii. Apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
iv. Describe the magnetic field produced by magnetic dipoles and electric currents.	x					
v. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
vi. Describe how magnetism is produced and list examples where its effects are observed.	x				x	x
vii. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	x	x			x	x
viii. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	x	x			x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Electricity & Magnetism		Hrs
Unit – 1		
Chapter No. 1	**Topics to be covered/taught/learnt:** Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy)	3
Chapter No. 2	**Topics to be Covered** Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).	3
Chapter No. 3	**Topics to be Covered** Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.	7
Topics for self study(If any)	*Constant potential surfaces - for self learning* *Work out problems listed in the reference*	
	Suggested Activities	
Activity No. 1	1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	
Activity No. 2	1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. 2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit – 2		

Chapter No. 4.	**Topics to be covered** Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law.	6
Chapter No. 5.	**Topics to be covered** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge.	7
Topics for self study(If any)	*Currents and voltage in combination of R, L and C circuits*	
	Suggested Activities	
Activity No. 3	1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
Activity No. 4	1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	

Unit – 3		
Chapter No.6	**Topics to be covered** Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.	7
Chapter No. 7	**Topics to be covered** Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.	6
Topics for self study(If any)	Hall Effect	
	Suggested Activities	
Activity No. 5	**Activity:** 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
Activity No.6	**Activity:** Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit - 4		
Chapter No. 8	Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	8
Chapter No. 9	**Topics to be covered:** Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	5
Topics for self study(If any)	*B-H curves and its characteristics* *Ferrites*	

	Suggested Activities	
Activity No.7	**Activity:** 1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity No. 8	**Activity:** 1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	

References Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Determination of components of earth's magnetic field using a Ballistic galvanometer.
3.	Determination of capacitance of a condenser using B.G.
4.	Determination of high resistance by leakage using B.G.
5.	Determination of mutual inductance using BG.
6.	Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements.
7.	Series and parallel resonance circuits (LCR circuits).
8.	Impedance of series RC circuits- determination of frequency of AC.
9.	Study the characteristics of a series RC and RL Circuit.
10.	Determination of self-inductance of a coil.
11.	Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
12.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.

(Minimum EIGHT experiments have to be carried out)

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF PHYSICS

Curriculum for I and II Semester BSc/BSc (Honours) Degree under NEP- from the Academic year 2021-22

PC, PM, PE, PCs

AND

Curriculum for Choice Based Credit System

PCM, PMCS, PME

2021-22

Course Content Semester – I

Mechanics and Properties of Matter

Course Title: Mechanics and Properties of Matter	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Programme Outcomes (POs)

PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO-4: Ethics: Apply the professional ethics and norms in respective discipline.

PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs) *(UGC guidelines)*	1	2	3	4	5	6
CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	x	x				x
CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures.	x	x				
CO-3: Will know how g can be determined experimentally and derive satisfaction.	x					
CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	x			x	x	x

CO-5: Will come to know how various elastic moduli can be determined.	**x**				x	**x**

CO-6: Will measure surface tension and viscosity and appreciate the methods adopted.	x	x				
CO-7: Will get hands on experience of different equipment.	x	x	x		x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked 'X' in the intersection cell if a course outcome addresses a particular program outcome.

<table>
<tr><td colspan="2">Mechanics & Properties of Matter</td><td>Hrs</td></tr>
<tr><td colspan="3">Credit : 4+2   Unit – 1   Theory : 4 hours /Week</td></tr>
<tr><td>Chapter No. 1</td><td>Topics to be covered/taught/learnt:
Units and measurements: System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.</td><td rowspan="3">(13)</td></tr>
<tr><td>Chapter No. 2</td><td>Momentum and Energy: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets.</td></tr>
<tr><td>Chapter No. 3</td><td>Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.</td></tr>
<tr><td>Topics for self study(If any)</td><td>Self Study
Chapter.4 Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.   Ref: 1-4,9,10</td><td></td></tr>
<tr><td></td><td>Suggested Activities</td><td></td></tr>
<tr><td>Activity No. 1</td><td>1. i). Students can measure diameters of small balls of different size and estimate their volumes.
2. ii). Students can measure lengths of nails of different size.
iii). Students can measure volume of a liquid
iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement.
v). students can estimate standard deviations wherever possible.</td><td></td></tr>
<tr><td>Activity No. 2</td><td>Students can try and understand conservation of energy in every day examples. For example:
i) What happens in solar conservation panels
ii) Pushing an object on the table it moves
iii) Moving car hits a parked car causes parked car to move.
In these cases, energy is conserved. How? Understand and verify if possible.</td><td></td></tr>
<tr><td colspan="3">Unit – 2</td></tr>
<tr><td>Chapter No. 4.</td><td>Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.</td><td rowspan="3">(13)</td></tr>
<tr><td>Chapter No. 5.</td><td>Dynamics of Rigid bodies: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g.</td></tr>
<tr><td>Chapter No. 6.</td><td>Gravitation: Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit.</td></tr>
</table>

Topics for self study(If any)	**Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS). Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI α mr^2.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks in the class.	

Unit - 3		
Chapter No. 8	**Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method	(13)
	Suggested Activities	
Activity No. 5	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
Activity No.6	**Activity:** Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	

<table>
<tr><td colspan="2">Unit - 4</td><td></td></tr>
<tr><td>Chapter No. 9</td><td>Surface tension: Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact.</td><td rowspan="3">(13)</td></tr>
<tr><td>Chapter No. 11</td><td>Viscosity: Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle’s method, Stoke’s method. Problems.</td></tr>
<tr><td>Topics for self study(If any)</td><td>Capillarity determination of surface tension by drop weight method.
Ref: 6,7,9,10</td></tr>
<tr><td></td><td>Suggested Activities</td><td></td></tr>
<tr><td>Activity No.7</td><td>1. Measure surface tension of water and other common liquids and compare and learn
i) Why water has high ST? think of reasons.
ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST.
iii) Plot ST versus T and learn how it behaves.

Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons.</td><td></td></tr>
<tr><td>Activity No. 8</td><td>Activity:
2. Collect a set of different liquids and measure their viscosity.
i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons.
ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non- sticky liquid concentration.
iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid.

List the applications where concept of Viscosity plays a dominant role</td><td></td></tr>
</table>

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, *et.al.*	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.		

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics. 9th Edn,	Resnick, Halliday & Walter,	Wiley	2010
2	Physics Vol-I	Halliday and Resnick,		

List of Experiments to be performed in the Laboratory:

1.	Determination of g using bar pendulum (L versus T and L versus LT^2 graphs).
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum.
4.	Modulus of rigidity of a rod – Static torsion method.
5.	Determination of elastic constants of a wire by Searle's method.
6.	Young's modulus by Koenig's method.
7.	Viscosity by Stoke's method.
8.	Verification of Hook's law.
9.	Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method.
10.	Study of motion of a spring and to calculate Spring constant, g and unknown mass.
11.	Determination of Young's modulus of a bar by the single cantilever method.
12.	Determination of Young's modulus of a bar by uniform bending method.
13.	Radius of capillary tube by mercury pellet method.
14	Verification of parallel and perpendicular axis theorems.

(Minimum EIGHT experiments have to be carried out)

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A lab manual of Physics for undergraduate classes, 1st Edition,		Vikas Publications.	
3	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	2002

SYLLABUS FOR OPEN ELECTIVE ENERGY SOURCES

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

		No. of lectures
Unit-I	**Non-Renewable energy sources**	
	Chapter-1: Introduction	
	Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources.	**04**
	Chapter-2: Conventional energy sources	
	Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology.	**09**
	Total	**13**
Unit-II	**Renewable energy sources**	
	Chapter-1: Introduction:	
	Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	**05**
	Chapter 2 : Solar energy:	
	Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**08**
	Total	**13**
Unit-III	**Chapter-3: Wind and Tidal Energy harvesting**:	
	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.	**08**
	Chapter-4 : Geothermal and hydro energy	
	Geothermal Resources, Geothermal Technologies.	**02**
	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**03**
	Carbon captured technologies, cell, batteries, power consumption	**01**
	Total	**13**

	Activity for tutorial classes 01 lectures/week 1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India 7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.	
	Reference Books: 1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy	

Climate Science

.

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Module 1:	**Atmosphere** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds.	(13 hours)
Module 2:	**Climate Science** Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more	(13 hours)
Module 3:	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering.	(13 hours)

	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200ºC. If you put your hands out of the window of the aircraft, you will not feel hot. (b) What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place.	

	4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).	
	References: 1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010. 2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.	

.

Astronomy

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Content		Hrs
Unit – 1 -History and Introduction		
Chapter 1	Ancient Astronomy Greek Observations, Sumerian Observations,Mayan Observations, Arabic Observations ,Chinese Observations	2
Chapter 2	Indian Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Astronomy in Indian Scriptures, Precession of the Equinox,Celebrations of Equinox	2
Chapter 3	Medieval & Modern Astronomy Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other,Modern Astronomy	2
Chapter 4	Optical tools for Astronomy Pin Hole, Binoculars, Telescopes & Imaging.	1
Chapter 5	Mathematical Methods of Observations Angular Measurement, Trigonometric functions, Stellar Parallax	1
Chapter 6	Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc.	2
Unit – 2: Unit 2: Observations of the Solar System		
Chapter 7.	The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots	1
Chapter 8	The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names	1
Chapter 9.	Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits.	2
Chapter 10	**Outer Planets** **Outer Planets: Mars, Jupiter & Saturn** Observational History.Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Moons Eclipses.Galilean Moons, Saturn's Rings	2

Unit III Major Astronomy Observations		
Chapter 11	March to June Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 12	June to September Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 13	September to December Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 14	December to March **Pr**ominent Stars and Constellations Visible during this period, Methods of Spotting.	2

Reference Books:

1. The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelrod

Text Books

1. P. N. SHANKAR A GUIDE TO THE NIGHT SKY
   https://www.arvindguptatoys.com/arvindgupta/nightskyshankar.pdf
2. BimanBasu , Joy of Star Watching , National Book Trust of India 2013

References Books

Christopher De Pree :The Complete Idiot's Guide to Astronomy, Penguin USA, 2008

Emily Winterburn ,The Stargazer's Guide: How to Read Our Night Sky, Constable and Robinson, 2008

Activities

Sl No	**Experiment**
1	Measuring Seasons using Sun's Position.
2	Measuring Distance using Parallax
3	Estimation of the Stellar Diameter using Pin Hole
4	Measuring Height of an Object Using Clinometer.
5	Star spotting using constellation maps
6	Constellation spotting using Skymaps
7	Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere.
8	Estimation of the Size of the Solar System in using Light Years.
9	Identification of Lunar Phases across a year.
10	Measuring Constellation of the Sun using Night Skymaps or Planispheres.

Medical Physics

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit I:	**Human Anatomy and Physiology** Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system	(13 hours)
Unit II:	**Physics of Medical Diagnostics** Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler.	(13 hours)
Unit III:	**Physics of Radiotherapy** Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques.	(13 hours)
	Class Room Activities Unit I: Students can demonstrate the shape, size, positions and functions of different organs in the body with the help of models. Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes. Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers. (ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines. **Other related activities/projects:** 1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines. 2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis. 3. Project on principle and use of X-ray films in imaging. 4. Visit to radiotherapy centers to study the modalities of radiotherapy.	

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.
2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.
3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.
4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.
5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.
6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.
2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.
3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.
4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.
5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.
6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.
7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.
8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.
9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.
10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.
11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.
12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.
13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.
14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.
15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.
16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.

	17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002. 18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005. 19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.	

.

Semester – II

Electricity & Magnetism

Course Title: Electricity and Magnetism	Course Credits: 4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Model Syllabus Authors:	Physics Expert Committee

Programme Outcomes

1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
2. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
3. Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. Ethics: Apply the professional ethics and norms in respective discipline.
5. Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	x	x				
ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
iii. Apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
iv. Describe the magnetic field produced by magnetic dipoles and electric currents.	x					
v. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
vi. Describe how magnetism is produced and list examples where its effects are observed.	x				x	x
vii. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	x	x			x	x
viii. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	x	x			x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Electricity & Magnetism		**Hrs**
Unit – 1		
Chapter No. 1	**Topics to be covered/taught/learnt:** Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy)	3
Chapter No. 2	**Topics to be Covered** Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).	3
Chapter No. 3	**Topics to be Covered** Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.	7
Topics for self study(If any)	*Constant potential surfaces - for self learning* *Work out problems listed in the reference*	
	Suggested Activities	
Activity No. 1	1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	
Activity No. 2	1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. 2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit – 2		

Chapter No. 4.	**Topics to be covered** Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law.	6
Chapter No. 5.	**Topics to be covered** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge.	7
Topics for self study(If any)	*Currents and voltage in combination of R, L and C circuits*	
	Suggested Activities	
Activity No. 3	1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
Activity No. 4	1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	

Unit – 3		
Chapter No.6	**Topics to be covered** Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.	7
Chapter No. 7	**Topics to be covered** Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.	6
Topics for self study(If any)	Hall Effect	
	Suggested Activities	
Activity No. 5	**Activity:** 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
Activity No.6	**Activity:** Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit - 4		
Chapter No. 8	Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	8
Chapter No. 9	**Topics to be covered:** Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	5
Topics for self study(If any)	*B-H curves and its characteristics* *Ferrites*	

	Suggested Activities	
Activity No.7	**Activity:** 1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity No. 8	**Activity:** 1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	

References Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Determination of components of earth's magnetic field using a Ballistic galvanometer.
3.	Determination of capacitance of a condenser using B.G.
4.	Determination of high resistance by leakage using B.G.
5.	Determination of mutual inductance using BG.
6.	Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements.
7.	Series and parallel resonance circuits (LCR circuits).
8.	Impedance of series RC circuits- determination of frequency of AC.
9.	Study the characteristics of a series RC and RL Circuit.
10.	Determination of self-inductance of a coil.
11.	Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
12.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.

(Minimum EIGHT experiments have to be carried out)

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF PHYSICS

Curriculum for I and II Semester BSc/BSc (Honours) Degree under NEP- from the Academic year 2021-22

PC, PM, PE, PCs

AND

Curriculum for Choice Based Credit System

PCM, PMCS, PME

2021-22

Course Content Semester – I

Mechanics and Properties of Matter

Course Title: Mechanics and Properties of Matter	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Programme Outcomes (POs)

PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO-4: Ethics: Apply the professional ethics and norms in respective discipline.

PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs) *(UGC guidelines)*	1	2	3	4	5	6
CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	x	x				x
CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures.	x	x				
CO-3: Will know how g can be determined experimentally and derive satisfaction.	x					
CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	x			x	x	x

CO-5: Will come to know how various elastic moduli can be determined.	**x**				x	**x**

CO-6: Will measure surface tension and viscosity and appreciate the methods adopted.	x	x				
CO-7: Will get hands on experience of different equipment.	x	x	x		x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Mechanics & Properties of Matter

		Hrs
Credit : 4+2	**Unit – 1** **Theory : 4 hours /Week**	
Chapter No. 1	**Topics** to be covered/taught/learnt: **Units and measurements:** System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.	(13)
Chapter No. 2	**Momentum and Energy**: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets.	
Chapter No. 3	**Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	
Topics for self study(If any)	**Self Study** Chapter.4 Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass. Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 1	1. i). Students can measure diameters of small balls of different size and estimate their volumes. 2. ii). Students can measure lengths of nails of different size. iii). Students can measure volume of a liquid iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement. v). students can estimate standard deviations wherever possible.	
Activity No. 2	Students can try and understand conservation of energy in every day examples. For example: i) What happens in solar conservation panels ii) Pushing an object on the table it moves iii) Moving car hits a parked car causes parked car to move. In these cases, energy is conserved. How? Understand and verify if possible.	
	Unit – 2	
Chapter No. 4.	**Laws of Motion:** Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.	(13)
Chapter No. 5.	**Dynamics of Rigid bodies**: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g.	
Chapter No. 6.	**Gravitation:** Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit.	

Topics for self study(If any)	**Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS). Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI α mr^2.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks in the class.	

Unit - 3		
Chapter No. 8	**Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method	(13)
	Suggested Activities	
Activity No. 5	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
Activity No.6	**Activity:** Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	

Unit - 4		
Chapter No. 9	**Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact.	(13)
Chapter No. 11	**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems.	
Topics for self study(If any)	Capillarity determination of surface tension by drop weight method. Ref: 6,7,9,10	
	Suggested Activities	
Activity No.7	1. Measure surface tension of water and other common liquids and compare and learn i) Why water has high ST? think of reasons. ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST. iii) Plot ST versus T and learn how it behaves. Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons.	
Activity No. 8	Activity: 2. Collect a set of different liquids and measure their viscosity. i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons. ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non- sticky liquid concentration. iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid. List the applications where concept of Viscosity plays a dominant role	

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, *et.al.*	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.		

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics. 9th Edn,	Resnick, Halliday & Walter,	Wiley	2010
2	Physics Vol-I	Halliday and Resnick,		

List of Experiments to be performed in the Laboratory:

1.	Determination of g using bar pendulum (L versus T and L versus LT^2 graphs).
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum.
4.	Modulus of rigidity of a rod – Static torsion method.
5.	Determination of elastic constants of a wire by Searle's method.
6.	Young's modulus by Koenig's method.
7.	Viscosity by Stoke's method.
8.	Verification of Hook's law.
9.	Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method.
10.	Study of motion of a spring and to calculate Spring constant, g and unknown mass.
11.	Determination of Young's modulus of a bar by the single cantilever method.
12.	Determination of Young's modulus of a bar by uniform bending method.
13.	Radius of capillary tube by mercury pellet method.
14	Verification of parallel and perpendicular axis theorems.

(Minimum EIGHT experiments have to be carried out)

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A lab manual of Physics for undergraduate classes, 1st Edition,		Vikas Publications.	
3	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	2002

SYLLABUS FOR OPEN ELECTIVE ENERGY SOURCES

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

		No. of lectures
Unit-I	**Non-Renewable energy sources**	
	Chapter-1: Introduction	
	Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources.	**04**
	Chapter-2: Conventional energy sources	
	Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology.	**09**
	Total	**13**
Unit-II	**Renewable energy sources**	
	Chapter-1: Introduction:	
	Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	**05**
	Chapter 2 : Solar energy:	
	Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**08**
	Total	**13**
Unit-III	**Chapter-3: Wind and Tidal Energy harvesting**:	
	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.	**08**
	Chapter-4 : Geothermal and hydro energy	
	Geothermal Resources, Geothermal Technologies.	**02**
	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**03**
	Carbon captured technologies, cell, batteries, power consumption	**01**
	Total	**13**

	Activity for tutorial classes 01 lectures/week 1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India 7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.	
	Reference Books: 1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy	

Climate Science

.

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Module 1:	**Atmosphere** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds.	(13 hours)
Module 2:	**Climate Science** Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more	(13 hours)
Module 3:	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering.	(13 hours)

	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200ºC. If you put your hands out of the window of the aircraft, you will not feel hot. (b) What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place.	

	4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).	
	References: 1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010. 2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.	

.

Astronomy

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Content		Hrs
Unit – 1 -History and Introduction		
Chapter 1	Ancient Astronomy Greek Observations, Sumerian Observations,Mayan Observations, Arabic Observations ,Chinese Observations	2
Chapter 2	Indian Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Astronomy in Indian Scriptures, Precession of the Equinox,Celebrations of Equinox	2
Chapter 3	Medieval & Modern Astronomy Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other,Modern Astronomy	2
Chapter 4	Optical tools for Astronomy Pin Hole, Binoculars, Telescopes & Imaging.	1
Chapter 5	Mathematical Methods of Observations Angular Measurement, Trigonometric functions, Stellar Parallax	1
Chapter 6	Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc.	2
Unit – 2: Unit 2: Observations of the Solar System		
Chapter 7.	The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots	1
Chapter 8	The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names	1
Chapter 9.	Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits.	2
Chapter 10	**Outer Planets** **Outer Planets: Mars, Jupiter & Saturn** Observational History.Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Moons Eclipses.Galilean Moons, Saturn’s Rings	2

Unit III Major Astronomy Observations		
Chapter 11	March to June Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 12	June to September Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 13	September to December Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 14	December to March **Pr**ominent Stars and Constellations Visible during this period, Methods of Spotting.	2

Reference Books:

1. The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelrod

Text Books

1. P. N. SHANKAR A GUIDE TO THE NIGHT SKY https://www.arvindguptatoys.com/arvindgupta/nightskyshankar.pdf
2. BimanBasu , Joy of Star Watching , National Book Trust of India 2013

References Books

Christopher De Pree :The Complete Idiot's Guide to Astronomy, Penguin USA, 2008

Emily Winterburn ,The Stargazer's Guide: How to Read Our Night Sky, Constable and Robinson, 2008

Activities

Sl No	Experiment
1	Measuring Seasons using Sun's Position.
2	Measuring Distance using Parallax
3	Estimation of the Stellar Diameter using Pin Hole
4	Measuring Height of an Object Using Clinometer.
5	Star spotting using constellation maps
6	Constellation spotting using Skymaps
7	Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere.
8	Estimation of the Size of the Solar System in using Light Years.
9	Identification of Lunar Phases across a year.
10	Measuring Constellation of the Sun using Night Skymaps or Planispheres.

Medical Physics

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit I:	**Human Anatomy and Physiology** Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system	(13 hours)
Unit II:	**Physics of Medical Diagnostics** Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler.	(13 hours)
Unit III:	**Physics of Radiotherapy** Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques.	(13 hours)
	Class Room Activities Unit I: Students can demonstrate the shape, size, positions and functions of different organs in the body with the help of models. Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes. Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers. (ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines. **Other related activities/projects:** 1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines. 2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis. 3. Project on principle and use of X-ray films in imaging. 4. Visit to radiotherapy centers to study the modalities of radiotherapy.	

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.

2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.

3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.

4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.

5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.

6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.

2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.

3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.

4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.

5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.

6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.

7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.

8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.

9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.

10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.

11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.

12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.

13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.

14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.

15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.

16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.

	17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002. 18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005. 19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.	

.

Semester – II

Electricity & Magnetism

Course Title: Electricity and Magnetism	Course Credits: 4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Model Syllabus Authors:	Physics Expert Committee

Programme Outcomes

1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
2. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
3. Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. Ethics: Apply the professional ethics and norms in respective discipline.
5. Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	x	x				
ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
iii. Apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
iv. Describe the magnetic field produced by magnetic dipoles and electric currents.	x					
v. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
vi. Describe how magnetism is produced and list examples where its effects are observed.	x				x	x
vii. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	x	x			x	x
viii. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	x	x			x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark ‘X’ in the intersection cell if a course outcome addresses a particular program outcome.

Electricity & Magnetism		Hrs
Unit – 1		
Chapter No. 1	**Topics to be covered/taught/learnt:** Electric charge and field Coulomb’s law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy)	3
Chapter No. 2	**Topics to be Covered** Gauss’s law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).	3
Chapter No. 3	**Topics to be Covered** Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.	7
Topics for self study(If any)	*Constant potential surfaces - for self learning* *Work out problems listed in the reference*	
	Suggested Activities	
Activity No. 1	1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	
Activity No. 2	1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. 2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit – 2		

Chapter No. 4.	**Topics to be covered** Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law.	6
Chapter No. 5.	**Topics to be covered** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge.	7
Topics for self study(If any)	*Currents and voltage in combination of R, L and C circuits*	
	Suggested Activities	
Activity No. 3	1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
Activity No. 4	1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	

Unit – 3		
Chapter No.6	**Topics to be covered** Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.	7
Chapter No. 7	**Topics to be covered** Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.	6
Topics for self study(If any)	Hall Effect	
	Suggested Activities	
Activity No. 5	**Activity:** 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
Activity No.6	**Activity:** Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit - 4		
Chapter No. 8	Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	8
Chapter No. 9	**Topics to be covered:** Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	5
Topics for self study(If any)	*B-H curves and its characteristics* *Ferrites*	

	Suggested Activities	
Activity No.7	**Activity:** 1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity No. 8	**Activity:** 1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	

References Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Determination of components of earth's magnetic field using a Ballistic galvanometer.
3.	Determination of capacitance of a condenser using B.G.
4.	Determination of high resistance by leakage using B.G.
5.	Determination of mutual inductance using BG.
6.	Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements.
7.	Series and parallel resonance circuits (LCR circuits).
8.	Impedance of series RC circuits- determination of frequency of AC.
9.	Study the characteristics of a series RC and RL Circuit.
10.	Determination of self-inductance of a coil.
11.	Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
12.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.

(Minimum EIGHT experiments have to be carried out)

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF PHYSICS

Curriculum for I and II Semester BSc/BSc (Honours) Degree under NEP- from the Academic year 2021-22

PC, PM, PE, PCs

AND

Curriculum for Choice Based Credit System

PCM, PMCS, PME

2021-22

Course Content Semester – I

Mechanics and Properties of Matter

Course Title: Mechanics and Properties of Matter	Course Credits:4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Model Syllabus Authors: Physics Expert Committee	

Programme Outcomes (POs)

PO-1: Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.

PO-2: Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-3: Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.

PO-4: Ethics: Apply the professional ethics and norms in respective discipline.

PO-5: Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.

PO-6: Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs) *(UGC guidelines)*	1	2	3	4	5	6
CO-1: Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)	x	x				x
CO-2: Will learn about accuracy of measurement and sources of errors, importance of significant figures.	x	x				
CO-3: Will know how g can be determined experimentally and derive satisfaction.	x					
CO-4: Will see the difference between simple and torsional pendulum and their use in the determination of various physical parameters.	x			x	x	x

CO-5: Will come to know how various elastic moduli can be determined.	**x**				x	**x**

CO-6: Will measure surface tension and viscosity and appreciate the methods adopted.	x	x				
CO-7: Will get hands on experience of different equipment.	x	x	x		x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course are Marked 'X' in the intersection cell if a course outcome addresses a particular program outcome.

<table>
<tr><td colspan="2">Mechanics & Properties of Matter</td><td>Hrs</td></tr>
<tr><td colspan="3">Credit : 4+2   Unit – 1   Theory : 4 hours /Week</td></tr>
<tr><td>Chapter No. 1</td><td>Topics to be covered/taught/learnt:
Units and measurements: System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae. Minimum deviation, errors.</td><td rowspan="3">(13)</td></tr>
<tr><td>Chapter No. 2</td><td>Momentum and Energy: Work and energy, Conservation of momentum (linear). Conservation of energy with examples. Motion of rockets.</td></tr>
<tr><td>Chapter No. 3</td><td>Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.</td></tr>
<tr><td>Topics for self study(If any)</td><td>Self Study
Chapter.4 Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass. Ref: 1-4,9,10</td><td></td></tr>
<tr><td></td><td>Suggested Activities</td><td></td></tr>
<tr><td>Activity No. 1</td><td>1. i). Students can measure diameters of small balls of different size and estimate their volumes.
2. ii). Students can measure lengths of nails of different size.
iii). Students can measure volume of a liquid
iv). Students can measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Ask them to mention the precession of the measurement.
v). students can estimate standard deviations wherever possible.</td><td></td></tr>
<tr><td>Activity No. 2</td><td>Students can try and understand conservation of energy in every day examples. For example:
i) What happens in solar conservation panels
ii) Pushing an object on the table it moves
iii) Moving car hits a parked car causes parked car to move.
In these cases, energy is conserved. How? Understand and verify if possible.</td><td></td></tr>
<tr><td colspan="3">Unit – 2</td></tr>
<tr><td>Chapter No. 4.</td><td>Laws of Motion: Newton's Laws of motion. Dynamics of single and a system of particles. Centre of mass.</td><td rowspan="3">(13)</td></tr>
<tr><td>Chapter No. 5.</td><td>Dynamics of Rigid bodies: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy. moment of inertia: M I of a rectangular Lamina and solid cylinders. Flywheel, Theory of compound pendulum and determination of g.</td></tr>
<tr><td>Chapter No. 6.</td><td>Gravitation: Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's laws (statements). Satellite in a circular orbit.</td></tr>
</table>

Topics for self study(If any)	**Chapter 7**: Geosynchronous orbits. Basic idea of global positioning system (GPS). Ref: 1-4,9,10	
	Suggested Activities	
Activity No. 3	Activity: Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m. Students by referring to websites, can construct and perform simple experiments to verify that MI α mr^2.	
	Reference : www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edn	
Activity No. 4	Activity: Prepare suitable charts and give seminar talks in the class.	

	Unit - 3	
Chapter No. 8	**Elasticity:** Hooke's law - Stress-strain diagram, elastic moduli-relation between elastic constants, Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Torsional pendulum-Determination of rigidity modulus and moment of inertia - q, η and σ by Searle's method	(13)
	Suggested Activities	
Activity No. 5	**Activity:** Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.	
Activity No.6	**Activity:** Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.	

Unit - 4		
Chapter No. 9	**Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact.	(13)
Chapter No. 11	**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poisulle's method, Stoke's method. Problems.	
Topics for self study(If any)	Capillarity determination of surface tension by drop weight method. Ref: 6,7,9,10	
	Suggested Activities	
Activity No.7	1. Measure surface tension of water and other common liquids and compare and learn i) Why water has high ST? think of reasons. ii) Check whether ST is a function of temperature? You can do it by heating the water to different temperatures and measure ST. iii) Plot ST versus T and learn how it behaves. Mix some quantity of kerosene or any oil to water and measure ST. Check whether ST for the mixture is more or less than pure water. List the reasons.	
Activity No. 8	Activity: 2. Collect a set of different liquids and measure their viscosity. i) Find out whether sticky or non-sticky liquids are most viscous. List the reasons. ii) Mix non sticky liquid to the sticky liquid in defined quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non- sticky liquid concentration. iii) Do the above experiment by mixing sticky liquid to the non sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid. List the applications where concept of Viscosity plays a dominant role	

Text Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Mechanics by, New Eition	D. S. Mathur	S.Chand & Co.	2000
2	Mechancis and Relativity by 3rd Edition,	Vidwan Singh Soni,	PHI Learning Pvt. Ltd.	
3	Mechanics Berkeley Physics Course, Vol.1:	Charles Kittel, *et.al.*	Tata McGraw-Hill	2007
4	Properties of Matter	Brijlal & Subramanyam.		

References Books

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics. 9th Edn,	Resnick, Halliday & Walter,	Wiley	2010
2	Physics Vol-I	Halliday and Resnick,		

List of Experiments to be performed in the Laboratory:

1.	Determination of g using bar pendulum (L versus T and L versus LT^2 graphs).
2.	Determination of moment of inertia of a Fly Wheel.
3.	Determination of rigidity modulus using torsional pendulum.
4.	Modulus of rigidity of a rod – Static torsion method.
5.	Determination of elastic constants of a wire by Searle's method.
6.	Young's modulus by Koenig's method.
7.	Viscosity by Stoke's method.
8.	Verification of Hook's law.
9.	Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method.
10.	Study of motion of a spring and to calculate Spring constant, g and unknown mass.
11.	Determination of Young's modulus of a bar by the single cantilever method.
12.	Determination of Young's modulus of a bar by uniform bending method.
13.	Radius of capillary tube by mercury pellet method.
14	Verification of parallel and perpendicular axis theorems.

(Minimum EIGHT experiments have to be carried out)

Reference Book for Laboratory Experiments

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics through experiments	B.Saraf	Vikas Publications	2013
2	A lab manual of Physics for undergraduate classes, 1st Edition,		Vikas Publications.	
3	BSc Practical Physics Revised Ed	CL Arora	S.Chand & Co.	2007
4	An advanced course in practical physics.	D. Chatopadhyay, PC Rakshit, B.Saha	New Central Book Agency Pvt Ltd.	2002

SYLLABUS FOR OPEN ELECTIVE ENERGY SOURCES

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

		No. of lectures
Unit-I	**Non-Renewable energy sources**	
	Chapter-1: Introduction	
	Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources.	**04**
	Chapter-2: Conventional energy sources	
	Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology.	**09**
	Total	**13**
Unit-II	**Renewable energy sources**	
	Chapter-1: Introduction:	
	Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	**05**
	Chapter 2 : Solar energy:	
	Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	**08**
	Total	**13**
Unit-III	**Chapter-3: Wind and Tidal Energy harvesting**:	
	Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.	**08**
	Chapter-4 : Geothermal and hydro energy	
	Geothermal Resources, Geothermal Technologies.	**02**
	Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**03**
	Carbon captured technologies, cell, batteries, power consumption	**01**
	Total	**13**

	Activity for tutorial classes 01 lectures/week 1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs. 2. Conversion of vibration to voltage using piezoelectric materials. 3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules. 4. Project report on Solar energy scenario in India 5. Project report on Hydro energy scenario in India 6. Project report on wind energy scenario in India 7. Field trip to nearby Hydroelectric stations. 8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc. 9. Field trip to solar energy parks like Yeramaras near Raichur. 10. Videos on solar energy, hydro energy and wind energy.	
	Reference Books: 1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University. 5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009 6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7. http://en.wikipedia.org/wiki/Renewable_energy	

Climate Science

.

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Module 1:	**Atmosphere** Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, Some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Green house gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds.	(13 hours)
Module 2:	**Climate Science** Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more	(13 hours)
Module 3:	**Global Climate Change** Green house effect and global warming, Enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, Conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering.	(13 hours)

	Activities to be carried out on Climate Science: 1. Try to find answer to the following questions: (a) Imagine you are going in a aircraft at an altitude greaten than 100 km. The air temperature at that altitude will be greater than 200ºC. If you put your hands out of the window of the aircraft, you will not feel hot. (b) What would have happened if ozone is not present in the stratosphere. 2. Visit a nearby weather Station and learn about their activities. 3. Design your own rain gauge for rainfall measurement at your place.	

	4. Learn to determine atmospheric humidity using wet bulb and dry bulb thermometers. 5. Visit the website of Indian Institute of Tropical Meteorology (IITM), and keep track of occurrence and land fall of cyclone prediction. 6. Learn about ozone layer and its depletion and ozone hole. 7. Keep track of melting of glaciers in the Arctic and Atlantic region through data base available over several decades. 8. Watch documentary films on global warming and related issues (produced by amateur film makers and promoted by British Council and BBC).	
	References: 1. Basics of Atmospheric Science – A Chndrashekar, PHI Learning Private Ltd. New Delhi, 2010. 2. Fundamentals of Atmospheric Modelling- Mark Z Jacbson, Cambridge University Press, 2000.	

.

Astronomy

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

	Content	**Hrs**
	Unit – 1 -History and Introduction	
Chapter 1	Ancient Astronomy Greek Observations, Sumerian Observations,Mayan Observations, Arabic Observations ,Chinese Observations	2
Chapter 2	Indian Astronomy Vedic Astronomy, Ancient Astronomy – Aryabhata, Varahamihira, Bhaskara Astronomy in Indian Scriptures, Precession of the Equinox,Celebrations of Equinox	2
Chapter 3	Medieval & Modern Astronomy Invention of Telescopes, Models of the Solar System & Universe, Observations by Tycho Brahe, Kepler, Galileo, Herschel and Other,Modern Astronomy	2
Chapter 4	Optical tools for Astronomy Pin Hole, Binoculars, Telescopes & Imaging.	1
Chapter 5	Mathematical Methods of Observations Angular Measurement, Trigonometric functions, Stellar Parallax	1
Chapter 6	Observational Terminologies Cardinal Directions, Azimuth, Altitude, Measurements using Compass and Hand. Equatorial Co-ordinates, Light years, Magnitude, Colors etc.	2
	Unit – 2: Unit 2: Observations of the Solar System	
Chapter 7.	The Sun Ecliptic and the Orientation of the Earth, Seasons - Solstices and Equinox, Observations of the Sun from Earth during seasons. Eclipses, Zero-shadow day, Sunspots	1
Chapter 8	The Moon Earth-Moon system – Phases, Lunar Eclipses, Ecliptic and Lunar Orbital Plane – Nodes, Lunar Month, Full Moon Names	1
Chapter 9.	Inner Planets: Mercury & Venus Observational History, Observational Windows, Appearance, Apparitions, Elongations, Superior Conjunctions, Inferior Conjunctions, Transits.	2
Chapter 10	**Outer Planets** **Outer Planets: Mars, Jupiter & Saturn** Observational History.Observational Windows, Appearance, Frequency of Oppositions Oppositions, Conjunctions, Moons Eclipses.Galilean Moons, Saturn's Rings	2

Unit III Major Astronomy Observations		
Chapter 11	March to June Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 12	June to September Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 13	September to December Prominent Stars and Constellations Visible during this period, Methods of Spotting.	2
Chapter 14	December to March **Pr**ominent Stars and Constellations Visible during this period, Methods of Spotting.	2

Reference Books:

1. The Stargazer's Guide - How to Read Our Night Sky by Emily Winterburn
2. A guide to the Night Sky – Beginner's handbook by P.N. Shankar
3. The Complete Idiot's guide to Astronomy by Christopher De Pree and Alan Axelrod

Text Books

1. P. N. SHANKAR A GUIDE TO THE NIGHT SKY
   https://www.arvindguptatoys.com/arvindgupta/nightskyshankar.pdf
2. BimanBasu , Joy of Star Watching , National Book Trust of India 2013

References Books

Christopher De Pree :The Complete Idiot's Guide to Astronomy, Penguin USA, 2008

Emily Winterburn ,The Stargazer's Guide: How to Read Our Night Sky, Constable and Robinson, 2008

Activities

Sl No	Experiment
1	Measuring Seasons using Sun's Position.
2	Measuring Distance using Parallax
3	Estimation of the Stellar Diameter using Pin Hole
4	Measuring Height of an Object Using Clinometer.
5	Star spotting using constellation maps
6	Constellation spotting using Skymaps
7	Estimation of 'Suitable Periods' to observe deep sky objects using Planisphere.
8	Estimation of the Size of the Solar System in using Light Years.
9	Identification of Lunar Phases across a year.
10	Measuring Constellation of the Sun using Night Skymaps or Planispheres.

Medical Physics

Time: 2 hrs./week + 01 Hr tutorial **Max Marks:**

Unit I:	**Human Anatomy and Physiology** Overview of human anatomy - cells, cell structure, type of cells and their functions, tissues, organs, and their functions. Different systems in the human body, their structure and function, physiological properties of the circulatory system, digestive system, respiratory system, reproductive system, excretory system, endocrine system and nervous system	(13 hours)
Unit II:	**Physics of Medical Diagnostics** Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: Interaction of sound waves with body tissues, production of ultrasound, transducers, acoustic coupling, image formation, modes of image display and color Doppler.	(13 hours)
Unit III:	**Physics of Radiotherapy** Clinical aspects of radiation therapy: Biological basis of radiotherapy, radiation sources, radiation dose, time dose fractionation. External beam radiation therapy, radiation therapy modalities, production of radioisotopes, use of radioisotopes in therapy, particle and ion beam radiotherapy. Brachytherapy - principle of brachytherapy and classification of brachytherapy techniques.	(13 hours)
	Class Room Activities Unit I: Students can demonstrate the shape, size, positions and functions of different organs in the body with the help of models. Unit II: The use of X-rays in the diagnosis of the fractured bone can be demonstrated with the help of a gamma source and a gamma ray survey meter. As the density of materials between the source and the detector changes the reading on the meter (or intensity of the beefing sound) changes. Unit III: (i) Students can be asked to list out different type of cancers and possible causative factors. They can be asked to list out the healthy practices to reduce the risk of cancers. (ii) As there will be students from different disciplines in the OE course, group discussion can be arranged to discuss about their programme and outcome. This will be an opportunity for the students to know about other disciplines. **Other related activities/projects:** 1. Visit to nearby hospitals/diagnostic centers to study the working of X-ray machines. 2. Visit to ultrasound diagnostic centers to study the principle and use of ultrasound in diagnosis. 3. Project on principle and use of X-ray films in imaging. 4. Visit to radiotherapy centers to study the modalities of radiotherapy.	

Text Books

1. C. H. Best and N. B. Taylor. A Test in Applied Physiology. Williams and Wilkins Company, Baltimore, 1999.

2. C. K. Warrick. Anatomy and Physiology for Radiographers. Oxford University Press, 2001.

3. Jerrold T. Bushberg. The Essential Physics for Medical Imaging (2nd Edition). Lippincott Williams & Wilkins, 2002.

4. Jean A. Pope. Medical Physics: Imaging. Heinemann Publishers, 2012.

5. Faiz M. Khan and Roger A. Potish. Treatment Planning in Radiation Oncology. Williams and Wilkins, USA, 2003.

6. D. Baltas. The physics of modern brachytherapy for oncology. Taylor and Francis, 2007.

Reference Books

1. J. R. Brobek. Physiological Basis of Medical Practice. Williams and Wilkins, London, 1995.

2. Edward Alcamo, Barbara Krumhardt. Barron's Anatomy and Physiology the Easy Way. Barron's Educational Series, 2004.

3. Lippincott, Anatomy and Physiology. Lippincott Williams & Wilkins, 2002.

4. W. E. Arnould Taylor. A textbook of anatomy and physiology, Nelson Thornes, 1998.

5. G. S. Pant. Advances in Diagnositc Medical Physics. Himalaya Publishing House, 2006.

6. Sabbahaga, Diagnositc Ultrasound applied to OBG. Maryland, 1980.

7. Faiz M Khan. The Physics of Radiation Therapy (3rd edition). Lippincott Williams & Wilkins, USA, 2003.

8. Jatinder R. Palta and T. Rockwell Mackie. Intensity Modulation Radiation Therapy. Medical Physics publishing, Madison, Wisconsin, 2003.

9. AAPM Report No. 72. Basic Applications of Multileaf collimators, AAPM, USA, 2001.

10. AAPM Report No. 91. Management of Respiratory motion in radiation oncology, 2006.

11. CA Joslin, A. Flynn, E. J. hall. Principles and Practice of Brachytherapy. Arnold publications, 2001.

12. Peter Hoskin, Catherine Coyle. Radiotherapy in Practice. Oxford University Press, 2011.

13. W. R. Handee. Medical Radiation Physics. Year Book Medical Publishers Inc., London, 2003.

14. Donald T. Graham, Paul J. Cloke. Principles of Radiological Physics. Churchill Livingstone, 2003.

15. Thomas S. Curry. Christensen',s Physics of Diagnostic Radiology (4th Edition). Lippincott Williams & Wilkins, 1990.

16. Madison. MRI – Perry Sprawls – Medical Physics Publishing. Wisconsin, 2000.

	17. Steve Webb. The Physics of Three–Dimensional Radiotherapy. Institute of Physics Publishing, Bristol and Philadelphia, 2002. 18. Radiation oncology physics: A Handbook for teachers and students. IAEA publications, 2005. 19. F. M. Khan. The Physics of Radiation Therapy (3rd Edition), Lippincott Williams and Wilkins, U.S.A., 2003.	

.

Semester – II

Electricity & Magnetism

Course Title: Electricity and Magnetism	Course Credits: 4
Total Contact Hours: 52	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Model Syllabus Authors:	Physics Expert Committee

Programme Outcomes

1. Discipline Knowledge: Knowledge of science and ability to apply to relevant areas.
2. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.
3. Modern tool usage: Use a modern scientific, engineering and IT tool or technique for solving problems in the areas of their discipline.
4. Ethics: Apply the professional ethics and norms in respective discipline.
5. Individual and teamwork: Work effectively as an individual as a team member in a multidisciplinary team.
6. Communication: Communicate effectively with the stake holders, and give and receive clear instructions.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Program Outcomes (POs)

Course Outcomes (COs)	1	2	3	4	5	6
i. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.	x	x				
ii. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.	x					
iii. Apply Gauss's law of electrostatics to solve a variety of problems.	x	x			x	
iv. Describe the magnetic field produced by magnetic dipoles and electric currents.	x					
v. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.	x					
vi. Describe how magnetism is produced and list examples where its effects are observed.	x				x	x
vii. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.	x	x			x	x
viii. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity,• Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.	x	x			x	x

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Electricity & Magnetism		**Hrs**
Unit – 1		
Chapter No. 1	**Topics to be covered/taught/learnt:** Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy)	3
Chapter No. 2	**Topics to be Covered** Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).	3
Chapter No. 3	**Topics to be Covered** Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.	7
Topics for self study(If any)	*Constant potential surfaces - for self learning* *Work out problems listed in the reference*	
	Suggested Activities	
Activity No. 1	1. Learn the difference between and DC and AC electricity and their characteristics. Voltage and line frequency standards in different countries. 2. A small project report on production of electricity as a source of energy: Different methods	
Activity No. 2	1. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. 2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures	
Unit – 2		

Chapter No. 4.	**Topics to be covered** Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Guass's law.	6
Chapter No. 5.	**Topics to be covered** Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. force on a moving charge.	7
Topics for self study(If any)	*Currents and voltage in combination of R, L and C circuits*	
	Suggested Activities	
Activity No. 3	1. Learn about electrical appliances which work with AC and DC electricity 2. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)	
Activity No. 4	1. Learn about power transmission: 3-phase electricity, voltage and phase 2. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? 3. Prepare a small project report on street lighting and types of electrical bulbs.	

Unit – 3		
Chapter No.6	**Topics to be covered** Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.	7
Chapter No. 7	**Topics to be covered** Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.	6
Topics for self study(If any)	Hall Effect	
	Suggested Activities	
Activity No. 5	**Activity:** 1. Prepare a small project report on street lighting and types of electrical bulbs. 2. Learn the measurement of electric current using tangent galvanometer.	
Activity No.6	**Activity:** Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet.	
Unit - 4		
Chapter No. 8	Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.	8
Chapter No. 9	**Topics to be covered:** Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. B-H hysteresis curves.	5
Topics for self study(If any)	*B-H curves and its characteristics* *Ferrites*	

	Suggested Activities	
Activity No.7	**Activity:** 1. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets. 2. Learn the principle of working of a Gauss meter to measure magnetic field	
Activity No. 8	**Activity:** 1. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.	

References Books:

Sl No	Title of the Book	Authors Name	Publisher	Year of Publication
1	Physics-Part-II,	David Halliday and Robert Resnick	Wiley Eastern Limited	2001
2	Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition	Edward M Purcell	Tata Mc Graw-Hill Publishing Company Ltd, New Delhi	2008

List of Experiments to be performed in the Laboratory

1.	Experiments on tracing of electric and magnetic flux lines for standard configuration.
2.	Determination of components of earth's magnetic field using a Ballistic galvanometer.
3.	Determination of capacitance of a condenser using B.G.
4.	Determination of high resistance by leakage using B.G.
5.	Determination of mutual inductance using BG.
6.	Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements.
7.	Series and parallel resonance circuits (LCR circuits).
8.	Impedance of series RC circuits- determination of frequency of AC.
9.	Study the characteristics of a series RC and RL Circuit.
10.	Determination of self-inductance of a coil.
11.	Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
12.	Determination of B_H using Helmholtz double coil galvanometer and potentiometer.

(Minimum EIGHT experiments have to be carried out)

UG_BBA_FINANCIAL MANAGEMENT 2021-2022

Unit 1: Working Capital Management

Meaning, Features, types of working capital, factors influencing working capital, level of current assets, operating cycle and cash cycle, current assets financing policy

Unit 2: Cash Management

Cash budget cash collection and disbursement, options for investment of surplus funds, credit management- credit policy variables-credit evaluation. Inventory management- need for inventories; order quantity-EOQ model- monitoring and control of inventories-ABC- JIT techniques.

Unit 3: Working Capital Financing

Leasing-types of leases, Rationale for leasing, operating leases, leasing as a financing decision; hire purchase financing- Hire purchase financing v/s lease financing, instalment sale, evaluation of Hire purchase financing

Unit 4: Venture Capital Financing

Meaning, features, development of venture capital in India, stages in venture financing- the business plan- essentials of a business plan, the process of venture capital financing- Methods of venture financing; Disinvestment mechanisms

Unit 5: Share Holder Value Creation

Financial goals and strategy, shareholder value creation- market value added, Market to book value, Economic value added(EVA)- Balanced scorecard- the learning and growth perspective, significance of balanced score card , implementation of score card.

Unit 6: International Financial Management

Foreign exchange market, foreign exchange rates- spot exchange rates, bid-ask rate, forward exchange rates- foreign exchange risk- transaction exposure, economic exposure, translation exposure, hedging of foreign exchange risk- foreign currency option, money market operations- financing international operations.

UG_BBA_INVESTMENT ANALYSIS & PORTFOLIO MANAGEMENT 2021-2022

Unit 1: **Basics of risk and return**:
Concept of returns, application of standard deviation, coefficient of variation, beta, alpha. Bonds : present value of a bond, yield to maturity, yield to call, yield to put, systematic risk, price risk, interest rate risk, default risk. Yield curve and theories regarding shape of yield curve. Unsystematic risk and non-risk factors that influence yields. Duration and modified duration, immunization of a bond portfolio. Fundamental analysis: EIC framework; Economic analysis: Leading lagging & coincident macro-economic indicators, Expected direction of movement of stock prices with macroeconomic variables in the Indian context; Industry analysis: stages of life cycle, Porter's five forces model, SWOT analysis, financial analysis of an industry; Company analysis.

Unit 2: **Share valuation**:
Dividend discount models - no growth, constant growth, two stage growth model, multiple stages; Relative valuation models using P/E ratio, book value to market value. Technical analysis: meaning, assumptions, difference between technical and fundamental analysis; Price indicators- Dow theory, advances and declines, new highs and lows - circuit filters. Volume indicators- Dow Theory, small investor volumes. Other indicators- futures, institutional activity, Trends: resistance, support, consolidation, momentum- Charts: line chart, bar chart, candle chart, point & figure chart. Patterns: head & shoulders, triangle, rectangle, flag, cup & saucer, double topped, double bottomed, Indicators: moving averages. Efficient market hypothesis; Concept of efficiency: Random walk, Three forms of EMH and implications for investment decisions. (No numerical in EMH and technical analysis)

Unit 3: **Portfolio analysis**:
Portfolio risk and return, Markowitz portfolio model: risk and return for 2 and 3 asset portfolios, concept of efficient frontier & optimum portfolio. Market Model: concept of beta systematic and unsystematic risk. Investor risk and return preferences: Indifference curves and the efficient frontier, and anticipated inflation. Asset allocation: Asset allocation pyramid, investor life cycle approach, Portfolio management services: Passive – Index funds, systematic investment plans. Active – market timing, style investing.

Unit 4: **Capital Asset Pricing Model (CAPM):**
Efficient frontier with a combination of risky and risk free assets. Assumptions of single period classical CAPM model. Characteristic line, Capital Market Line, Security market Line. Expected return, required return, overvalued and undervalued assets. Mutual Funds : Introduction, calculation of Net Asset Value (NAV) of a Fund, classification of mutual fund schemes by structure and objective, advantages and disadvantages of investing through mutual funds. Performance Evaluation using Sharpe's Treynor's and Jensen's measures and Fama's Decomposition.

DME21006/ DME21007 SEMESTER V

DSE -1: NUTRITIONAL BIOCHEMISTRY

(Credits: Theory – 04, Practical – 01) **Theory: 60 Hrs**

Course Outcome:

After completion of the course the student is able to;

CO1: Understand the characteristics of energy metabolism
CO2: Specify the characteristics of dietary carbohydrates
CO3: Identify in detail with examples dietary lipid & health
CO4: Understand the characteristics of minerals

Unit : 1	**INTRODUCTION TO NUTRITION & ENERGY METABOLISM** Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups (Adult man, women and children).	**09 Hrs**
Unit: 2	**DIETARY CARBOHYDRATES & HEALTH**: Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, blood glucose level.	**07 Hrs**
Unit :3	**DIETARY LIPID & HEALTH:** Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids.	**08 Hrs**
Unit: 4	**DIETARY PROTEINS & HEALTH:** Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids. Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.	**08 Hrs**
Unit :5	**FAT & WATER SOLUBLE VITAMINS:** Vitamin A, C, E, K and D Dietary sources, RDA, Absorption, Distribution, Metabolism and excretion (ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation.	**10 Hrs**

Role of Vitamin E as an antioxidant. Role of Vitamin D and its effect on bone physiology.
Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

Unit: 6	**MINERALS:** Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Deficiency, Sources, RDA. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese - Absorption, Utilization, Transport, Excretion, Deficiency, Sources, RDA.	**09 Hrs**
Unit: 7	**ASSESSMENT OF NUTRITIONAL STATUS:** Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment.	**05 Hrs**
Unit: 8	**FOOD & DRUG INTERACTIONS & NUTRICEUTICALS:** Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions.	**04 Hrs**

DME21106/ DME21107 PRACTICALS

1. Bioassay for vitamin B12/B1.
2. Extraction of oil from oil seeds by soxlet.
3. Separation of sugars by circular paper chromatography
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Extraction of cafein from tea leaves
6. Vitamin A/E estimation in serum.
7. Determination of moisture content of food sample
8. Detection of adulterants in food.
9. Estimation of Calcium in ragi.
10. Estimation of Vitamin – C in lemon or gooseberries by DPPH method
11. Estimation of Lactose in milk by Benedict’s method
12. Estimation of iron in drumsticks
13. Determination of iodine value of an oil or fat
14. Determination of saponification value of an oil or fat

Note: Minimum of eight experiments to be done.

Reference:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

2. Nutrition for health, fitness and sport (2013) Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.

1. Krause's Food and Nutrition Care process (2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.

1. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.

2. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

DME21606/ DME21607

SEMESTER V

SEC-2: CLINICAL BIOCHEMISTRY

(Credits: Theory – 02) **Theory: 30 Hrs**

Course Outcome:

After completion of the course the student is able to;

CO1: Specify the characteristics of clinical laboratory
CO2: Identify in depth blood glucose
CO3: Deliberate the detail of lipid profile
CO4: Learn in detail with examples cardiovascular diseases

Unit : 1	**INTRODUCTION:** Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations. **Exercises** Collection of blood and storage. Separation and storage of serum.	**04 Hrs**
Unit :2	**EVALUATION OF BIOCHEMICAL CHANGES IN DISEASES:** Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.	**04 Hrs**
Unit: 3	**ASSESSMENT OF GLUCOSE METABOLISM IN BLOOD:** Clinical significance of variations in blood glucose. Diabetes mellitus. **Exercises** Estimation of blood glucose by glucose oxidase peroxidase method.	**04 Hrs**
Unit :4	**LIPID PROFILE:** Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein. **Exercises** Estimation of triglycerides.	**04 Hrs**
Unit :5	**LIVER FUNCTION TESTS** **Exercises** Estimation of bilirubin (direct and indirect).	**04 Hrs**
Unit: 6	**RENAL FUNCTION TESTS & URINE ANALYSIS:** Use of urine strip / dipstick method for urine analysis. **Exercises** Quantitative determination of serum creatinine and urea.	**06 Hrs**

Unit: 7	**TESTS FOR CARDIOVASCULAR DISEASES:** Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin. **Exercises** Estimation of creatine kinase MB.	**04 Hrs**

Reference:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol.I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN: 9780070076594 / ISBN: 9780070076631.

2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests VoI. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.

3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.

DME21406/ DME21407

SEMESTER V

SEC-1: TOOLS AND TECHNIQUES IN BIOCHEMISTRY

(Credits: Theory – 02) **Theory: 30 Hrs**

Course Outcome:

After completion of the course the student is able to;

CO1: Understand in depth chromatography
CO2: Learn in depth electrophoresis technique
CO3: Deliberate the characteristics of centrifugation
CO4: Understand in detail with examples spectrophotometry

Unit : 1	**BIOCHEMICAL REAGENTS & SOLUTIONS:** Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter. **Exercise** Preparation of a buffer of given pH and molarity.	**06 Hrs**
Unit : 2	Chromatography- Definition**,** types, Principles of Adsorption and Partition chromatography. Techniques of circular, 2D chromatography, Thin Layer Chromatography**-** and its advantages Column chromatography – Principle and applications of Gel Filtration chromatography, HPLC	**07 Hrs**
Unit : 3	Electrophoresis: Principle and applications of electrophoresis technique- PAGE, SDS - PAGE	**03 Hrs**
Unit : 4	Centrifugation: Principle of differential and density gradient centrifugation. Ultra centrifuge – construction and applications	**03 Hrs**
Unit: 5	**SPECTROPHOTOMETRIC TECHNIQUES:** Principle and instrumentation of UV-visible and fluorescence spectroscopy. **Exercises** Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule). Measurement of fluorescence spectrum. Determination of concentration of a protein solution by Lowry/BCA method.	**05 Hrs**
Unit :6	**Introduction and importance of virtual labs in biochemistry**	**06 Hrs**

Reference:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.

2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company, ISBN:0-7167-1315-2/ISBN:0-7167-1444-2.

3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

DME21006/ DME21007 SEMESTER V

DSE -1: NUTRITIONAL BIOCHEMISTRY

(Credits: Theory – 04, Practical – 01) Theory: 60 Hrs

Course Outcome:

After completion of the course the student is able to;

CO1: Understand the characteristics of energy metabolism
CO2: Specify the characteristics of dietary carbohydrates
CO3: Identify in detail with examples dietary lipid & health
CO4: Understand the characteristics of minerals

Unit : 1	**INTRODUCTION TO NUTRITION & ENERGY METABOLISM** Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. Measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups (Adult man, women and children).	**09 Hrs**
Unit: 2	**DIETARY CARBOHYDRATES & HEALTH**: Review functions of carbohydrates. Digestion, absorption, utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, blood glucose level.	**07 Hrs**
Unit :3	**DIETARY LIPID & HEALTH:** Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids.	**08 Hrs**
Unit: 4	**DIETARY PROTEINS & HEALTH:** Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids. Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.	**08 Hrs**
Unit :5	**FAT & WATER SOLUBLE VITAMINS:** Vitamin A, C, E, K and D Dietary sources, RDA, Absorption, Distribution, Metabolism and excretion (ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation.	**10 Hrs**

Role of Vitamin E as an antioxidant. Role of Vitamin D and its effect on bone physiology.
Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

Unit: 6	**MINERALS:** Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Deficiency, Sources, RDA. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese - Absorption, Utilization, Transport, Excretion, Deficiency, Sources, RDA.	**09 Hrs**
Unit: 7	**ASSESSMENT OF NUTRITIONAL STATUS:** Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment.	**05 Hrs**
Unit: 8	**FOOD & DRUG INTERACTIONS & NUTRICEUTICALS:** Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions.	**04 Hrs**

DME21106/ DME21107 PRACTICALS

1. Bioassay for vitamin B12/B1.
2. Extraction of oil from oil seeds by soxlet.
3. Separation of sugars by circular paper chromatography
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Extraction of cafein from tea leaves
6. Vitamin A/E estimation in serum.
7. Determination of moisture content of food sample
8. Detection of adulterants in food.
9. Estimation of Calcium in ragi.
10. Estimation of Vitamin – C in lemon or gooseberries by DPPH method
11. Estimation of Lactose in milk by Benedict’s method
12. Estimation of iron in drumsticks
13. Determination of iodine value of an oil or fat
14. Determination of saponification value of an oil or fat

Note: Minimum of eight experiments to be done.

Reference:

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

2. Nutrition for health, fitness and sport (2013) Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.

1. Krause's Food and Nutrition Care process (2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.

1. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.

2. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

DME21606/ DME21607

SEMESTER V

SEC-2: CLINICAL BIOCHEMISTRY

(Credits: Theory – 02) **Theory: 30 Hrs**

Course Outcome:
After completion of the course the student is able to;

CO1: Specify the characteristics of clinical laboratory
CO2: Identify in depth blood glucose
CO3: Deliberate the detail of lipid profile
CO4: Learn in detail with examples cardiovascular diseases

Unit : 1	**INTRODUCTION:** Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations. **Exercises** Collection of blood and storage. Separation and storage of serum.	**04 Hrs**
Unit :2	**EVALUATION OF BIOCHEMICAL CHANGES IN DISEASES:** Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.	**04 Hrs**
Unit: 3	**ASSESSMENT OF GLUCOSE METABOLISM IN BLOOD:** Clinical significance of variations in blood glucose. Diabetes mellitus. **Exercises** Estimation of blood glucose by glucose oxidase peroxidase method.	**04 Hrs**
Unit :4	**LIPID PROFILE:** Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein. **Exercises** Estimation of triglycerides.	**04 Hrs**
Unit :5	**LIVER FUNCTION TESTS** **Exercises** Estimation of bilirubin (direct and indirect).	**04 Hrs**
Unit: 6	**RENAL FUNCTION TESTS & URINE ANALYSIS:** Use of urine strip / dipstick method for urine analysis. **Exercises** Quantitative determination of serum creatinine and urea.	**06 Hrs**

Unit: 7 **TESTS FOR CARDIOVASCULAR DISEASES:** Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin. **04 Hrs**

Exercises

Estimation of creatine kinase MB.

Reference:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol.I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN: 9780070076594 / ISBN: 9780070076631.

2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests VoI. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.

3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.

DME21406/ DME21407

SEMESTER V

SEC-1: TOOLS AND TECHNIQUES IN BIOCHEMISTRY

(Credits: Theory – 02) **Theory: 30 Hrs**

Course Outcome:

After completion of the course the student is able to;

CO1: Understand in depth chromatography
CO2: Learn in depth electrophoresis technique
CO3: Deliberate the characteristics of centrifugation
CO4: Understand in detail with examples spectrophotometry

Unit : 1	**BIOCHEMICAL REAGENTS & SOLUTIONS:** Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter. **Exercise** Preparation of a buffer of given pH and molarity.	**06 Hrs**
Unit : 2	Chromatography- Definition**,** types, Principles of Adsorption and Partition chromatography. Techniques of circular, 2D chromatography, Thin Layer Chromatography**-** and its advantages Column chromatography – Principle and applications of Gel Filtration chromatography, HPLC	**07 Hrs**
Unit : 3	Electrophoresis: Principle and applications of electrophoresis technique- PAGE, SDS - PAGE	**03 Hrs**
Unit : 4	Centrifugation: Principle of differential and density gradient centrifugation. Ultra centrifuge – construction and applications	**03 Hrs**
Unit: 5	**SPECTROPHOTOMETRIC TECHNIQUES:** Principle and instrumentation of UV-visible and fluorescence spectroscopy. **Exercises** Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule). Measurement of fluorescence spectrum. Determination of concentration of a protein solution by Lowry/BCA method.	**05 Hrs**
Unit :6	**Introduction and importance of virtual labs in biochemistry**	**06 Hrs**

Reference:

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.

2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company, ISBN:0-7167-1315-2/ISBN:0-7167-1444-2.

3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(An autonomous College of University of Mysuru)
Re-accredited by NAAC with ‘A’ grade
Ooty road, Mysuru-570 025, Karnataka

DEPARTMENT OF BIOCHEMISTRY

SYLLABUS
FOR

I to VI Semester B. Sc.
Program in Biochemistry

Biotechnology &Biochemistry -BScBtBc40
Microbiology & Biochemistry -BScMbBc42

Under

NATIONAL EDUCATION
POLICY -2020(NEP-2020)

Reviewsed Syllabus 2021-2022 Onwards

Syllabus Theory and Practical

B.Sc. (Basic/Honors) Semester-I

Course code:DSC-1T: BC-101;
Course Title: Chemical Foundations of Biochemistry-1 (Theory)

Course title	**Chemical Foundation of Biochemistry-1**
Couse code	DSC-1T: BC-101
Course credits	04
Total contact hours	56
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course Outcome:
This will inculcate confidence and clarity of mind in students to understand the chemistry of Biomolecules, and Biological reactions.

Course Outcomes /Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude	x	x	x									
Critical thinking		x										
Subject clarity	x	x										x
Analytical Skill	x				x	x						

Content of Theory course- Chemical Foundation of Biochemistry-1 Total credits = 4	**56hr**
Unit 1: Scope of Biochemistry and Units of measurement	**14 hr**
Origin of life, types of organisms, prokaryotes, eukaryotes, unicellular, multicellular, compartmentation of functions in lower and higher organisms, and common physiological events of organisms, chemical composition of living organisms, subcellular organelles, SI units, mass, volume, temperature, amount, length and time. An overview on the metric system, atomic weight, molecular weight, equivalent weight, basicity of acids, acidity of bases, Avogadro`s number, molarity, normality, molality, Dalton concept, mole concept, concentration, mole to molar conversion, oxidation number and its significance, density and specific gravity, their significances.	
Unit 2 : Atomic structure and Chemical bonds	**14 hr**
Structure of an atom, electrons and Quantum numbers, orbitals, shapes of orbitals, s, p, d, and f subshells, K, L, M, N, O, P, and Q shells. Illustration of Pauli`s exclusion principle, Aufbau principle, and Hund`s rule, electron configuration, octet rule. Formation and properties of noncovalent and covalent bonds, hydrogen bonds, ionic bonds, van der Waals interactions, London forces, dipole-dipole interactions, electrostatic interactions, and hydrophobic interactions. Sigma, pi and co-ordinate bonds, back bonding.	

Corresponding energy associated, outline of theories of bonding.	
Unit 3: Buffers and Colligative properties	**14 hr**
Acids, bases, Arrhenius concept, proton transfer theory, Lewis concept, Lowry and Bronsted concepts. Buffers, composition, pH, pH scale, Henderson-Hasselbalch equation, titration curve of H_3PO_4, pK value, isoelectric pH, ionization of HCl, HNO3, H2SO4. Colligative properties and anomalous colligative properties of solutions, structure of water, phase diagram of pure water, ionic product of water, special properties of water, buffers in animal system. Solutions and types, ionizable solutes, non-ionizable solutes, vapor pressure and its application in distillation, Vant Hoff law, Roult`s law, boiling point, freezing point, de-icing, osmosis and osmotic pressure determination, reverse osmosis, surface tension.	
Unit 4: Electrochemistry and Redox reactions	**14 hr**
Scope of electrochemistry, electrochemical cells, Daniel cell, galvanic cell, electrode potential and its measurement, electrolysis, types of electrolytes, primary and secondary batteries, electrodes, half-cell reaction, standard electrodes. Laws of thermodynamics, entropy and enthalpy, their relation, Gibb`s energy, free energy change, Lewis concept, ions, redox reactions, redox potential, application of redox potential, energy linked to redox reactions, reduction of oxygen, oxidation and reduction of iron in hemoglobin, biological active forms of zinc, calcium, nickel, molybdenum, selenium, and cobalt, NAD+/NADH, NADP+/NADPH, FAD/FADH2, FMN/FMNH2. Molecularity and order of a reaction.	

References:

1. Advanced Inorganic Chemistry: A comprehensive Text,1999, Cotton A and Geoffrey
   Wilkinson, 6th edition, Wiley publication
2. Inorganic Chemistry, 2014, Miessler GL, Paul Fischer PJ, and Tarr DA, 5th edition,Pearson Publication
3. Inorganic Chemistry, 2004, Catherine E and Sharpe AG, ACS publication
4. Inorganic Chemistry, 2015, Overton, Rourke, Weller , Armstrong and Hagerman,Oxford Press
5. Physical Chemistry: A molecular approach ,2019, Donald A, McQuarrie and Simon JD,Viva Books Publication
6. Physical chemistry 2019, Atkins P, Paula JD, Keeler J , 11th edition , Oxford press

Pedagogy: MOOC/desk work/book chapter/problem solving /assignment

Formative Assessment	
Assessment occasion	Weightage in marks
Class test (Two class tests)/ Continuous evaluation	20
Seminar/ class work	10
Assignment/ open discussion/ quiz	10
Total	40

Course code: DSC-1P: BC-102;
Course Title: Volumetric Analysis – Practicals-1

Course title	Volumetric analysis – practicals-1
Couse code	DSC-1P: BC-102
Course credits	02
Total contact hours	56 (4 h/ week)
Duration of ESA (Hour)	3
Formative assessment marks	25
Summative assessment marks	25

Content of Practical course- Volumetric analysis- Practical-1	
Total Teaching Hours = 56; **Total Credits = 2**	**56 hr**
List of experiments to be conducted	
1. Concept of molarity, molality and normality. Calculation and preparation of molar solutions. (Problems to be given in exams). Calculation and preparation of normal solutions and percent solutions and dilute solutions. 2. Calibration of volumetric glassware's (Burette, pipette). 3. Preparation of standard Sodium carbonate solution, standardization of HCl (Methylorange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein). 4. Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H_2SO_4in the given solution (phenolphthalein). 5. Preparation of standard Oxalic acid. Standardization of $KMnO_4$ and estimation of H_2O_2 in the given solution. 6. Preparation of standard $K_2Cr_2O_7$. Standardization of $Na_2S_2O_3$ and estimation of $CuSO_4$ in the given solution. 7. Preparation of $ZnSO_4$. Standardization of EDTA and estimation of total hardness of water using Eriochrome-Black-T indicator. 8. Preparation of standard potassium bipthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein). 9. Estimation of sulphuric acid and oxalic acid in a mixture using standard NaOH solution and standard $KMnO_4$ solution. 10. Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration). 11. Preparation of standard oxalic acid solution. Standardization of NaOH solution and estimation of acidity in vinegar. 12. Preparation of standard potassium bi-phthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids 13. Preparation of standard Oxalic acid solution. Standardization of $KMnO_4$ solution and estimation of calcium in milk.	

References

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,

4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata McGraw Hill
7. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).
11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, SunithaDingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

Pedagogy: MOOC/desk work/book chapter/problem solving /assignment

Formative Assessment	
Assessment occasion	Weightage in marks
Class test (Two class tests)/ Continuous evaluation	20
Practical record and Viva voce	05
Total	25

Syllabus Theory and Practical

B.Sc. (Basic/Honors) Semester-II

Course code:DSC-2T: BC-201;
Course Title: Chemical Foundations of Biochemistry -2(theory)

Course title	**Chemical Foundations of Biochemistry -2**
Couse code	DSC-2T: BC-201
Course credits	04
Total contact hours	56
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course Outcome: These topics will enable students to understand the fundamentals of chemical processes in biological systems

Course Outcomes / Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude	x	x	x									
Critical thinking	x	x										
Subject clarity	x	x										x
Analytical Skill	x	x			x	x						

Content of Theory course- Chemical Foundations of Biochemistry-2 **Total credits = 4**	**56 hr**
Unit 1: Chemical Catalysis	**14 hr**
Definition, characteristics, types, intermolecular, multifunctional, theories of catalysis, properties, characteristics of enzyme catalysis, autocatalysis, industrial catalysis and their role in biological systems (brief). Colloids: true solutions, classification, peptisation, purification, ultrafiltration, Brownian movements, electric properties, coagulation, mutual, lyophilic sols, boiling, dialysis, electro and persistent dialysis, addition of electrolytes, colloids in daily life and applications. Emulsion, types, micelles with biomolecules and its biological applications.	
Unit 2: Nomenclature of Organic Compounds	**14 hr**
Classification, naming- IUPAC nomenclature, compounds containing one, two functional groups with chains, homologous series. Stereochemistry, geometrical and structural Isomerism, conformation and free rotation. Optical isomerism, symmetry of elements, plane polarized light and optical purity. Nomenclature of enantiomers, epimers, racemic mixture, resolution. Fischer and Newman projection formulae, molecule with one and two chiral and achiral centers. Priority rules; E and Z (CIP rules), R and S, D and L notations, absolute (r and s) and relative (d and l) configuration. Role of stereochemistry in biological systems.	

Unit 3: Organometallic Compounds	14 hr
Metal atom linked organic compounds. Preparation of Grignard reagents and structure, limitations, protonolysis and reactions. Organolithium compounds, preparation and reactions. Organozinc compounds. Organoboranes its mechanisms. Ferrocenes. Introduction to mineral and ores, classification, concentration, extraction, refining, uses of minerals and metals and its importance. Porphyrins and Metal ions: Role of metal ions in biological systems, Fe, Cu, Zn, structureand functions of porphyrins, metalloporphyrins and iron-sulphur clusters with suitableexamples and their role in biological systems.	
Unit 4: Inorganic Chemistry	**14 hr**
Nomenclature of inorganic molecules and coordination compounds, formula. IUPACnomenclature. Central metal ion, ligand, coordination number, sphere, complex ion, oxidation number of central atom, homoleptic and heteroleptic complexes. Isomerism in complexes, structural, ionisation, solvate, linkage and coordination, Stereoisomerism, geometrical, optical isomerism with simple inorganic complexes. Applications of qualitative, quantitative analysis, photographic, metallurgy, medicine, catalysis and biosystems. Heavy Metal Poisons: Introduction, poisons, lead, mercury, aluminium, arsenic, corrosives, cyanide, irritants, phosphorus, CO_2, SO_2, SO_3, NO_2, halides and acid fumes, poisoning, sources, signs and symptoms. Free radicals: introduction, definition, generation and scavenger systems. Redox reactions, types, stock notations, change in oxidation number and combination. Endergonic and exergonic reactions with examples. The Importance in biological systems.	

References

1. Physical Chemistry 2006, Peter Atkins. 8th edition, W.H. Freeman and Company
2. Inorganic Chemistry: Principles of structure and Reactivity, 2006, Huheey JE,Keiter EA, Keiter RL, Pearson Education India
3. Stereochemistry: Conformation and Mechanism, 2009, Kalsi PS, New AgeInternational Publications
4. Introduction to Stereochemistry 2012, Kurt Mislow, Dover Publications
5. A text book of Organic Chemistry 2016, Raj K Bansal, 6th edition, New AgeInternational Publications
6. Advanced Inorganic Chemistry 1999, Cotton et al , 6th edition, A Wiley - International
7. Principles of physical Chemistry by Puri, Sharma and Pathania.
8. Physical Chemistry by R. L. Madan, G. D. Tuli. S. Chand and Co.
9. A Text Book of Physical Chemistry by K.L.Kapoor. Vol.2.Mc. Millan Publisher, IndiaLtd.
10. Advanced Organic Chemistry by Bahl and Arun Bahl.

Pedagogy: MOOC/desk work/book chapter/problem solving /assignment

Formative Assessment	
Assessment occasion	Weightage in marks

Class test (Two class tests)/ Continuous evaluation	20

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS)
OOTY ROAD, MYSORE – 25.

CURRICULUM FOR

For B.Sc., (Basic/ Hons.) Degree

BIOTECHNOLOGY

(As per NEP-2020 Model Curriculum)

FSA460 P Course 1: Practical: DSC-1P, BTC 101, Cell Biology and Genetics

1) Study and maintenance of simple and compound microscope
2) Use of Micrometer and calibration, measurement of onion epidermal cells and yeast
3) Study of stages in mitosis from onion root tips
4) Study of stages in meiosis in grasshopper testes/onion or Rhoeo flower buds.
5) Mounting of polytene chromosomes
6) Buccal smear – Barrbodies
7) Karyotype analysis - Human and Onion
   Human – Normal and Abnormal – Down and Turner’s syndromes
8) Isolation and staining of Mitochondria
9) Isolation and staining of Chloroplast
10) RBC cell count by Haemocytometer
11) Simple genetic problems based on theory

Text Books / References

Reference:

1. Molecular Biology of Cell - Bruce Alberts et al, Garlandpublications.
2. Animal Cytology and Evolution- MJD, White Cambridge UniversityPublications
3. Molecular Cell Biology-Daniel, Scientific AmericanBooks
4. Cell Biology - Jack d Bruke, The William TwilkinsCompany
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBSPublications
7. Fundamentals of Cytology- L. W. Sharp, McGraw HillCompany
8. Cytology-Willson&Marrison, ReinformPublications
9. Molecular Biology- Christopher Smith, Faber & FaberPublications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, HimalayaPublications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett PublishersUSA
13. Human Genetics and Medicine lark Edward Arnold PLondon
14. Genetics – Monroe W Strickberger, Macmillain Publishers, NewYork
15. Genes V - Benjamin Lewin, Oxford UniversityPress.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd.,Delhi
17. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky,McGraw-Hill.
18. Genetics – Edgar Altenburg Oxford & IBH publications
19. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & SonPublications
20. Genetics- P.K.Gupta, Rastogi Publication, Meert,India

FSB460P Course 1: Practicals: DSC-2P, Microbiological Methods and Techniques

1. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and Biotechnologylaboratory.
2. Sterilization of medium using Autoclave and assessment forsterility
3. Sterilization of glassware using Hot Air Oven and assessment forsterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Preparation of culture media for bacteria, fungi and theircultivation.
6. Plating techniques: Spread plate, pour plate andstreakplate.
7. Isolation of bacteria and fungi from soil, water andair
8. Study of Rhizopus, Penicillium, Aspergillus using temporarymounts
9. Colony characteristics study of bacteria from air exposureplate
10. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining
Fungi – Lactophenol cotton bluestaining
11. Bacterial cell motility Water analysis - MPNtest
12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatinhydrolysis
13. - hanging drop technique

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE (AUTONOMOUS)
OOTY ROAD, MYSORE – 25.

CURRICULUM FOR

For B.Sc., (Basic/ Hons.) Degree

BIOTECHNOLOGY

(As per NEP-2020 Model Curriculum)

FSA460 P Course 1: Practical: DSC-1P, BTC 101, Cell Biology and Genetics

1) Study and maintenance of simple and compound microscope
2) Use of Micrometer and calibration, measurement of onion epidermal cells and yeast
3) Study of stages in mitosis from onion root tips
4) Study of stages in meiosis in grasshopper testes/onion or Rhoeo flower buds.
5) Mounting of polytene chromosomes
6) Buccal smear – Barrbodies
7) Karyotype analysis - Human and Onion
   Human – Normal and Abnormal – Down and Turner's syndromes
8) Isolation and staining of Mitochondria
9) Isolation and staining of Chloroplast
10) RBC cell count by Haemocytometer
11) Simple genetic problems based on theory

Text Books / References

Reference:

1. Molecular Biology of Cell - Bruce Alberts et al, Garlandpublications.
2. Animal Cytology and Evolution- MJD, White Cambridge UniversityPublications
3. Molecular Cell Biology-Daniel, Scientific AmericanBooks
4. Cell Biology - Jack d Bruke, The William TwilkinsCompany
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBSPublications
7. Fundamentals of Cytology- L. W. Sharp, McGraw HillCompany
8. Cytology-Willson&Marrison, ReinformPublications
9. Molecular Biology- Christopher Smith, Faber & FaberPublications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, HimalayaPublications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett PublishersUSA
13. Human Genetics and Medicine lark Edward Arnold PLondon
14. Genetics – Monroe W Strickberger, Macmillain Publishers, NewYork
15. Genes V - Benjamin Lewin, Oxford UniversityPress.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd.,Delhi
17. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky,McGraw-Hill.
18. Genetics – Edgar Altenburg Oxford & IBH publications
19. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & SonPublications
20. Genetics- P.K.Gupta, Rastogi Publication, Meert,India

FSB460P Course 1: Practicals: DSC-2P, Microbiological Methods and Techniques

1. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and Biotechnologylaboratory.
2. Sterilization of medium using Autoclave and assessment forsterility
3. Sterilization of glassware using Hot Air Oven and assessment forsterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Preparation of culture media for bacteria, fungi and theircultivation.
6. Plating techniques: Spread plate, pour plate andstreakplate.
7. Isolation of bacteria and fungi from soil, water andair
8. Study of Rhizopus, Penicillium, Aspergillus using temporarymounts
9. Colony characteristics study of bacteria from air exposureplate
10. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining Fungi – Lactophenol cotton bluestaining
11. Bacterial cell motility Water analysis - MPNtest
12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatinhydrolysis
13. - hanging drop technique

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS)
OOTY ROAD, MYSORE – 25.

CURRICULUM FOR

For B.Sc., (Basic/ Hons.) Degree

BIOTECHNOLOGY

(As per NEP-2020 Model Curriculum)

FSA460 P Course 1: Practical: DSC-1P, BTC 101, Cell Biology and Genetics

1) Study and maintenance of simple and compound microscope
2) Use of Micrometer and calibration, measurement of onion epidermal cells and yeast
3) Study of stages in mitosis from onion root tips
4) Study of stages in meiosis in grasshopper testes/onion or Rhoeo flower buds.
5) Mounting of polytene chromosomes
6) Buccal smear – Barrbodies
7) Karyotype analysis - Human and Onion
   Human – Normal and Abnormal – Down and Turner's syndromes
8) Isolation and staining of Mitochondria
9) Isolation and staining of Chloroplast
10) RBC cell count by Haemocytometer
11) Simple genetic problems based on theory

Text Books / References

Reference:

1. Molecular Biology of Cell - Bruce Alberts et al, Garlandpublications.
2. Animal Cytology and Evolution- MJD, White Cambridge UniversityPublications
3. Molecular Cell Biology-Daniel, Scientific AmericanBooks
4. Cell Biology - Jack d Bruke, The William TwilkinsCompany
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBSPublications
7. Fundamentals of Cytology- L. W. Sharp, McGraw HillCompany
8. Cytology-Willson&Marrison, ReinformPublications
9. Molecular Biology- Christopher Smith, Faber & FaberPublications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, HimalayaPublications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett PublishersUSA
13. Human Genetics and Medicine lark Edward Arnold PLondon
14. Genetics – Monroe W Strickberger, Macmillain Publishers, NewYork
15. Genes V - Benjamin Lewin, Oxford UniversityPress.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd.,Delhi
17. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky,McGraw-Hill.
18. Genetics – Edgar Altenburg Oxford & IBH publications
19. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & SonPublications
20. Genetics- P.K.Gupta, Rastogi Publication, Meert,India

FSB460P Course 1: Practicals: DSC-2P, Microbiological Methods and Techniques

1. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and Biotechnologylaboratory.
2. Sterilization of medium using Autoclave and assessment forsterility
3. Sterilization of glassware using Hot Air Oven and assessment forsterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Preparation of culture media for bacteria, fungi and theircultivation.
6. Plating techniques: Spread plate, pour plate andstreakplate.
7. Isolation of bacteria and fungi from soil, water andair
8. Study of Rhizopus, Penicillium, Aspergillus using temporarymounts
9. Colony characteristics study of bacteria from air exposureplate
10. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining Fungi – Lactophenol cotton bluestaining
11. Bacterial cell motility Water analysis - MPNtest
12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatinhydrolysis
13. - hanging drop technique

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS)
OOTY ROAD, MYSORE – 25.

CURRICULUM FOR

For B.Sc., (Basic/ Hons.) Degree

BIOTECHNOLOGY

(As per NEP-2020 Model Curriculum)

FSA460 P Course 1: Practical: DSC-1P, BTC 101, Cell Biology and Genetics

1) Study and maintenance of simple and compound microscope
2) Use of Micrometer and calibration, measurement of onion epidermal cells and yeast
3) Study of stages in mitosis from onion root tips
4) Study of stages in meiosis in grasshopper testes/onion or Rhoeo flower buds.
5) Mounting of polytene chromosomes
6) Buccal smear – Barrbodies
7) Karyotype analysis - Human and Onion
   Human – Normal and Abnormal – Down and Turner's syndromes
8) Isolation and staining of Mitochondria
9) Isolation and staining of Chloroplast
10) RBC cell count by Haemocytometer
11) Simple genetic problems based on theory

Text Books / References

Reference:

1. Molecular Biology of Cell - Bruce Alberts et al, Garlandpublications.
2. Animal Cytology and Evolution- MJD, White Cambridge UniversityPublications
3. Molecular Cell Biology-Daniel, Scientific AmericanBooks
4. Cell Biology - Jack d Bruke, The William TwilkinsCompany
5. Principles of Gene Manipulations- Old & Primrose, Black Well Scientific Publications
6. Cell Biology-Ambrose &Dorothy M Easty, ELBSPublications
7. Fundamentals of Cytology- L. W. Sharp, McGraw HillCompany
8. Cytology-Willson&Marrison, ReinformPublications
9. Molecular Biology- Christopher Smith, Faber & FaberPublications
10. Cell Biology & Molecular Biology – EDP De Robertis& EMF Robertis, Saunder College.
11. Cell Biology- C.B Powar, HimalayaPublications
12. Basic Genetics- Daniel L. Hartl, Jones &Barlett PublishersUSA
13. Human Genetics and Medicine lark Edward Arnold PLondon
14. Genetics – Monroe W Strickberger, Macmillain Publishers, NewYork
15. Genes V - Benjamin Lewin, Oxford UniversityPress.
16. Genes I - Benjamin Lewin, Wiley Eastern Ltd.,Delhi
17. Principles of Genetics- Sinnott, L.C. Dunn, Dobzhansky,McGraw-Hill.
18. Genetics – Edgar Altenburg Oxford & IBH publications
19. Principles of Genetics – E.J. Gardener, M.J. Simmons and D.P. Snustad, John Wiley & SonPublications
20. Genetics- P.K.Gupta, Rastogi Publication, Meert,India

FSB460P Course 1: Practicals: DSC-2P, Microbiological Methods and Techniques

1. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology and Biotechnologylaboratory.
2. Sterilization of medium using Autoclave and assessment forsterility
3. Sterilization of glassware using Hot Air Oven and assessment forsterility
4. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
5. Preparation of culture media for bacteria, fungi and theircultivation.
6. Plating techniques: Spread plate, pour plate andstreakplate.
7. Isolation of bacteria and fungi from soil, water andair
8. Study of Rhizopus, Penicillium, Aspergillus using temporarymounts
9. Colony characteristics study of bacteria from air exposureplate
10. Staining techniques: Bacteria– Gram, Negative, Capsule, Endospore staining
Fungi – Lactophenol cotton bluestaining
11. Bacterial cell motility Water analysis - MPNtest
12. Biochemical Tests – IMViC, Starch hydrolysis, Catalase test, Gelatinhydrolysis
13. - hanging drop technique

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(AUTONOMOUS)

Ooty road, Mysuru - 570025.

DEPARTMENT OF BOTANY

Schematic Syllabus under Choice Based Credit System (CBCS) & Continuous Assessment Grading Pattern (CAGP) as per UGC template

w.e.f.

2019-2020

TABLE OF CONTENTS

DEPARTMENT OF BOTANY
PROFORMA OF INSTRUCTIONS AND EXAMINATION FOR B.Sc. PROGRAMME IN BOTANY (CBCS)
DURATION OF THE COURSE: 3YEARS (6SEMESTER)
PROGRAMME: BSc BBM/CBZ, PROGRAMME CODE: BSc07/08 (2019-20)

Year	Sem	Core course	Title of the paper	Course Code	Lecture + Practical's hours per week	No. of credits	Total credits	Total hours		Maximum Marks in exam/Assessment				
						L T P		Th	Pr		IA(Theory) C-1	C-2	Total	
I B.Sc	I	DSC-I :Theory	Biodiversity of Microbes and Archegoniate	DMA23007/08	04	4: 0 : 0	06	60	60	70	15	15	100	3h
		DSC-I: Pract.	Biodiversity of Microbes and Archegoniate	DMA23107/08	04	0: 0: 2				35	7.5	7.5	50	3h
	II	DSC-II: Theory	Plant Ecology Morphology and Angiosperm Taxonomy	DMB23007/08	04	4: 0 : 0				70	15	15	100	3h
		DSC-II: Pract.	Plant Ecology Morphology and Angiosperm Taxonomy	DMB23107/08	04	0: 0: 2	06	60	60	35	7.5	7.5	50	3h
II B.Sc	III	DSC-III:Theory	Plant Anatomy and Embryology of Angiosperm	DMC23007/08	04	4: 0 : 0				70	15	15	100	3h
		DSC-III:Pract.	Plant Anatomy and Embryology of Angiosperm	DMC23107/07	04	0: 0: 2	06	60	60	35	7.5	7.5	50	3h
	IV	DSC-IV: Theory	Plant Physiology and Metabolism	DMD23007/08	04	4: 0 : 0				70	15	15	100	3h
		DSC-IV:Pract.	Plant Physiology and Metabolism	DMD23107/08	04	0: 0: 2	06	60	60	35	7.5	7.5	50	3h
III B.Sc.	V	DSEA: Theory	No. of courses:1 DSE- A: Cell and Molecular Biology	DME23007/08		4: 0 : 0								3h
		DSE:Practicals	Based on theory	DME23107/08										
		DSEB: Theory	DSE-B: Economic Botany and Biotechnology	DME23207/08	04	0: 0: 2	06	60	60	70	15	15	100	3h
		DSE:Practicals	Based on theory	DME23307/08										
		SEC	No. of courses:1 SEC-A : Ethnobotany	DME23407/08	02	2:0:0	02	30	-	35	7.5	7.5	50	2h
			SEC-B : Floriculture	DME23607/08										
	VI	DSEB: Theory	No. of courses:1 DSE-A: Genetics and Plant Breeding	DMF23007/08		4: 0 : 0								
		DSE:Practicals	Based on theory	DMF23107/08	04									3h
		DSEB: Theory	DSE -B : Analytical Techniques and Plant Sciences	DMF23207/08		0: 0: 2	06	60	60	70	15	15	100	
		DSE:Practicals	Based on theory	DMF23307/08										3h

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE (AUTONOMOUS)
OOTY ROAD, MYSURU-25

DEPARTMENT OF BOTANY

PROCEEDINGS OF THE MEETING OF BOARD OF STUDIES FOR THE PROGRAMMES B. Sc. IN BOTANY, BIOCHEMISTRY, MICROBIOLOGY (B.Sc. 07) AND CHEMISTRY, BOTANY, ZOOLOGY, (B.Sc. 08) HELD ON 14 JUNE 2019 AT 11.00 AM IN THE CHAMBER OF THE CHAIRMAN, DEPARTMENT OF BOTANY, JSS COLLEGE, OOTY ROAD, MYSURU-25

MEMBERS	SIGNATURE
Dr. S Prathibha Associate Professor, Dept. of Botany, JSS College, Ooty Road Mysuru Chairman	
Dr. Sowmya Associate Professor, Department of Botany Yuvaraja's college, Mysuru Member (VC Nominee)	
Dr. Syed Fasihuddin Associate professor of Botany Govt. Science College Bengaluru- 560001 Member (AC Nominee)	
Dr. V. N. Muralidhar Associate professor of Botany Govt. first grade College Sira- 572137 Tumkur District Member (AC Nominee)	

At the outset, the Chairman, BOS in Botany, welcomed the members to the meeting of BOS and briefed about the agenda to be discussed. The following agenda were placed by the Chairman which were discussed and resolved as follows:

Agenda 1: To frame/ revise, discuss and approve the Scheme/ Syllabus under Choice Based Credit System for the programmes: B.Sc. in Botany, Biochemistry, Microbiology and Chemistry, Botany, Zoology from the academic year 2019-20 onwards.

The Chairman appraised the members about the introduction of Choice Based Credit System to the above said programmes with the course matrix in 2017-18. Accordingly, a draft revised/ modified Scheme/ Syllabus was presented and placed before the Board for their opinion and approval.

Resolution: The BOS went through the Scheme/ Syllabus and discussed in length about various aspects of the same. After incorporation of the changes suggested by the members of BOS, the Syllabus was approved. Details of changes made with respect to the introduction of revised/ modified Scheme/ Syllabus in the existing courses is shown in Annexure-I.

Agenda 2: To prepare the Panel of Examiners for the examinations for the year 2019-20.

The Chairman presented the proposed Panel of Examiners to I to VI Semester examinations of 2019-20.

Resolution: After incorporating of certain changes suggested by the members, the Panel of Examiners was approved.

Agenda 3: Approval of Reference Books

The Chairman presented the proposed list of Reference Books to the Members.

Resolution: After incorporating of certain changes suggested by the members, the list of Reference Books was approved.

Agenda 4: Any other matter with the permission of the Chairman

---

The career oriented course Horticulture syllabi was thoroughly analysed and the contents were restructured according to the present day requirement. Question paper pattern, Maximum marks allotted and the hours per unit are also changed as per the BOS member's corroboration to bring uniformity

Finally the meeting was concluded with the Chairman thanking the Members for their active participation in the deliberations of the meeting.

Chairman

Annexure-I:

Revision/ modification made in the existing Syllabus for 2019-2020 batch onwards:

Existing	Proposed	Justification	Approved
I B.Sc. I Sem DSC-I			
Biodiversity of Microbes and Archegoniate (CMA23007/08):	**Biodiversity of Microbes and Archegoniate (DMA23007/08):**		
Unit 1: Microbial diversity:			
A. **Virus**- replication	Deleted	Repetition	**Approved**
D. Fungi- *Puccinia*	Yeast	Yeast is most important from economic point of view	**Approved**
Unit 2: Archegoniate:			
A. Pteridophytes -*Marsilea*	Deleted	Better to study in higher level	**Approved**
Practicals: Gram's Staining of Bacteria	Deleted	Repetition in Microbiology	**Approved**
Study of *Marsilea*		Better to study in higher level	
Study of *Puccinia*	Yeast	Yeast is most important from economic point of view	
I B.Sc. II Sem DSC-II			
Plant Ecology Morphology and Angiosperm Taxonomy	**Plant Ecology Morphology and Angiosperm Taxonomy**		

(CMB23007/08):	**(DMB23007/ 08):**		**Approved**
Unit-3: Taxonomy: **C. Angiosperm families:** Apiaceae	Arecaceae	To Represent Monocot family	
Practicals: Apiaceae	Solanaceae & Arecaceae	Routinely used vegetables belong Solanaceae family & to represent Monocot family	**Approved**
II B.Sc. III Sem-DSC III			
Plant Anatomy Embryology (CMC23007/08):	**Plant Anatomy and Embryology of Angiosperm (DMC23007/ 08):**		**Approved**
Unit 3: Adaptive and protective systems	Brief Account of Epidermis, cuticle, Stomata & Trichome. Added	Blown up syllabi	
Practicals:	Content Restructured	Appropriate	
Unit 4: Embryology	**Unit 4: Embryology of Angiosperms**		**Approved**
Structure of pollen grains	Types of Tetrad, Male gametophyte & Embryosac development- Monosporic,Bisporic,Tetrasporic added	For detailed embryological studies.	
Mechanism & Adaptation of Pollination	deleted	Studied previously in lower levels	
Practicals:	Content Restructured	Appropriate	
III B.Sc. V Sem-DSC IV			
Plant Physiology and Metabolism. (CMD23007/08):	**Plant Physiology and Metabolism**		

	(DMD23007/08):		
Unit 1: Plant-water relations: **Unit 2: Mineral nutrition** **Unit 3: Translocation in phloem** **Unit 4: Photosynthesis** **Unit 5: Respiration** **Unit 6: Enzymes** **Unit 7: Nitrogen metabolism** **Unit 8: Plant growth regulators** **Unit 9: Plant response to light and temperature**	**UNIT 1 Plant – Water Relations:** **1.Fundamental concepts,** **2.Short Distance Transport,** **3. Long distance Transport,** **4.Transpiration,** 5.**Mineral nutrition,** 6.**Translocation of solutes** **UNIT 2 – Enzymes:** **UNIT 3 – Bioenergetics:** **UNIT 4 -Nitrogen Metabolism:** **UNIT 5 - Plant Growth and Movements:**	Content Restructured	**Approved**
Practicals:	Content Restructured	Appropriate	**Approved**
III B.Sc. V Sem-DSE I			
DSE-1: Cell and Molecular Biology (CME23007/08):	**DSE-1: Cell and Molecular Biology (DME23007/08):**		
Unit 1-Techniques in Biology: Sample Preparation for light microscopy; Sample Preparation for electron microscopy; X-ray diffraction analysis.	**deleted**	Repetition in microbiology	**Approved**
Unit 2-Cell Membrane and Cell Wall : Carbohydrates in the membrane; Faces of the membranes;	**deleted**	Better to study in higher classes	**Approved**

<table>
<tr><td>Unit 7-Genetic material:
DNA replication
(Prokaryotes and eukaryotes): bidirectional replication,
semi–conservative method</td><td>Unit 7-Gene concept:
Semi-conservative method required</td><td>Appropriate</td><td>Approved</td></tr>
<tr><td colspan="4">III B.Sc. V Sem SEC-I</td></tr>
<tr><td>Floriculture</td><td>Contents restructured</td><td>Appropriate</td><td>Approved</td></tr>
<tr><td colspan="4">III B.Sc. VI Sem DSE-II</td></tr>
<tr><td>DSE-2: Genetics and Plant Breeding (CMF23007/08)</td><td>DSE-2: Genetics and Plant Breeding (DMF23007/08)</td><td></td><td rowspan="2">Approved</td></tr>
<tr><td>Unit 1- Heredity: lethal genes
Pleiotropism, co- dominance
9:7; 9:4:3; 13:3; 12:3:1</td><td>deleted</td><td>Repetition in Zoology</td></tr>
<tr><td rowspan="2">Practicals:</td><td>Complementary factors; supplementary factors, Duplicate factors, Epistatis</td><td>Proper terminologies have been used instead of ratios</td><td>Approved</td></tr>
<tr><td>Genetic problems on Mendel’s laws included</td><td>For better elucidation of theoretical concepts</td><td>Approved</td></tr>
</table>

Chairman

Programme Outcomes for BSc. in Chemistry, Botany, Zoology:

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Demonstrate the ability to justify and explain their thinking and/or approach, both written and oral. Demonstrate the ability to present clear, logical and succinct arguments, including prose and mathematical language. Write and speak using professional norms, and demonstrate an ability to collaborate effectively.

PO2. Develop state-of-the-art laboratory skills and professional communication skills.

PO3. Apply the scientific method to design, execute, and analyze an experiment and also to explain their scientific procedures as well as their experimental observations.

PO4. Appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

PO5. Explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

PO6. Identify the taxonomic position of plants using principles and methods of nomenclature and classification in Botany.

PO7. Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Use interdisciplinary approaches with quantitative skills to work on biological problems.

PO9. Identify the major groups of organisms with an emphasis on animals and be able to classify them within a phylogenetic framework.

PO10. Compare and contrast the characteristics of animals that differentiate them from other forms of life.

PO11. Give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of life.

Programme specific Outcomes for BSc. in Chemistry, Botany and Zoology

After completing the graduation in the Bachelor of Science the students are able to:

PS01: Communicate effectively the fundamentals and applications of chemical and Biological sciences

PS02: Possess deeper understanding of Natural laws, accuracy and validity of both theoretical and practical knowledge

PS03: Explicate ecological interconnectedness of life, by tracing energy and nutrient flows through the environment

PS04: Analyse the avenues and remedies for burning environmental issues

PS05: Pursue, enhance and appreciate conservation practices for sustainable use of plants and development

PS06: Interact with the social activities with ethical approach due to collaborative field visits, botanical tours and academic trips.

Programme Outcome for Bachelor of Science in Botany, Biochemistry & Microbiology

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Identify the taxonomic position of plants using principles and methods of nomenclature and classification in Botany

PO2. Understand the impact of the plant diversity in societal and environmental context

PO3.Demonstrate the knowledge of, and need for sustainable development

PO4. Use interdisciplinary approaches with quantitative skills to work on biological problems

PO5. Demonstrate the ability to justify and explain their thinking and/or approach

PO6. Develop state-of-the-art laboratory and professional communication skills

PO7. Apply the scientific method to design, execute, and analyze an experiment

PO8. Explain scientific procedures and their experimental observations

PO9.Demonstrate an understanding of fundamental biochemical principles, structure and function

PO10. Work as a laboratory technician, biochemists or medical scientist

PO11. Explain the processes used by microorganisms for the growth

PO12. Explain the theoretical basis of the tools, technologies and methods of microbiology

Programme Specific Outcome
Bachelor of Science in Botany, Biochemistry & Microbiology

After completing the graduation in the Bachelor of Science the students are able to;

PSO1: Demonstrate applications of biochemical and biological sciences

PSO2: Inculcating proficiency in all experimental techniques and methods of analysis

PSO3: Acquire, articulate, retain and demonstrate laboratory safety skills

PSO4: Communicate scientific information effectively, relating to microbes and their role in ecosystem and health

PSO5: Gain proper procedures and regulations in handling and disposal of chemicals

PSO6: Understand biochemical and molecular processes that occur in and between the cells

LIST OF APPROVED PANEL OF EXAMINERS:

Sl. No	Name	Designation and DOB	Joining Date
	Internal Examiners		
1.	Dr.Prathibha S Jss College, Ooty Road, Mysore	Asso. Prof. 28/04/1964	28/08/1986
2.	Kiran B L Jss College, Ooty Road, Mysore	Asst. Prof. 30/12/1992	23/09/2015
3.	Divya gouda Jss College, Ooty Road, Mysore	Asst. Prof.	
	External Examiners		
4.	Shivanna M Bharathi College, Bharathi Nagarar	Asso. Prof. 30/06/1958	19/11/1985
5.	Ravikumar B S AVK College For Women, Hassan	Asso. Prof. 13/07/1962	16/07/1987
6.	Nagarathnamma Govt College For Women, Mandya	Asso. Prof. 01/06/1959	10/08/1992
7.	Mallikarjunamiah M N Govt. first grade boys college, Mandya.	Asso. Prof. 05/11/1963	14/08/1992
8.	Hemavathi C Maharani`s Science College For Women, Mysore	Asso. Prof. 05/04/1966	17/08/1992
9.	Vijay C R Maharani`s Science College For Women, Mysore	Asso. Prof. 01/10/1962	29/12/1992
10.	Shivalingaiah Maharani`s Science College for Women, Mysore	Asst. Prof. 01/06/1968	08/01/1996
11.	Purushotham S P Maharani`s Science College for Women, Mysore	Asst. Prof. 15/05/1967	02/08/1996
12.	Lingaraju D P AVK College for Women, Hassan	Asst. Prof. 26/02/1965	23/10/2002
13.	Basavaraju G L Govt College for Women, Mandya	Asst. Prof. 21/07/1976	30/01/2004
14.	Devika M Saradavilas College, Mysore	Asst. Prof. 14/03/1970	14/12/2005
15.	Suresh N S Maharani`s Science College for Women, Mysore	Asst. Prof. 25/02/1975	02/05/2006
16.	Jayalakshmi B Maharani`s Science College for Women, Mysore	Asst. Prof. 18/11/1974	14/07/2006
17.	Sowmya H K Govt Science College,Hassan	Asst. Prof. 18/06/1970	22/12/2007
18.	Thoyajaksha Govt Science College, Hassan	Asst. Prof. 20/07/1970	24/12/2007
19.	Sandhya Rani D Maharani`s Science College for Women, Mysore	Asst. Prof. 24/08/1972	24/12/2007
20.	Pushpalatha H G Maharani`s Science College for Women, Mysore	Asst. Prof. 23/12/1979	26/12/2007
21.	Ashok N Pyati Maharani`s Science College for Women, Mysore	Asst. Prof. 22/04/1970	28/12/2007
22.	Indushree PES College, Mandya	Asst. Prof.	
23.	Lalitha V Maharani`s Science College for Women, Mysore	Asst. Prof.	

24.	Gayathrri Devi N Jss College for women Chamarajanagar	Asst. Prof.	
25.	Revanamaba B Maharani`s Science College for Women, Mysore	Asst. Prof.	
26.	Dr.M.K. Mahesh Yuvarajas college, Mysore.	Asso. Prof.	
27.	Shravani, K.A Yuvarajas college, Mysore.	Asst. Prof.	
28.	Dr.krishna Yuvarajas college, Mysore.	Asst. Prof.	
29.	Dr.krishnamurthy Yuvarajas college, Mysore.	Asst. Prof.	
30.	Kalpashree Yuvarajas college, Mysore	Asst. Prof.	
31.	Dr. Sowmya, R Yuvarajas college, Mysore	Asst. Prof.	
32.	Deepa hebbar Maharani`s Science College for Women, Mysore	Asst. Prof.	

DMA23008/DMA23007

I B.Sc., I Semester DSC-I

Biodiversity of Microbes and Archegoniate

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand the characteristics of viruses

CO2 Learn the classification and characteristics of bacteria

CO3 Identify the classification and characteristics of archegoniate

CO4 Identify the characteristics of algae

CO5 Understand the classification and characteristics of fungi.

Unit 1- Microbial diversity:

A. Virus **(4 Lectures)**

General structure, DNA virus (T_4-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance.

B. Bacteria **(5 Lectures)**

Definition, Classification (Based on Shape, Arrangement and flagellation) and Economic importance; ultra structure, Reproduction – vegetative (fission, Budding) asexual (Endospore) Sexual (Genetic recombination-Conjugation, Transformation and Transduction).

C. Algae **(14 Lectures)**

General characteristics; Classification, Reproduction and Economic importance of algae.
Type study- *Nostoc, Spirogyra, Sargassum.*

D. Fungi **(16 Lectures)**

1. General characteristics, classification , nutrition , reproduction and economic importance.
Type Study - *Rhizopus, saaccharomyces* (Yeast), *Penicillium,*
2. Lichens: Distribution, classification and Economic importance, structure and reproduction.

Unit 2- Archegoniate:

A. Bryophytes **(7 Lectures)**

General characteristics, Classification and Economic importance . Type Study- *Marchantia* and *Polytrichum*

B. Pteridophytes **(7 Lectures)**

General characteristics and classification, Stelar evolution. Type Study - *Selaginella* and *Equisetum*.

C. Gymnosperms **(7 Lectures)**

General characteristics, classification and Economic importance. Type Study- *Cycas* and *Pinus.*

DMA2318/ DMA2317

I B.Sc., I Semester DSC-I

Biodiversity of Microbes and Archegoniate

Practical (Credits: 2)

Lectures: 60 Hours
(4 hours/week)

1. Study of TMV and of T_4- Phage through Microphotographs
2. Study of Bacteria.
3. Study of *Nostoc* (Specimen and permanent slides)
4. Study of *Spirogyra* (Specimen and permanent slides)
5. Study of *Sargassum* (Specimen and permanent slides)
6. Study of *Rhizopus*
7. Study of *Yeast*
8. Study of *Penicillium*
9. Study of Lichens
10. Study of *Marchantia*
11. Study of *Polytrichum*
12. Study of *Selaginella*
13. Study of *Equisetum*
14. Study of *Cycas*
15. Study of *Pinus*

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

I B.Sc., I Semester DSC-I
Scheme of theory question paper
Biodiversity of Microbes and Archegoniate

Time: 3.00 Hours **Max. Marks: 70**

<u>Blue print</u>:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit I :Microbial Diversity					
A&B.Virus and Bacteria	09	2X1=2	5X1=5	10X1=10	**17**
C. Algae	14	2X2=4	5X2=10	10X1=10	**24**
D. Fungi	16	2X1=2	5X3=15	10X1=10	**27**
Unit II: Archegoniate					
A. Bryophytes	07	2X1=2	-	10X1=10	**12**
B. Pteridophytes	07	2X1=2	-	10X1=10	**12**
C. Gymnosperms	07	2X2=4	-	10X1=10	**14**
Total	**60**	**8X2=16**	**4X6=30**	**6X6=60**	**106**

DMA23108/ DMA23107 **I B.Sc., I Semester DSC-I**

Biodiversity of Microbes and Archegoniate

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35(25+05+05)**

I. Identify the specimens 'A' and 'B' with reasons and labeled sketches **3x2=06 marks**

(**A**-Algae and **B**-Microphotographs of virus/Bacteria/fungi)

Identification – 1 mark
Reasons with labelled sketch – 2 marks

II. Prepare a stained temporary slide of 'C'. Sketch, label and Identify with reasons. Leave the preparation for evaluation. **4x01=04 marks**

(C-*Nostoc/Rhizopus/Saccharomyces* (yeast) / *Penicillium*)

Identification – 1 marks
Preparation/staining and mounting– 2 marks
Reasons with labelled sketch – 1 marks

III. Write critical notes on 'D', 'E' and 'F' **3x3=09 marks**

(D-Algae/Fungi, E-Lichens/Bryophytes, F- Pteridophytes /Gymnosperms)

Identification _ 1 mark
Reasons with lablled sketch – 2 marks

IV. Identify the Microslides 'G', 'H', and 'I' with reasons and labeled Sketches **02x03=06 marks**

(G-Algae/Fungi, H-Lichens/Bryophytes, I- Pteridophytes /Gymnosperms)

Identification – 1 mark
Reasons with lablled sketch – 1 marks

V. Practical record **05marks**

VI. Viva- Voce **05marks**

Note: Each student should submit the **duly valued and certified practical record** at the time of practical examination.

***

DMA23108/ DMA23107 **I B.Sc., I Semester DSC-I**

Biodiversity of Microbes and Archegoniate

Practical Question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Identify the specimens 'A' and 'B' with reasons and labeled sketches 3x2=06 marks

II. Prepare a stained temporary slide of 'C'. Sketch, label and Identify with Reasons leave the preparation for evaluation. 4x1=04 marks

III. Write critical notes on 'D', 'E' and 'F' 3x3=09 marks

IV. Identify the Microslides 'G', 'H' and 'I' and with reasons and labeled Sketches

2x3=06 marks

V. Practical record 05 marks

VI. Viva- Voce 05marks

***

I B.Sc., II Semester DSC-II

Plant Ecology, Morphology and Angiosperm Taxonomy

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Specify the characteristics of ecosystem

CO2 Learn the classification and characteristics of Plant communities

CO3 Understand in details with examples plant morphology

CO4 Understand in depth Herbarium

Unit 1- Plant Ecology:

A. Introduction to Ecology and Ecological factors: **(6 Lectures)**

Introduction to ecology, Climatic factors- Light, temperature and water. Edaphic factors- soil formation, types and profile. Shelford law of tolerance.

B. Ecosystem **(6 Lectures)**

Structure and components of an ecosystem, study of pond and forest ecosystem, energy flow and trophic levels; Food chains, food webs, Ecological pyramids. Biogeochemical cycles- Carbon, Nitrogen and Phosphorous.

C. Plant communities **(6 Lectures)**

Morphological Adaptations of hydrophytes and xerophytes. Plant Succession, Hydrosere and Xerosere.

Unit 2- Leaf and Floral Morphology: **(15 Lectures)**

A. Leaf- Structure, types and phyllotaxy.

B. Types of Inflorescence

C. Flower- structure of a typical flower (*Tribulus terrestris* / *Muntingia calabura*), Variation in floral morphology and floral organs in detail.

D. Types of Inflorescence

E. Types of fruits

Unit-3: Taxonomy:

A. Introduction to plant taxonomy **(8 Lectures)**

1. Taxonomic hierarchy
2. Types of classification (artificial, natural and phylogenetic)
3. Systems of classification- Bentham and Hooker, Engler and Prantl
4. Plant Nomenclature-Binomial system and ICBN principles.

B. Herbarium technique: **(5 Lectures)**

1. Herbarium- Techniques and importance
2. Botanical gardens

C. Angiosperm families: **(14 Lectures)**

Study of the following families according to Bentham and Hooker's system of classification.--Malvaceae, Leguminosae (Papilionaceae, Caesalpiniaceae and Mimosaceae), Apocynaceae Asteraceae and Arecaceae.

***

DMB23108/ DMB23107

I B.Sc., II Semester DSC-II

Plant Ecology, Morphology and Angiosperm Taxonomy

Practical (credits: 2) **Lectures: 60 Hours (4 hours/week)**

1. Study of Ecological instruments used to measure microclimatic variables: Soil thermometer, Maximum and Minimum Thermometer, Anemometer, Psychrometer/Hygrometer, Rain gauge.
2. Study of morphological adaptations of the following
   a. Hydrophytes Eg: ***Hydrilla. Pistia and Eichhornia***
   b. Xerophytes Eg: ***Opuntia, Euphorbia Tirucalli,Nerium and Casuarina***
3. Study of biotic interactions of the following:
   a.Stem parasite Eg: ***Cuscuta.***
   b.Root parasite Eg: ***Striga***.
   c.Epiphytes, Eg: ***Vanda***
   d. Predatary plants (Insectivorous plants) Eg: ***Nepenthes***.
4. Study of root modifications
5. Study of stem modifications
6. Study of leaf-structure, types, phyllotaxy and modifications.
7. Parts of a typical flower **(*Tribulus terrestris* / *Muntingia calabura*)**
8. Floral organs in detail with their variations.
9. Types of inflorescence
10. Types of fruits
11. Study of families Malvaceae, Apocynaceae
12. Study of families Leguminosae (Papilionaceae, Caesalpiniaceae and Mimosaceae)
13. Study of families and Asteraceae
14. Study of Solanaceae and Arecaceae
15. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label

Suggested Readings:

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi.

DMB23008/ DMB23007

I B.Sc., II Semester DSC-II

Plant Ecology, Morphology and Angiosperm Taxonomy

Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: A. Plant Ecology	06	-	-	10x1=10	**10**
B. Ecosystem	06	-	5x2=10	-	**10**
C. Plant communities	06	2x1=2	-	10x1=10	**12**
Unit II: Leaf and Floral Morphology, Fruits	15	2x3=6	5x2=10	10x1=10	**26**
Unit III: Taxonomy A. Introduction to plant taxonomy	08	2x2=4	-	10x1=10	**14**
B. Herbarium technique	05	2x1=2	5x1=5	-	**07**
C.Angiosperm families	14	2x1=2	5x1=5	10x2=20	**27**
Total	**60**	**8x2=16**	**5x6=30**	**10x6=60**	**106**

DMB23108/ DMB23107

I B.Sc., II Semester DSC-II
Plant Ecology, Morphology and Angiosperm Taxonomy
Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled Sketches. **3x3=9 marks**

(A-Ecological instruments, B-Hydrophytes/xerophytes/parasites/epiphytes, C-Underground root & stem modifications/Leaf phyllotaxy /leaf types/)

Identification – 1 mark
Labeled sketch with reasons – 2 marks

II. Assign the plant 'D' to its respective family giving reasons. **4x1=4 marks**
(D- Malvaceae/Apocynaceae/Asteraceae/Arecaceae
Family name – 1 mark
Salient features – 3 marks

III. Describe the plant 'E' in technical terms. **4x1=4 marks**
(Papilionaceae /Caesalpiniaceae)
Family name – 1 mark
Technical terms – 3 marks

IV. Draw the floral diagram and write the floral formula of the give plant 'F' **4x1=4 marks**
(Malvaceae, Solanaceae, Apocynaceae)
Floral formula -1mark
Floral diagram -3marks

V. Identify the specimen 'G' and 'H' **2x2=4marks**
(J-Inflorescence, H- Fruits)
Identification – 1 mark
Reasons – 1mark

VI. Practical **05marks**

VII. Viva- Voce **05marks**

Note: each student should submit the **duly valued and certified practical record** at the time of practical examination.

***

I B.Sc., II Semester DSC-II
Plant Ecology, Morphology and Angiosperm Taxonomy
Practical Question Paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled Sketches **3x3=9 marks**

II. Assign the plants 'D' to its respective family giving reasons. **4x1=4marks**

III. Describe the plant 'E' in technical terms. **4x1=4 marks**

IV. Draw the floral diagram and write the floral formula of the give plant 'F' **4x1=4marks**

V. Identify the specimen 'G' and 'H' **2x2=4marks**

VII. Practical record **05marks**

VIII. Viva-Voce **05marks**

***

DMC23008/DMC23007 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand the details of histology
CO2 Understand the details of anatomy
CO3 Understand the characteristics of secondary growth
CO4 Learn the details of embryology

Unit 1: Histology and Anatomy (18 Lectures)

Meristem- structure, classification, based on origin, position and function. Study of Simple and complex tissues.
Internal Structure of dicot and monocot root,stem and leaf.

Unit 2: Secondary Growth (4 Lectures)

Process of secondary growth in dicot stem.

Unit 3: Adaptive and protective systems (7 Lectures)

Anatomical adaptations in xerophytes (Nerium & Causarina) and Hydrophytes (Hydrilla & Eichhornia). Epidermis, cuticle, Stomata & Trichome. (Brief Account)

Unit 4: Embryology of Angiosperms (8 Lectures)

T.S of mature anther, Microsporogenesis, types of tetrads and Male gametophyte, Megasporogenesis- types of ovules, L.S of Anatropous ovule, Embryosac development- Monosporic (Polygonum), Bisporic (Allium), Tetrasporic (Frittilaria) structure of Mature Embryo sac.

Unit 5: Pollination and fertilization (11 Lectures)

Definition, types, contrivances for self and cross pollinations
Process of Double Fertilization, Post Fertilization changes

Unit 6: Embryo and endosperm (6 Lectures)

Structure and development of Dicot (Capsella) and Monocot embryo (Maize). Endosperm- nucellar, cellular, helobial and ruminate.

Unit 7: Experimental Embryology (6 Lectures)

Brief account of apomixis (recurrent and non-recurrent), apospory, polyembryony, parthenocarpy.

DMC23108/DMC23107 **II B.Sc., III Semester DSC-III**

Plant Anatomy and Embryology of Angiosperms

Practical (Credits: 2)

Lectures: 60 Hours
(4 hours/week)

1. Study of Meristems through permanent slides and photographs- apical, intercalary and lateral meristems.
2. Study of simple Tissues (parenchyma, collenchyma and sclerenchyma) through Permanent slides and photographs.
3. Study of complex Tissue (xylem and phloem) through Permanent slides and photographs.
4. Study of Anatomical characteristics of Root: Monocot- *Zea mays* and Dicot- *Helianthus*.
5. Study of Anatomical characteristics of Stem: Monocot- *Zea mays*; Dicot-*Helianthus*.
6. Study of Anatomical characteristics of Monocot and Dicot Leaf.
7. Adaptive anatomy: Xerophyte (*Nerium* & *Causaurina*); Hydrophyte (*Hydrilla* & *Eichhornia)*.
8. Structure of anther (young and mature) and mounting of Pollen grains.
9. Calculation of percentage of germinated pollen in a given medium (Hanging drop method).
10. Types of ovules: Anatropous, Orthotropous, Circinotropous, Amphitropous/ Campylotropous.
11. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development.
12. Pollination types and seed dispersal mechanisms. (Photographs and specimens).
13. Dissection/ mounting of embryo/endosperm from seeds.

***

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

***

DMC23008/DMC23007 **II B.Sc., III Semester DSC-III**

Plant Anatomy and Embryology of Angiosperms

Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Histology and Anatomy	18	2X1=2	5X2=10	10X2=20	**32**
Unit 2: Secondary Growth	04	2X1=2	5X1=5	-	**07**
Unit 3: Adaptive and protective systems	07	2X1=2	5X2=10	-	**12**
Unit 4: Embryology	08	2X1=2	-	10X1=10	**12**
Unit 5: Pollination andfertilization	11	2X1=2	-	10X2=20	**22**
Unit 6: Embryo and endosperm	06	2X1=2	-	10X1=10	**12**
Unit 7: Experimental Embryology	06	2X2=4	5X1=5	-	**09**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

DMC23108/DMC23107 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled sketches 2x3=6 marks

(A-Meristem- Apical, intercalary and lateral, B-Simple tissues, C-Complex tissues)

Identification – 1 mark
Labeled sketch with reasons – 1marks

II. Prepare a stained temporary slide of 'D. Sketch, label and identify with reasons Leave the preparation for evaluation 5x1=5 marks

(D-Dicot stem/ Monocot stem Anatomy)

Identification – 1 mark
Mounting and Preparation -2 marks
Labeled sketch with reasons – 2 marks

III. Identify the microslides/ photographs 'E' 'F' & 'G' sketch, label with reasons 3x3=09 marks

(E-root/ leaf, F-Xerophytes/ Hydrophytes, G-T.S of anther/ types of ovule

Identification – 1 mark
Labeled sketch with reasons – 2marks

IV. 'H'- Dissect Embryo/Endosperm, sketch label with reasons/ Mounting of Pollen grains / calculate the percentage of germinated pollen

5x1=5 marks

Identification – 1 mark
Labeled sketch with reasons – 4marks

V. Practical record 05 marks

VI. Viva-Voce 05 marks

Note: Each student should submit the **duly valued and certified practical record** at the time of practical examination.

***

DMC23108/DMC23107 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled sketches 2x3=6 marks

II. Prepare a stained temporary slide of 'D. Sketch, label and identify with reasons.
Leave the preparation for evaluation 05marks

III. Identify the microslides/ photographs 'E' 'F'& 'G', sketch, label with reasons
3x3=9 marks

IV. 'H'- Dissect Embryo/Endosperm, sketch label with reasons/ Mounting of Pollen grains / calculate the percentage of germinated pollen.

V. Practical record 5 marks

VI. Viva-Voce 5 marks

***

DMD23008/DMD23007 **II B.Sc., IV Semester DSC-IV**

Plant Physiology and Metabolism

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Learn in depth translocation in phloem
CO2 Specify the classification and characteristics of enzyme
CO3 Understand the details of photosynthesis
CO4 Identify the characteristics of plant response to light and temperature

UNIT 1 - Plant – Water Relations: **(20 Lectures)**

1. **Fundamental concepts:** Importance of water to plants, Diffusion, Imbibition, Osmosis, Endosmosis and Exosmosis, Plasmolysis, Osmotic Pressure, Water potential and its components.
2. **Short Distance Transport:** Absorption of water – Active and passive absorption, Absorption of minerals – Donnan's equilibrium (Passive absorption), Carrier-ion concept (Active absorption)
3. **Long distance Transport:** Ascent of sap; Root pressure theory (Vital theory), TCT Theory (Physical theory), Soil plant atomospheric continum (SPAC)
4. **Transpiration:** Types, Mechanism of stomatal movement; Starch-sugar interconversion theory, Potassium ion pump theory, Significance of transpiration, Antitranspirants, Guttation.
5. **Mineral nutrition:** Macro and Micro nutrients; Role of Nitrogen, Phosphorous, Potassium, Sulphur, Manganese and Zinc, Hydroponics.
6. **Translocation of solutes:** Path of translocation, Munch's mass flow hypothesis with merits and demerits.

UNIT 2 – Enzymes: **(4 Lectures)**

Properties, Classification and Mode of action (Lock & Key theory, Induced fit theory)

UNIT 3 – Bioenergetics: **(18 Lectures)**

1. Photosynthesis : Introduction, Photosynthetic apparatus, Mechanism – Light and Dark reactions (C_3 pathway/Calvin Cycle), C_4 pathway, Significance of Photosynthesis.

2.Respiration : Introduction,,Types, Ultrastructure of Mitochondrion, Mechanism of Aerobic respiration – Glycolysis, Krebs' cycle and Terminal Oxidation of reduced coenzymes , Anaerobic respiration – alcoholic & lactic acid fermentation, Significance .

UNIT 4 -Nitrogen Metabolism: **(6 Lectures)**

Nitrogen fixation (Symbiotic and Non Symbiotic), Nitrate reduction, Aminoacids & their synthesis (Transamination & Reductive amination)

UNIT 5 - Plant Growth and Movements: **(12 Lectures)**

1. Growth: Definition, Phases of growth and Growth curve
2. Growth regulators Chemical nature, application of Auxins, Gibberellins, Cytokinins, Abcissic acid (ABA) & Ethylene.
3. Photoperiodism and Vernalisation : A brief account.
4. Plant movements : Tropisms & their types (Phototropism, Thigmotropism, Hydrotropism & Geotropism)

DMD23108/DMD23107 **II B.Sc., IV Semester DSC-IV**

Plant Physiology and Metabolism

Practicals (2 credits) **Lectures: 60 Hours**

(4 hours/week)

I. Minor Experiments:

1. a) Root pressure experiment

   b) Ganong's Potometer experiment

2. c) Ganong's light screen experiment

   d) Mohl's half leaf experiment

3. f) Kuhne's experiment to demonstrate fermentation.

   g) Phototropism

4. h) Geotropism

   i) Arc Auxanometer experiment

5. j) Bolting.

   k) Effect of auxins on rooting.

II. Major Experiments:

1. Determination of Osmotic Potential by Plasmolytic method using *Rhoeo discolor (Epidermal peel)*
2. Experiment to demonstrate the Relationship between Absorption and Transpiration.
3. Experiment to demonstrate the Suction force due to transpiration.
4. Separation of photosynthetic pigments using paper Chromatography.
5. Evolution of Oxygen during photosynthesis
6. Calculation of stomatal index and stomatal frequency.

III. Biochemical tests:

Qualitative biochemical tests for Carbohydrates, fats and protein**.**

***

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.

2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

II B.Sc., IV Semester DSC-IV
Plant Physiology and Metabolism
Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Plant-water relations	20	2X3=6	5X2=10	10X2=20	**36**
Unit 2: Enzymes	4	2X1=2	5X1=5	-	**7**
Unit 3: Bioenergetics	18	2X2=4	5X1=5	10X2=20	**29**
Unit 4: Nitrogen metabolism	6		5X1=5	10X1=10	**15**
Unit 5: Plant Growth and Movements:	12	2X2=4	5X1=5	10X1=10	**19**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

DMD23108/DMD23107 II B.Sc., IV Semester DSC-IV

Plant Physiology and Metabolism

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Perform the major experiment 'A' write the principle, Requirements, Procedure and record the result with inference and leave the setup for evaluation 9x1 = 9 marks

(Determination of osmotic potential of plant cell sap by plasmolytic method. Study of plasmolysis and deplasmolysis on Rhoeo leaf

OR

Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophytes

OR

Experiment to demonstrate the Relationship between Absorption and Transpiration.

OR

Separation of photosynthetic pigments by paper chromatography

OR

Evolution of Oxygen during photosynthesis

OR

Experiment to demonstrate the Suction force due to transpiration

Principle	-2 marks	Procedure	-3 marks
Requirements	-1 mark	Result and inference	-1 marks
Setting	-2 marks		

II. Comment on 'B' &'C' (Minor experiments) 4x2 =8 marks

(Root pressure experiment/ Ganong's Potometer experiment / Ganong's light screen experiment/ Mohl's half leaf experiment/ Kuhne's experiment / Phototropism/ Arc Auxanometer experiment/ Bolting/ Effect of auxins on rooting)

Identification -1 marks
Critical notes -2 marks
Labeled sketch -1 marks

III. Perform the biochemical test of the given sample 'D' & 'E'

Procedure -3marks Result-1 marks **4x2=8 marks**

IV. Practical record 05 marks

V. Viva-Voce 05 marks

***

DMD23108/DMD23107 II B.Sc., IV Semester DSC-IV

Plant Physiology and Metabolism

Practical Question Paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Perform the major experiment 'A' write the principle, Requirements, Procedure and record the result with inference and leave the setup for evaluation 9x1 =9 marks

II. Comment on 'B' & 'C' (Minor experiments) 4x2=8 marks

II. Perform the biochemical test of the given sample 'D' & 'E' 4x2=8 marks

IV. Practical record 05 marks

V. Viva-Voce 05 marks

***

DME23008/DME23007 III B.Sc., V Semester DSE-V

Cell and Molecular Biology

Theory (4 credits) Lectures: 60 Hours

(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand in depth microscopy
CO2 Learn the details of cell
CO3 Specify the details of DNA
CO4 Learn the details of gene regulation

Unit 1- Microscopy: (5 Lectures)

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM).

Unit 2- Cell: (4 Lectures)

Cell Theory; Ultra structure of Prokaryotic and eukaryotic cells;

Unit 3- Cell Wall and Cell Membrane: (4 Lectures)

Cell wall- Structure; Cell Membrane- Fluid mosaic model and functions

Unit 4- Cell Organelles: (13 Lectures)

Ultrastructure and functions of Nucleus, Mitochondrion, Chloroplast, Endoplasmic reticulum, Golgi bodies, Lysosomes, Ribosomes, Peroxisomes and Glyoxisomes

Morphology of chromosomes in general, Ultrastructure of Chromosome (Nucleosome concept), Karyotype and Ideogram

Unit 5-Cell Division: (6 Lectures)

Cell cycle, Mitosis and Meiosis and their significance

Unit 6- Nucleic acids: (12 Lectures)

A. **DNA**: Chemistry, Structure and Replication in Eukaryotes (semi- conservative method) DNA as a genetic material Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment.

B.RNA: Chemistry, Structure, Types (mRNA, tRNA, rRNA) and structure. Frankel Conrat's experiment

Unit 7-Gene concept: (12 Lectures)

A. Cistron, Recon, Muton- Prokaryotic and Eukaryotic gene structure, Split gene concept.

B. Genetic code- features, Wobble concept. Protein synthesis: Transcription, Splicing and Translation. Central dogma of molecular Biology.

Unit 8-Regulation of gene expression: (4 Lectures)

Lac operon and Tryp operon concepts.

DME23108/DME23107 **III B.Sc., V Semester DSE-V**

Cell and Molecular Biology

Practical (2 credits) **Lectures: 60 Hours**

(4 hours/week)

1. Preparation of fixatives and stains: FAA, Carnoy's fixative, safranine, acetocarmine and aceto-orcein.
2. Study of viruses, prokaryotic cell (bacteria) and eukaryotic cell with the help of light and electron micrographs.
3. Study of cell organelles through photographs.
4. Study of structure of plant cell through temporary mounts- Onion peeling and tomato pulp
5. Study of Mitosis (temporary mounts and permanent slides).
6. Study of Meiosis (temporary mounts and permanent slides).
7. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
8. Structure of DNA and RNA (mRNA, rRNA, tRNA).
9. Study DNA packaging through photographs- solenoid model.
10. Lac operon and Tryp operon concepts.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

III B.Sc., V Semester DSE-V
Cell and Molecular Biology
Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Alloted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Microscopy	5	-	-	10X1=10	10
Unit 2: Cell	4	2X1=2	5X1=5	-	07
Unit 3: Cell Membrane and Cell Wall	4	2X1=2	5X1=5	-	07
Unit 4: Cell Organelles	13	2X1=2	-	10X2=20	22
Unit 5: Cell Division	06	2X1=2	-	10X1=10	12
Unit 6: Nucleic acid	12	2X1=2	5X2=10	10X1=10	22
Unit 7: Gene concept	12	2X2=4	5X1=5	10X1=10	19
Unit 8: Regulation of gene expression	04	2X1=2	5X1=5	-	07
Total	60	8X2=16	5X6=30	10X6=60	106

DME23108/DME23107 III B.Sc., V Semester DSE-I

Cell and Molecular Biology

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Prepare a temporary squash of given material 'A'. Sketch, label and identify with reasons. Leave the preparation for evaluation. **07 marks**

(Onion root tip/ flower bud)

Preparation - 4marks
Identification - 1mark
Sketch and label - 1mark
Reasons - 1mark

II. Identify the cytological slide/Photograph 'B' with labeled diagram and reasons. **04 marks**

(Mitosis/ Meiosis)

Identification - 1mark

Sketch and label - 1mark

Reasons - 2marks

III. Comment on 'C' and 'D' (charts/photographs) **3 X 2= 06marks**

C- Cell organelle (Identification - 1mark, labeled Sketch and Reason - 2marks)

D- Fixative/ stain (Identification - 1mark,labeled Sketch and Reason - 2marks,)

IV. Prepare a temporary mount of a plant cell 'E' **04 marks**

(Onion peeling/ tomato pulp)

Preparation - 2 marks

Sketch and label - 2 marks

V. Write critical notes on 'F and 'G' **2 X 2 = 04 marks**

F-DNA/ DNA packaging/RNA types
G- Nuclear pore complex/ Lac operon/Tryp operon

Identification - 1 mark
Reasons - 1 marks

VI. Practical record **05marks**

VII. Viva-voce **05marks**

***

DME23108/DME23107 III B.Sc., V Semester DSE-I

Cell and Molecular Biology

Practical question paper

Time: 4 Hours Max. Marks: 35 (25+05+05)

I. Prepare a temporary squash of given material 'A'. Sketch, label and identify with reasons. Leave the preparation for evaluation. 07 marks

II. Identify the cytological slide/photograph 'B' with labeled diagram and reasons. 04 marks

III. Comment on 'C' and 'D' (charts/photographs) 3 X 2= 06 marks

IV. Prepare a temporary mount of a plant cell 'E' 04 marks

V. Write critical notes on F and G 2 X 2 = 04 marks

VI. Practical record 05 marks

VII. Viva-voce 05marks

***

DME23208/DME23207 **III B.Sc., V Semester DSE-II**

Economic Botany and Biotechnology

Theory (4 credits) **Lectures: 60 Hours**
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand in details with application, if applicable, economic botany
CO2 Specify the details of plant tissue culture
CO3 Understand in details with examples recombinant DNA technology

Unit 1: Cereals and Millets **(4 Lectures)**

Rice, Wheat, Maize, Ragi (Botanical name, family, part used, morphology and uses)

Unit 2: Legumes **(6 Lectures)**

General account with special reference to Pigeon pea, Green gram, Black gram, Bengal gram (Botanical name, family, part used, morphology and uses)

Unit 3: Spices and condiments **(8 Lectures)**

General account with special reference to clove, black pepper, cinnamom, cardamom, garlic, onion, chilli and coriander (Botanical name, family, part used, morphology and uses)

Unit 4: Beverages **(4 Lectures)**

Tea and coffee (Botanical name, family, part used, morphology and uses)

Unit 5: Oils and Fats **(4 Lectures)**

General description with special reference to groundnut, sunflower, mustard (Botanical name, family, part used, morphology and uses)

Unit 6: Fibre Yielding Plants **(4 Lectures)**

General description with special reference to Cotton, Jute, kapok and sunn hemp (Botanical name, family, part used, morphology and uses)

Unit 7: Introduction to biotechnology **(2 lecture)**

Unit 8: Plant tissue culture **(10 Lectures)**

Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

Unit 9: Recombinant DNA Techniques **(18 Lectures)**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection.

DME23308/DME23307

III B.Sc., V Semester DSE-II
Economic Botany and Biotechnology
Practical (2 credits)

Lectures: 60 Hours
(4 hours/week)

1. Study of Cereals and Millets
2. Study of Legumes
3. Study of Spices and condiments
4. Study of Beverages
5. Study of Oils and Fats
6. Study of Fibre Yielding Plants
7. Familiarization with basic equipments in tissue culture.
8. Study through photographs: Anther culture, somatic embryogenesis,
9. Study through photographs: endosperm and embryo culture; micropropagation.
10. Study of molecular techniques: PCR, Blotting techniques and PAGE.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.

2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

III B.Sc., V Semester DSE-II

Economic Botany and Biotechnology

Scheme of Theory Question Paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Cereals and Millets	4		5X1=5	-	07
Unit 2Legumes	6	2X1=2	-	10X1=10	12
Unit 3: Spices and condiments	8	-	5X1=5	10X1=10	15
Unit 4: Beverages	4	-	5X1=5	-	05
Unit 5: Oils and Fats	4	2X1=2	5X1=5	-	07
Unit 6: Fibre Yielding Plants	4	2X1=2	-	10X1=10	12
Unit 7: Introduction to biotechnolog	2	2X1=2	-	-	02
Unit 8: Plant tissue culture	10	2X1=2	5X1=5	10X1=1	17
Unit 9: Recombinant DNA Techniques	18	2X2=4	5X1=5	10X2=20	29
Total		8X2=16	5X6=30	10X6=60	106

DME23608/ DME23607 **III B.Sc., V Semester SEC-I**

Floriculture

Theory (2 credits) **Lectures: 30 Hours**
(2 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1	Specify the classification and characteristics of gardening
CO2	Understand in depth nursery management
CO3	Identify in details with examples ornamental plants

Unit 1- Establishment and management of Nurseries: **(7 Lectures)**

Definition, importance of nurseries, classification of nurseries, and management of nurseries

1. **Basic requirements for Nurseries**: Agro-climatic conditions, Topography, Selection of site Selection of soil, Seed bed preparation, Water supply and irrigation.

   Parts of nursery- a) Building structures, b) Propagating structures- raising of seedlings

2. **Management of nursery:** Irrigation, Nutrition, Weed control, Plant protection, Uprooting, packing and transplantation

Unit 2-Gardening and Landscaping **(8 Lectures)**

A. Features of a garden:

1. Introduction, living elements, hedges, edges, trees, flower beds, lawn, Shrubbery, climbers and creepers, paths, Steps, arches, pergola, rockery, Water garden, sunken garden, carpet beds, topiary, trophy, ,non living elements.

2. Gardening: Introduction, Formal style, Informal style, planning a garden, creating a garden, establishment of the garden.

3. Some Famous gardens of India

B. Landscaping:

1. Home garden, Public garden. Educational institution, commercial complexes and companies.

2. Importance, Scope of floriculture and landscape gardening.

Unit 3-Garden Plants: **(5 Lectures)**

Introduction, Annuals, Biennials, Perennials, Shrubs, Trees, Climbers(Divine Vines) Succulents, Cacti,Ferns, Gymnosperms, Palms, Orchids, Bulbous Ornamentals.

Unit 4- Commercial Floriculture: **(8 Lectures)**

Introduction, Importance of Floriculture from social, Economic, Health and Aesthetic point of view. Marketing and floristry in Indian scenario. Future and scope of Floriculture in India- Employment opportunities. Packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Rose, Chrysanthemum, Gerbera, Gladiolous, Marigold, Orchids).

Unit 5- Diseases and pests of ornamental plants: **(2 Lectures)**

***

References

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India Allied Publishers

DME23608/ DME23607 **III B.Sc., V Semester SEC-I**

Floriculture

Scheme of Theory Question Paper

<u>Blue print</u>: **Max. Marks: 50**

Units	Hours allotted	No. of questions from each category			Total Marks 50
		2 marks (5/8)=10	5marks (4/6)=20	10marks (2/4)=20	
Unit 1: Establishment and management of Nurseries.	7	2X2=4	5X1=5	10X1=10	**19**
Unit 2: Gardening and Landscaping:	8	2X2=4	5X2=10	10X1=10	**24**
Unit 3: Garden Plants:	5	2X2=4	5X2=10	-	**14**
Unit 4: Commercial Floriculture	8	2X1=2	-	10X2=20	**22**
Unit 5: Diseases and Pests of Ornamental Plants.	2	2X1=2	5X1=5	-	**07**
Total	**30**	**8X2=16**	**5X6=30**	**10X4=40**	**86**

DME23408 /DME23407 **III B.Sc., V Semester SEC-II**

Ethnobotany

Theory (Credits 2)

Lectures: 30 Hours
(2 hours/week)

Course outcome

After completion of the course the student is able to:

CO1. Understand the details of Ethnobotany

CO2. Learn the characteristics of traditional medicinal plants

Unit 1- Ethnobotany: **(6 Lectures)**

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit 2- Methodology of Ethnobotanical studies: **(6 Lectures)**

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3- Role of Ethnobotany in modern Medicine: **(10 Lectures)**

Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum*

c) *Vitex negundo* d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata*

g) *Cassia auriculata* h) *Indigofera tinctoria*

Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania.*

Role of ethnic groups in conservation of plant genetic resources Endangered taxa and forest management (participatory forest management).

Unit 4- Ethnobotany and legal aspects: **(8 Lectures)**

Ethnobotany as a tool to protect interests of ethnic groups.Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

References

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

3) Lone et al,. Palaeoethnobotany

4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.

6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester

7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-19969)

DME23408 /DME23407 III B.Sc., V Semester SEC-II

Ethnobotany

Scheme of Theory Question Paper

Blue print: **Max. Marks: 50**

Units	Hours allotted	No. of questions from each category			Total Marks 50
		2 marks (5/8)=10	5marks (4/6)=20	10marks (2/4)=20	
Unit 1: Ethnobotany	6	2X2=4	5X1=5	10X1=10	**19**
Unit 2: methodology of Ethanobotanical studies	6	2X3=6	5X2=10	-	**16**
Unit 3: role of ethonobotany in modern medicine	10	2X2=4	5X1=5	10X2=20	**29**
Unit 4: Ethnobotany and legal aspects	8	2X1=2	5X2=10	10X1=10	**22**
Total	**30**	**8X2=16**	**5X6=30**	**10X4=40**	**86**

DMF23008/ DMF23007 **III B.Sc., VI Semester DSE-III**

Genetics and Plant Breeding

Theory (4 credits) **Lectures: 60 Hours**
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1	Specify the details of heredity
CO3	Write down the classification and characteristics of mutations
CO4	Learn the details of plant breeding
CO2	Identify in details with examples linkage

Unit 1- Heredity: **(24 Lectures)**

1. Brief life history of Mendel
2. Terminologies
3. Laws of Inheritance
4. Modified Mendelian Ratios: incomplete dominance; complementary factors; supplementary factors, Duplicate factors, Epistatis.
6. Pedigree Analysis
7. Cytoplasmic Inheritance: leaf variegation in *Mirabilis jalapa*, Male sterility.
8. Chromosome theory of Inheritance.
9. Quantitative inheritance-Concept, mechanism, examples. Monogenic vs polygenic Inheritance.

Unit 2- Sex-determination and Sex-linked Inheritance: **(6 Lectures)**

Sex – determination in *Melandrium album* by XX-XY method, Bridges Genic balance theory, Sex-linked Inheritance

Unit 3- Linkage and Crossing over: **(8 Lectures)**

Linkage: complete & incomplete linkage, coupling & repulsion, recombination frequency, linkage in Maize, two point test cross, linkage maps, Coincidence and interference. Crossing over: concept and significance.

Unit 4-Mutations and Chromosomal Aberrations: **(6 Lectures)**

Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

Unit 5- Plant breeding and Methods of crop improvement: (12 lectures)

Introduction, objectives and Methods: Plant introduction, selection, Hybridization- Emasculation and bagging. Mutation breeding, polyploidy breeding, genetic or molecular plant breeding. Methods of propagation– Procedure, advantages and limitations

Unit 6- Inbreeding depression and heterosis: (4 lectures)

Inbreeding depression and Heterosis; Applications. Germplasm maintenance, Pollen banks and Quarantine measures.

DMF23108/ DMF23107 **III B.Sc., VI Semester DSE-III**

Genetics and Plant Breeding

Practical (2 credits)

Lectures: 60 Hours
(4 hours/week)

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
2. Chromosome mapping using point test cross data.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging (For demonstration only).
8. Induction of polyploidy conditions in plants (For demonstration only).

Suggested Readings

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia.

2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.

3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings

4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning 6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.

7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.

8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

III B.Sc., VI Semester DSE-III

Genetics and Plant Breeding

Scheme of Practical Question Paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Perform the experiment 'A'. **6 marks**

(Emasculation and bagging)

Preparation -2 marks

Sketch and label - 2marks

Reasons - 2marks

II. Conduct experiment 'B'. **4 marks**

(Induction of polyploidy)

Principle -1 marks
Requirements -1 marks
Procedure -1 marks
Result and inference -1 marks

III. Problems on Chromosome mapping using point test cross data'C'. **4 marks**

IV. Comment on the given specimen 'D' **3 marks**

(Pedigree analysis)

Identification - 1mark

Reasons - 2marks

V. Problems on gene interaction 'E' **4 marks**

VI. Identify the given photographs 'F' & 'G' **2x2=4 marks**

(F- Aneuploidy & G- Translocation)

Identification - 1mark

Reasons - 1marks

VI. Practical record **5 marks**

VII. Viva-Voce **5 marks**

III B.Sc., VI Semester DSE-III
Genetics and Plant Breeding
Scheme of Theory Question Paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)40	
Unit 1:Heredity	24	2X3=6	5X1=5	10X3=30	**41**
Unit 2: Sex-determination and Sex-linked Inheritance	4	2X1=2	5X1=5	-	**7**
Unit 3: Linkage and Crossing over	8	2X1=2	-	10X1=10	**12**
Unit 4: Mutations and Chromosoma Aberrations	4	2X1=2	5X1=5	-	**7**
Unit 5: Plant Breeding	4	2X1=2	5X1=5	-	**07**
Unit 6: Methods of crop improvement	8	-	5X1=5	10X1=10	**15**
Unit 7: Inbreeding depression and heterosis	4	2X1=2	5X1=5	-	**02**
Unit 8: Crop improvement and breeding	4	-	-	10X1=10	**10**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

DMF23208/ DMF23207 III B.Sc., VI Semester DSE-IV

Analytical Techniques in Plant Science

Theory (4 credits) Lectures: 60 Hours

(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO2 Learn the details of Spectrophotometry

CO3 Write down the details of chromatography

CO1 Specify the details of cell fractioning

CO4 Identify in details with application, if applicable, biostatistics

Unit 1: Imaging and related techniques (15 Lectures)

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell fractionation (8 Lectures)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes (4 Lectures)

Use in biological research, auto-radiography, pulse chase experiment.

Unit 4: **Spectrophotometry (4 Lectures)**

Principle and its application in biological research.

Unit 5: Chromatography (8 Lectures)

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6: Characterization of proteins and nucleic acids (6 Lectures)

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit 7:Biostatistics (15 Lectures)

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

DMF23308/ DMF23307 **III B.Sc., VI Semester DSE-IV**

Analytical Techniques in Plant Science

Practicals (2 credits) **Lectures: 60 Hours (4 hours/week)**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition

III B.Sc., VI Semester DSE-IV
Genetics and Plant Breeding
Scheme of Theory Question Paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)40	
Unit 1: Imaging and related techniques	15	2X2=4	5X2=10	10X1=10	**24**
Unit 2: Cell fractionation	8	2X1=2	5X1=5	10X1=10	**17**
Unit 3: Radioisotopes	4	2X2=4	-	-	**4**
Unit 4: Spectrophotometry	4	2X1=2	-	10X1=10	**12**
Unit 5: Chromatography	8	-	5X1=5	10X1=10	**15**
Unit 6: Characterization of proteins and nucleic acids	6	2X1=2	5X1=5	-	**7**
Unit 7: Biostatistics	15	2X1=2	5X1=5	10X2=20	**27**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

Botany Pattern of theory question paper (CBCS)
DSC I-DSC IV
(I semester to IV)

Time: 3 Hours **Max. Marks: 70**

Instructions to the candidates:
Draw neat labelled diagrams where ever necessary.

I. Explain / define any FIVE of the following. **2x5=10**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write short notes on any FOUR of the following. **5x4=20**

9.
10.
11.
12.
13.
14.

III. Give comprehensive and detailed account of any FOUR of the following. **10x4=40**

15.
16.
17.
18.
19.
20.

***

Botany Pattern of theory question paper (CBCS)
DSE
(V semester to VI)

Time: 3 Hours **Max. Marks: 70**

Instructions to the candidates:
Draw neat labelled diagrams where ever necessary.

II. Explain / define any FIVE of the following. 2x5=10

1.
2.
3.
4.
5.
6.
7.
8.

II. Write short notes on any FOUR of the following. 5x4=20

9.
10.
11.
12.
13.
14.

III. Give comprehensive and detailed account of any FOUR of the following. 10x4=40

15.
16.
17.
18.
19.
20.

***

Botany Pattern of theory question paper (CBCS)
SEC
(V semester)

Time: 2 Hours **Max. Marks: 50**

Instructions to the candidates:
Draw neat labelled diagrams where ever necessary.

III. Explain / define any FIVE of the following. 2x5=10

1.
2.
3.
4.
5.
6.
7.
8.

II. Write short notes on any FOUR of the following. 5x4=20

9.
10.
11.
12.
13.
14.

III. Give comprehensive and detailed account of any TWO of the following. 10x2=20

15.
16.
17.
18.

***

Suggested Readings:

Author	Title of the Book	Publisher
VIRUSES AND BACTERIA		
R.C.Dubey and D.K. Maheshwari	A textbook of Microbiology	S. Chand & company, Ramnagar N.Delhi-110005.
P.D. Sharma	Microbiology	Rastogi Publications; Shivaji road Meerat; 250002; India
P. D. Sharma	Microbiology and Plant pathology	Rastogi Publications; Shivaji road Meerat; 250002; India
H. C. Dube	Text book of fungi, Bacteria & Virus	Vani Educational books , Vikas house 20/4, Industrial area, Sahidabad, 201010, Ghaziabad, UP.
Power & Daginawala		Himalaya Publishing house, Bombay
Power & Daginawala	General Microbiology. Vol. I	Himalaya Publishing house, Bombay
	General Microbiology. Vol. II	
Pelzar Michael.J		
Prescott, Lansing and Others	Text Book of Microbiology Microbiology	Orient and Longman, New Delhi.
Ananthanarayana .R . Jayaram Panicker	Text Book of Microbiology	Tata Mc graw Hill
a) salle. A. J.	Functional Principles of Bacteriology	Himalaya Publishing house, Bombay
Vinita Kale and Kishore Bhusari	Applied Microbiology.	ELBS Publisher , New Delhi
Frazier William. C.	Food Microbiology	Prentice Hall of India N.Delhi
Cruckishank	Text book of Medical	Vardaman Publishers ,
Rangaswamy.G.	Microbiology	Bangalore. Vol. III & Vol. IV.
Sundar Rajan	Diseases of crop plants in India. College Microbiology	Tata McGraw Hill Publishing company.
William. C. Frazier and Dennis C. West hoff. 3^{rd} Edn	Food Microbiology	R. Chand & company, Publishers, N.Delhi.
ALGAE		Pradeep Pub., Jalandhar.
K.N. Bhatia	A Treatise on Algae	Mc graw Hill , New york. Thomas, Nelson and Sons
Chopra. G.L	A Text book of Algae	Rastogi Publications
G. M. Smith	Cryptogamic Botany Vol. I	
Prescott, G.W	The Algae to Review	Cambridge University Press
Kumar, M.A and Kashyap.	Recent advances in physiology	

A.K.		Mac Milan, Publishing New
Fritsch. F. E.	Structure and Reproduction of	York.
	Algae Vol. I & Vol. II	Rastogi Publications; Shivaji
ChapmanV.J&Chapman	The Algae 2nd Edn.	road Meerat; 250002; India
D.J.	A text book of Botany	S. Chand & company, Ltd.
Singh, Pande , Jain.		Ramnagar N.Delhi-110005.
	Simplified course in Botany	Black well Publishers.
B. P. Pandey		
	Algal Biology	Mc Grawhill, New york.
Darley. M. W.		Wiley Eastern Ltd. New Delhi.
FUNGI	Cryptogamic Botany Vol. I	
Smith. G. M.	Introduction to Mycology	Pradeep publications, Jalandar
Allexopolos. C. J. and		Mac Milan & Co Calcutta
Mims. C. W.	Text book of Fungi	Prentice Hall of India New Delhi.
Chopra G. L. and Verma. V	Fungi & Plant diseases	Rastogi Publications
Mundkur, B. B.	Diseases of India 3rd Edition	S. Chand and Company, New
Rangaswamy, G.	The fungi	Delhi.
Sharma. P. D.	Fungi	
Vashista, R.R		S. Chand and Company, New
		Delhi.
BRYOPHYTA	Bryophyta	S. Chand and Company, New
Pandey. B.P.		Delhi.
	Bryophyta	Central book depot, Allahabad.
Vashista. B. P.		Mc Grawhill, New York
	Bryophyta	Pradeep Publications, Jalandar.
Parihar. N.S.	Cryptogamic Botany vol. I	
G. M. Smith	Class Book and Pteridophytes	
G. L. Chopra		
	Bryophytes and Pteridophytes	
Chauhan D.K.S		MC Graw Hill, New York.
ANATOMY	Introduction to Plant Anatomy	Wiley Eastern, New Delhi.
Eames A.J. and Mac		S. Chand and Company.
Daniels, L. H	Anatomy of seed plants	Rastogi publications, Meerat.
Katherien Esau	Introduction to Plant Anatomy	
Pandey. B. P	Anatomy of seed plants	Rastogi publications, Meerat.
Singh. V., Pandey, P.C and		
Jain, D.K.	Plant anatomy	
Tayal M. S.	College Botany Vol. I	
Ganguli Das L Datta	Cytology and Anatomy	
Venkateshvaralu		
EMBRYOLOGY OF		Vikas publishing HOUSE, New
ANGIOSPERMS &		Delhi.
TAXANOMY	The Embryology of Angiosperms	Rastogi publications, Shivaji
Bhojwani. S. S. &		Road, Meerat, 250002.
Bhatnagar, S. P.	The Embryology of Angiosperms	MC Graw Hill publishing

Singh, Pandey, Jain		Company, New Delhi.
	The Embryology of Angiosperms	Ind. Sci. Acad. Bull. No.41, New
Maheshwari , P		Delhi.
	Comparative Embryology of	MC Graw Hill, New York.
Johri, B.M.	Angiosperms	Narosa publishing House New
	Morphology of Angiosperms	Delhi.
Eames A. J.	Plant cell and Tissue culture.	
Reinert . J and Yeoman		
M.M	Plant Anatomy	
	Taxonomy of Vascular plants	
Vashishta	A Text book of systematic	
George H.M. Lawarance.	Botany	Harper C Row, New York.
R.N. sutaria	Botany for Degree Students.	
A. C. Dutta		Mc Graw Hill, New York.
PTERIDOPHYTA	Morphology of plants and Fungi	
Bold , H.C., Alexopoulos,		Central book depot. Allahabad.
C.J	Morphology of vascular plants	
& Delevoryas, T.	(lower groups).	
Eames, Arthur, J.	The Biology and Morphology of	Vikas publishing House, New
	Pteridophytes.	Delhi.
Parihar, N.S. 1977		Vani educational books, New
	Text book of Botany, Vol. II	Delhi.
	An introduction to Pteridophyta.	Hutchinson university library,
Pandey, S.N.& Others	The Morphology of Pteridophytes	London.
Rashid,A.1986		S. Chand and Co., New Delhi.
Sporne,K.R.1970	Pteridophyta	
		Asia publishing house, New
Vashista,P.C. 1987	An Introduction to	Delhi.
GYMNOSPERMS	Gymnosperms.	K. Nath and Co.
Datta, S.C.	Gymnosperms.	Prasaranga, University of
Pandey, B.P.	Anavrutha beeja sasyagalu	Mysore, Mysore.
Ramaswamy, S.N. 1984	(Gymnosperms)	Ratna Prakashana Mandir, Agra
	Text book of Botany Vol. II.	Hutchinson university library,
Saxena and Sarabhai 1993	The Morphology of	London.
Sporne, K.R.1969	Gymnosperms.	Shashidhar Malaviya Prakashan.
		S.Chand & Co. New Delhi.
Trivedi, B.S.& Singh, D.K	An Introduction to	Wiley, New York.
Vashista, B.R.	Gymnosperms.	Narosa, New Delhi.
Andrews, H.N. 1961	Gymnosperms.	
Biswas, C. & Johri, B.M.	Studies in palaeobotany.	
1997	The Gymnosperms.	Wiley-Estern, New Delhi.
PLANT PHYSIOLOGY		
Conn, E.E. and		Centar book Depot, Allahabad.
Stumpf,P.K.1976	Out line of Biochemistry	Affiliated East West, New Delhi.
Datta, S.C.		Affiliated East West, New Delhi.
Delvin, R.M. 1969	Plant physiology	

Delvin, R.M. & Barker,	Plant physiology	S.Chand & Co. New Delhi.
A.V. 1971	Photosynthesis	East West Press Pvt. Ltd. New
Jain, V.K. 1990		Delhi.
Kumar, H.D. & Singh, H.N	Fundamentals of Plant physiology	Atma Ram & Sons, New Delhi.
1975, 1993	Plant Metabolism I Edn. & II	
Krishnamurthy, H.N.	Edn.	
		Prentice Hall of India Pvt. Ltd.
Lehninger, A.L. 1978	Physiology of plant Growth and	
Noggle, G.R. and Fritz	Development.	S.Vishwanatha, Pvt. Ltd.
George, J. 1977.	Biochemistry	
Rao, K.N. Sudhakar Rao	Introductory Plant physiology	Wiley Eastern, New Delhi.
and Bharatan, S. 1987		
Rabinowitch, E. &	The function of plant.	First Indian Edn. CBZ Publishers
Govindjee. 1970		and Distributers, New Delhi.
Salisbury, E.E. & ross,	Photosynthesis	
C.W. 1986		
	Plant physiology	
ECOLOGY &		
ENVIRONMENTAL		Ann Arbor Science, Michigan.
BIOLOGY		
Aarne Vesilid, P & Jeffrey		McGraw Hill.
Pierce, J. 1983		John Wiley and Sons, New York.
BentonAllen.H &	Environmental Pollution and	Tata-McGraw Hill publishing Co.
Warner,WE	Control	New Delhi.
Colinvaux paul, A. 1973		S.Chand & Co, New Delhi.
Dash,M.C.	Field Biology an Ecology	
	Introduction to Ecology	Prentice Hall of india New Delhi.
Dara, S.S. 1993	Fundamentals of Ecology	Ratna Prakashan mandir, Agra.
		Vishal Publications, Jalandar.
Kormondy Edward, J. 1986	A Text book of Environmental	
Kochhar, P.L. 1990	Chemistry and Pollution Control.	Vikas, New Delhi.
Kotpal, R.L. 7 Bali, N.P.	Concept of Ecology	Macmllan Education Ltd.
1987	Plant Ecology	London.
Kumar,H.D. 1990	Concept of Ecology	Longman Inc., newe York.
Lloyd, J.R.1980		Oxford and IBH, New Delhi.
Mason, C.E.1981	Concept of Ecology	Saunders, W.B. Philadelphia
Misra.K.C. 1989	Man and the ecosystem.	Wiley, New York.
Odum,E.P. 1971	Biology of fresh water Pollution	
Odum,E.P. 1983	Manual of plant Ecology	Divyajyoti prakashan Jodhpur.
	Fundamentals of Ecology	
Pratap Mowli, P & Venkata	Basic Ecology	Rastogi Publications, Meerut
Subbaya, N. 1989.		I Edn. Rastogi
Sharma, P.D.	Air Pollution and Control	Publications,Meerut.
Sharma, P.D.		Anmol Publications, New Delhi.
Trivedi, R.N. 1993	Ecology and Environment	
	Environmental Biology	Vishal Publications jalandhar.

Vashista, P.C. 1989	Text book of Environmental	S.Chand & Co., New Delhi.
Verma, P.S. and Agarwal,	Sciences	
V.K. 1992	Plant Ecology	Macmillan, new York.
Whittaker, R.H. 1975	Principles of Ecology	
	Communities and Ecosystems	
CYTOLOGY,GENETIC	II Edn.	Wiley Eastern Ltd.
S AND ELOLUTION		
Ahluwalia Kavita, B. 1985.		Addiison Wesley Longman,
Booker, R.J 1999	Genetics	California.
	Genetics-Analysis and Principles	Oxford and IBH, New Delhi
Archana Sharma, 1990		Benjamin Cummings.
Ayala, F.J. and Klug, Jr.	The Chromosomes	
1984	Modern Genetics II Edn.	Tata mcGrawHill, New Delhi
Cherayil,J.D 1974		W.B.Saunders and Co.
De Robertis, E.D.P. Solez,	Gene and Genetics	Philadelphi
F.A & Nowinski,	Cell Biology	
W.W.1966		Surjeet publications, New Delhi
Dobzhansky, T., Ayala, J.,	Evolution	
Stebbins		Oxford and IBH publishing Co.,
Dobzhansky, T. 1951	Genetics and Origin of species	New Delhi
		Harper and Row publishers,
Dowben Robert, M 1971	Cell biology	John Wiley and Sons,
Gardner, E.J	Principles of Genetics	
&Snustad,D.P. 1984&1990		Rastogi publications,meerut.
Gupta, P.K 1987	Genetics	Prentice Hall of India.
Hexter, W and Yost Henry,	The Science of Genetics	New York.
T. 1977		Macmillan, India, New Delhi
Jha, A.P. 1993.	Genes and Evolution	George allen & Unwin, London.
Huxley, j. 1974	Evolution	
		15^{th} Edn. Rattan prakashan
Kochhar, P.L.1994	Genetics and Evolution	Mandir, Agar.
		Amerind Publishing co. New
Loewy ariel,g. & Philip	Cell structure and function	Delhi
Siekevitz. 1974		Holt, Rinehart and Winston, New
Marril David, j. 1962	Evolution and Genetics	York.
Nair, P.G.K. Prabhakar	A Text book of Genetics	Konark Publishers pvt.Ltd. A.
Achar, K.	& Evolution	149, Main Vikar Marg, New
Fair banks, D.J. and	Genetics – the community of life	Delhi
Anderson, W.R. 1999		Brooks-Cole, California.
Pawar, C.B.1983	Essentials of Cytology	
		Himalayan publishing house,
Savage, J.M. 1969	Evolution	Bombay.
Stansfields, W.D.1977	The Science of Evolution	Oxford and IBH, New Delhi
		Calif polytechnic state university
Sinnot, E.W., Dunn, L.C.,	Principles of Genetics	and Macmillan, New York.

& Dobzhansky, T 1958		McGraw Hill, New York
Snustad, D.P., Simmons,	Principles of Genetics	
M.J. & Jenkins, J.R. 1997		John Wiley, New York.
Swanson Carl, P. 1963	Cytology and Cytogenetics	
Swanson Carl, P &	The Cell	Macmillan & Co,. Ltd. London.
Webster Peter, L.		Prentice Hall of India Pvt. Ltd,.
Strickberger Monroe, W.	Genetics	New Delhi
1968		Macmillan Company, New York.
Strichberger Monroe, W.	Evolution	
1996		John & Bartlett Sandburry.
Winchester, A.M. 1966	Genetics	
PLANT BREEDING,		Oxford & IBH, New Delhi
ECONOMIC BOTANY		
AND TAXONONY		
Allard, R.W. 1960	Principles of Plant Breeding	
Bailey,L.H. 1966	Manual of cultivated plants	John Wiley, New York
Chandrasekharn, S.N.,	Cytogenetics and Plant Breeding	Macmillan & Co., New York.
Parthasarathy,S.V.1973		Varadachary and Co., Madras.
Chaudhari, H.K. 1980	Elementary principles of Plant	
	Breeding	Oxford and IBH publishing Co.,
Hartman, h.T. & Kester,	Plant Breeding	New Delhi.
D.E. 1976		Principles and practices, Prentice
Hill, Albert, F. 1983	Economic Botany	Hall of India Pvt. Ltd., New
Jain S.C.	Medicinal plants	Delhi.
Hutchison, J. 1973	The families of Flowering plants	.Tata-McGraw Hill publishing
Lawrence, George, H.M.	Taxanomy of Vascular plants	Co. New Delhi.
1964.		Oxford University Press, London.
Naik, V.N. 1984	Taxonomy of Angiosperms	Oxford and IBH publishing Co.,
		New Delhi
Johri, B.M.&	Taxonomy of Angiosperms	Tata-McGraw Hill publishing Co.
Bhatnagar,S.P.		New Delhi.
	Taxonomy of Angiosperms	Narosa publishing House New
Pullaiah, T.1998	Vascular Plant Systematics	Delhi.
Radford,A.E.,		Regency Publications, New
Dickison,W.C., Massey, Jr	Breeding Asian Field Crops	Delhi.
& Bell, C.R 1974		Harper & Row, New York.
Poehlman, J.M. &	Flora of Shimoga District	
Dhirendranath, B.		Oxford and IBH publishing Co.,
Ramaswamy, S.N.,		New Delhi
Radhakrishna Rao,M &	Flora of Bangalore District.	Prasaranga, University of
Govindappa.D.A.2001		Mysore, Mysore.
Ramaswamy, S.V.& Razi,	Classification of Flowering	
B.A. 1973	Monocotyledons Vol.I. (Indian	Prasaranga, University of
Rendle, A.B. 1979	Reprint Edition)	Mysore, Mysore.
	Classification of Flowering	Vikas Publishing house, New
	plants-Dicotyledons Vol. II.	Delhi.

Rendle, A.B. 1979	(Indian Reprint Edition)	
	Atext book of Economic Botany.	
		Vikas Publishing house, New
Samba Murthy,A.V.S.S.&		Delhi.
Subramanyam. N.S. 1973	Flora of Karanataka, Vol. I &	
	Vol.II	
Saldhana, Cecil, J. 1984		Tata-McGraw Hill publishing Co.
	Flora of Hassan district	New Delhi.
Saldhana, Cecil, J.,	(Karnataka, India)	
&Nicolson Dan, H. 1976	Text book of Botany, Vol. III.	Oxford and IBH publishing Co.,
Saxena and Sarabhai. 1993	Plant Taxonomy	New Delhi
O.P. Sharma		Amerind Publishing Co. Pvt.Ltd.,
	Flora of India series 2: Flora of	New Delhi.
Sharma, B.D., Singh, N.P.,	Karnataka.	Ratan Prakashan Mandir.Agra.
Raghavan, R.S. & Miss.		Tata-McGraw Hill publishing Co.
Deshpande,U.R. 1984	Taxonomy of Angiosperms	Ltd.4/12, Asif ali road, New
Singh, V.	Introduction toPrinciples of plant	Delhi.
Sivarajan, V.V. 1984	taxonomy	Botanical Survey of India &
	Dictionary of Economic plants in	Dept. of Environment, New
Umarao Singh,, Wadhwani,	India	Delhi.
A.M. & Johri, B.M. 1983	Taxonomy of Angiosperms	
Vashishta, P.C. 1976		Rastogi Publications.
GENERAL	A Text book of Practical Botany	Kalyani Publications,New Delhi.
Ashok Bendre and Ashok	Vol.I & II	ICAR,New Delhi.
Kumar	Practical Botany Vol.I & II	R.Chand & Co., New Delhi
Dr. H.M. Srivastava		Rastogi Publications, Shivaji
	College Botany Vol. I, II, III &IV	road, Meerut.
Sundararajan, S.	Medicinal Plants Vol. 1- 5	Pradeep publications opp. Sitta
Kottakkal Arya Vaidya		Mandhir, Jalandhar.
sala"s	Global Biodiversity Assesment	Subha's Publications, Bangalore.
BOOKS ON		Cambridge University press,
BIODIVERSITY	Biodiversity and Ecosystem	U.K.
Heywood, H & Watson,	functions	Springer-verlag, Berlin.
R.J. 1995	Biodiversity and Ecosystem	
Schulze,E.D.& Mooney, H	function, Scope.	John wiley, Chichester.
(eds.) 1992	Biodiversity: Implications for	
Mooney, H.A.et.al. (eds).	global food security	Macmillan India Ltd. Madras.
1996	Endemic plants of the Indian	BSI Calcutta
Swamynathan, M.S. &	region Vol. I.	
Jana, S. 1992	Threatened Plants of India- A	BSI Calcutta
Ahmedullh, M. &	State-of-the-Art report	
Nayar,M.P.1987	Indian plant red data book Vol.I	BSI Calcutta
Jain, S.K.& Sastry,A.R.K		
1980	Biodiversity Database projects in	Indira Ghandi Conservation
Puri, S.K.	India.	Monitory Centre, New Delhi.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(AUTONOMOUS)

Ooty road, Mysuru - 570025.

DEPARTMENT OF BOTANY

Schematic Syllabus under Choice Based Credit System (CBCS) & Continuous Assessment Grading Pattern (CAGP) as per UGC template

w.e.f.

2019-2020

TABLE OF CONTENTS

DEPARTMENT OF BOTANY
PROFORMA OF INSTRUCTIONS AND EXAMINATION FOR B.Sc. PROGRAMME IN BOTANY (CBCS)
DURATION OF THE COURSE: 3YEARS (6SEMESTER)
PROGRAMME: BSc BBM/CBZ, PROGRAMME CODE: BSc07/08 (2019-20)

Year	Sem	Core course	Title of the paper	Course Code	Lecture + Practical's hours per week	No. of credits			Total credits	Total hours		Maximum Marks in exam/Assessment				
						L	T	P		Th	Pr		IA(Theory) C-1	IA(Theory) C-2	Total	
I B.Sc	I	DSC-I :Theory	Biodiversity of Microbes and Archegoniate	DMA23007/08	04	4: 0 : 0			06	60	60	70	15	15	100	3h
		DSC-I: Pract.	Biodiversity of Microbes and Archegoniate	DMA23107/08	04	0: 0: 2						35	7.5	7.5	50	3h
	II	DSC-II: Theory	Plant Ecology Morphology and Angiosperm Taxonomy	DMB23007/08	04	4: 0 : 0						70	15	15	100	3h
		DSC-II: Pract.	Plant Ecology Morphology and Angiosperm Taxonomy	DMB23107/08	04	0: 0: 2			06	60	60	35	7.5	7.5	50	3h
II B.Sc	III	DSC-III:Theory	Plant Anatomy and Embryology of Angiosperm	DMC23007/08	04	4: 0 : 0						70	15	15	100	3h
		DSC-III:Pract.	Plant Anatomy and Embryology of Angiosperm	DMC23107/07	04	0: 0: 2			06	60	60	35	7.5	7.5	50	3h
	IV	DSC-IV: Theory	Plant Physiology and Metabolism	DMD23007/08	04	4: 0 : 0						70	15	15	100	3h
		DSC-IV:Pract.	Plant Physiology and Metabolism	DMD23107/08	04	0: 0: 2			06	60	60	35	7.5	7.5	50	3h
III B.Sc.	V	DSEA: Theory	No. of courses:1 DSE- A: Cell and Molecular Biology	DME23007/08		4: 0 : 0										3h
		DSE:Practicals	Based on theory	DME23107/08												
		DSEB: Theory	DSE-B: Economic Botany and Biotechnology	DME23207/08	04	0: 0: 2			06	60	60	70	15	15	100	3h
		DSE:Practicals	Based on theory	DME23307/08												
		SEC	No. of courses:1 SEC-A : Ethnobotany	DME23407/08	02	2:0:0			02	30	-	35	7.5	7.5	50	2h
			SEC-B : Floriculture	DME23607/08												
	VI	DSEB: Theory	No. of courses:1 DSE-A: Genetics and Plant Breeding	DMF23007/08		4: 0 : 0										
		DSE:Practicals	Based on theory	DMF23107/08	04											3h
		DSEB: Theory	DSE -B : Analytical Techniques and Plant Sciences	DMF23207/08					06	60	60	70	15	15	100	
		DSE:Practicals	Based on theory	DMF23307/08		0: 0: 2										3h

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE (AUTONOMOUS)
OOTY ROAD, MYSURU-25

DEPARTMENT OF BOTANY

PROCEEDINGS OF THE MEETING OF BOARD OF STUDIES FOR THE PROGRAMMES B. Sc. IN BOTANY, BIOCHEMISTRY, MICROBIOLOGY (B.Sc. 07) AND CHEMISTRY, BOTANY, ZOOLOGY, (B.Sc. 08) HELD ON 14 JUNE 2019 AT 11.00 AM IN THE CHAMBER OF THE CHAIRMAN, DEPARTMENT OF BOTANY, JSS COLLEGE, OOTY ROAD, MYSURU-25

MEMBERS	SIGNATURE
Dr. S Prathibha Associate Professor, Dept. of Botany, JSS College, Ooty Road Mysuru Chairman	
Dr. Sowmya Associate Professor, Department of Botany Yuvaraja's college, Mysuru Member (VC Nominee)	
Dr. Syed Fasihuddin Associate professor of Botany Govt. Science College Bengaluru- 560001 Member (AC Nominee)	
Dr. V. N. Muralidhar Associate professor of Botany Govt. first grade College Sira- 572137 Tumkur District Member (AC Nominee)	

At the outset, the Chairman, BOS in Botany, welcomed the members to the meeting of BOS and briefed about the agenda to be discussed. The following agenda were placed by the Chairman which were discussed and resolved as follows:

Agenda 1: To frame/ revise, discuss and approve the Scheme/ Syllabus under Choice Based Credit System for the programmes: B.Sc. in Botany, Biochemistry, Microbiology and Chemistry, Botany, Zoology from the academic year 2019-20 onwards.

The Chairman appraised the members about the introduction of Choice Based Credit System to the above said programmes with the course matrix in 2017-18. Accordingly, a draft revised/ modified Scheme/ Syllabus was presented and placed before the Board for their opinion and approval.

Resolution: The BOS went through the Scheme/ Syllabus and discussed in length about various aspects of the same. After incorporation of the changes suggested by the members of BOS, the Syllabus was approved. Details of changes made with respect to the introduction of revised/ modified Scheme/ Syllabus in the existing courses is shown in Annexure-I.

Agenda 2: To prepare the Panel of Examiners for the examinations for the year 2019-20.

The Chairman presented the proposed Panel of Examiners to I to VI Semester examinations of 2019-20.

Resolution: After incorporating of certain changes suggested by the members, the Panel of Examiners was approved.

Agenda 3: Approval of Reference Books

The Chairman presented the proposed list of Reference Books to the Members.

Resolution: After incorporating of certain changes suggested by the members, the list of Reference Books was approved.

Agenda 4: Any other matter with the permission of the Chairman

---

The career oriented course Horticulture syllabi was thoroughly analysed and the contents were restructured according to the present day requirement. Question paper pattern, Maximum marks allotted and the hours per unit are also changed as per the BOS member’s corroboration to bring uniformity

Finally the meeting was concluded with the Chairman thanking the Members for their active participation in the deliberations of the meeting.

Chairman

Annexure-I:

Revision/ modification made in the existing Syllabus for 2019-2020 batch onwards:

Existing	Proposed	Justification	Approved
I B.Sc. I Sem DSC-I			
Biodiversity of Microbes and Archegoniate (CMA23007/08):	**Biodiversity of Microbes and Archegoniate (DMA23007/08):**		
Unit 1: Microbial diversity:			
A. **Virus**- replication	Deleted	Repetition	**Approved**
D. Fungi- *Puccinia*	Yeast	Yeast is most important from economic point of view	**Approved**
Unit 2: Archegoniate:			
A. Pteridophytes -*Marsilea*	Deleted	Better to study in higher level	**Approved**
Practicals: Gram's Staining of Bacteria	Deleted	Repetition in Microbiology	**Approved**
Study of *Marsilea*	Deleted	Better to study in higher level	
Study of *Puccinia*	Yeast	Yeast is most important from economic point of view	
I B.Sc. II Sem DSC-II			
Plant Ecology Morphology and Angiosperm Taxonomy	**Plant Ecology Morphology and Angiosperm Taxonomy**		

(CMB23007/08):	**(DMB23007/ 08):**		**Approved**
Unit-3: Taxonomy: **C. Angiosperm families:** Apiaceae	Arecaceae	To Represent Monocot family	
Practicals: Apiaceae	Solanaceae & Arecaceae	Routinely used vegetables belong Solanaceae family & to represent Monocot family	**Approved**
II B.Sc. III Sem-DSC III			
Plant Anatomy Embryology (CMC23007/08):	**Plant Anatomy and Embryology of Angiosperm (DMC23007/ 08):**		**Approved**
Unit 3: Adaptive and protective systems	Brief Account of Epidermis, cuticle, Stomata & Trichome. Added	Blown up syllabi	
Practicals:	Content Restructured	Appropriate	
Unit 4: Embryology	**Unit 4: Embryology of Angiosperms**		**Approved**
Structure of pollen grains	Types of Tetrad, Male gametophyte & Embryosac development- Monosporic,Bisporic,Tetrasporic added	For detailed embryological studies.	
Mechanism & Adaptation of Pollination	deleted	Studied previously in lower levels	
Practicals:	Content Restructured	Appropriate	
III B.Sc. V Sem-DSC IV			
Plant Physiology and Metabolism. (CMD23007/08):	**Plant Physiology and Metabolism**		

	(DMD23007/08):		
Unit 1: Plant-water relations: **Unit 2: Mineral nutrition** **Unit 3: Translocation in phloem** **Unit 4: Photosynthesis** **Unit 5: Respiration** **Unit 6: Enzymes** **Unit 7: Nitrogen metabolism** **Unit 8: Plant growth regulators** **Unit 9: Plant response to light and temperature**	**UNIT 1 Plant – Water Relations:** **1.Fundamental concepts,** **2.Short Distance Transport,** **3. Long distance Transport,** **4.Transpiration,** 5.**Mineral nutrition,** 6.**Translocation of solutes** **UNIT 2 – Enzymes:** **UNIT 3 – Bioenergetics:** **UNIT 4 -Nitrogen Metabolism:** **UNIT 5 - Plant Growth and Movements:**	Content Restructured	**Approved**
Practicals:	Content Restructured	Appropriate	**Approved**
III B.Sc. V Sem-DSE I			
DSE-1: Cell and Molecular Biology (CME23007/08):	**DSE-1: Cell and Molecular Biology (DME23007/08):**		
Unit 1-Techniques in Biology: Sample Preparation for light microscopy; Sample Preparation for electron microscopy; X-ray diffraction analysis.	**deleted**	Repetition in microbiology	**Approved**
Unit 2-Cell Membrane and Cell Wall : Carbohydrates in the membrane; Faces of the membranes;	**deleted**	Better to study in higher classes	**Approved**

Unit 7-Genetic material: DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative method	**Unit 7-Gene concept:** Semi-conservative method required	Appropriate	**Approved**
III B.Sc. V Sem SEC-I			
Floriculture	**Contents restructured**	Appropriate	**Approved**
III B.Sc. VI Sem DSE-II			
DSE-2: Genetics and Plant Breeding (CMF23007/08)	**DSE-2: Genetics and Plant Breeding (DMF23007/08)**		**Approved**
Unit 1- Heredity: lethal genes Pleiotropism, co- dominance 9:7; 9:4:3; 13:3; 12:3:1	**deleted**	Repetition in Zoology	
Practicals:	Complementary factors; supplementary factors, Duplicate factors, Epistatis	Proper terminologies have been used instead of ratios	**Approved**
	Genetic problems on Mendel's laws included	For better elucidation of theoretical concepts	**Approved**

Chairman

Programme Outcomes for BSc. in Chemistry, Botany, Zoology:

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Demonstrate the ability to justify and explain their thinking and/or approach, both written and oral. Demonstrate the ability to present clear, logical and succinct arguments, including prose and mathematical language. Write and speak using professional norms, and demonstrate an ability to collaborate effectively.

PO2. Develop state-of-the-art laboratory skills and professional communication skills.

PO3. Apply the scientific method to design, execute, and analyze an experiment and also to explain their scientific procedures as well as their experimental observations.

PO4. Appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

PO5. Explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

PO6. Identify the taxonomic position of plants using principles and methods of nomenclature and classification in Botany.

PO7. Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Use interdisciplinary approaches with quantitative skills to work on biological problems.

PO9. Identify the major groups of organisms with an emphasis on animals and be able to classify them within a phylogenetic framework.

PO10. Compare and contrast the characteristics of animals that differentiate them from other forms of life.

PO11. Give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of life.

Programme specific Outcomes for BSc. in Chemistry, Botany and Zoology

After completing the graduation in the Bachelor of Science the students are able to:

PS01: Communicate effectively the fundamentals and applications of chemical and Biological sciences

PS02: Possess deeper understanding of Natural laws, accuracy and validity of both theoretical and practical knowledge

PS03: Explicate ecological interconnectedness of life, by tracing energy and nutrient flows through the environment

PS04: Analyse the avenues and remedies for burning environmental issues

PS05: Pursue, enhance and appreciate conservation practices for sustainable use of plants and development

PS06: Interact with the social activities with ethical approach due to collaborative field visits, botanical tours and academic trips.

Programme Outcome for Bachelor of Science in Botany, Biochemistry & Microbiology

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Identify the taxonomic position of plants using principles and methods of nomenclature and classification in Botany

PO2. Understand the impact of the plant diversity in societal and environmental context

PO3.Demonstrate the knowledge of, and need for sustainable development

PO4. Use interdisciplinary approaches with quantitative skills to work on biological problems

PO5. Demonstrate the ability to justify and explain their thinking and/or approach

PO6. Develop state-of-the-art laboratory and professional communication skills

PO7. Apply the scientific method to design, execute, and analyze an experiment

PO8. Explain scientific procedures and their experimental observations

PO9.Demonstrate an understanding of fundamental biochemical principles, structure and function

PO10. Work as a laboratory technician, biochemists or medical scientist

PO11. Explain the processes used by microorganisms for the growth

PO12. Explain the theoretical basis of the tools, technologies and methods of microbiology

Programme Specific Outcome

Bachelor of Science in Botany, Biochemistry & Microbiology

After completing the graduation in the Bachelor of Science the students are able to;

PSO1: Demonstrate applications of biochemical and biological sciences

PSO2: Inculcating proficiency in all experimental techniques and methods of analysis

PSO3: Acquire, articulate, retain and demonstrate laboratory safety skills

PSO4: Communicate scientific information effectively, relating to microbes and their role in ecosystem and health

PSO5: Gain proper procedures and regulations in handling and disposal of chemicals

PSO6: Understand biochemical and molecular processes that occur in and between the cells

LIST OF APPROVED PANEL OF EXAMINERS:

Sl. No	Name	Designation and DOB	Joining Date
	Internal Examiners		
1.	Dr.Prathibha S Jss College, Ooty Road, Mysore	Asso. Prof. 28/04/1964	28/08/1986
2.	Kiran B L Jss College, Ooty Road, Mysore	Asst. Prof. 30/12/1992	23/09/2015
3.	Divya gouda Jss College, Ooty Road, Mysore	Asst. Prof.	
	External Examiners		
4.	Shivanna M Bharathi College, Bharathi Nagarar	Asso. Prof. 30/06/1958	19/11/1985
5.	Ravikumar B S AVK College For Women, Hassan	Asso. Prof. 13/07/1962	16/07/1987
6.	Nagarathnamma Govt College For Women, Mandya	Asso. Prof. 01/06/1959	10/08/1992
7.	Mallikarjunamiah M N Govt. first grade boys college, Mandya.	Asso. Prof. 05/11/1963	14/08/1992
8.	Hemavathi C Maharani`s Science College For Women, Mysore	Asso. Prof. 05/04/1966	17/08/1992
9.	Vijay C R Maharani`s Science College For Women, Mysore	Asso. Prof. 01/10/1962	29/12/1992
10.	Shivalingaiah Maharani`s Science College for Women, Mysore	Asst. Prof. 01/06/1968	08/01/1996
11.	Purushotham S P Maharani`s Science College for Women, Mysore	Asst. Prof. 15/05/1967	02/08/1996
12.	Lingaraju D P AVK College for Women, Hassan	Asst. Prof. 26/02/1965	23/10/2002
13.	Basavaraju G L Govt College for Women, Mandya	Asst. Prof. 21/07/1976	30/01/2004
14.	Devika M Saradavilas College, Mysore	Asst. Prof. 14/03/1970	14/12/2005
15.	Suresh N S Maharani`s Science College for Women, Mysore	Asst. Prof. 25/02/1975	02/05/2006
16.	Jayalakshmi B Maharani`s Science College for Women, Mysore	Asst. Prof. 18/11/1974	14/07/2006
17.	Sowmya H K Govt Science College,Hassan	Asst. Prof. 18/06/1970	22/12/2007
18.	Thoyajaksha Govt Science College, Hassan	Asst. Prof. 20/07/1970	24/12/2007
19.	Sandhya Rani D Maharani`s Science College for Women, Mysore	Asst. Prof. 24/08/1972	24/12/2007
20.	Pushpalatha H G Maharani`s Science College for Women, Mysore	Asst. Prof. 23/12/1979	26/12/2007
21.	Ashok N Pyati Maharani`s Science College for Women, Mysore	Asst. Prof. 22/04/1970	28/12/2007
22.	Indushree PES College, Mandya	Asst. Prof.	
23.	Lalitha V Maharani`s Science College for Women, Mysore	Asst. Prof.	

24.	Gayathrri Devi N Jss College for women Chamarajanagar	Asst. Prof.	
25.	Revanamaba B Maharani`s Science College for Women, Mysore	Asst. Prof.	
26.	Dr.M.K. Mahesh Yuvarajas college, Mysore.	Asso. Prof.	
27.	Shravani, K.A Yuvarajas college, Mysore.	Asst. Prof.	
28.	Dr.krishna Yuvarajas college, Mysore.	Asst. Prof.	
29.	Dr.krishnamurthy Yuvarajas college, Mysore.	Asst. Prof.	
30.	Kalpashree Yuvarajas college, Mysore	Asst. Prof.	
31.	Dr. Sowmya, R Yuvarajas college, Mysore	Asst. Prof.	
32.	Deepa hebbar Maharani`s Science College for Women, Mysore	Asst. Prof.	

DMA23008/DMA23007

I B.Sc., I Semester DSC-I

Biodiversity of Microbes and Archegoniate

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand the characteristics of viruses

CO2 Learn the classification and characteristics of bacteria

CO3 Identify the classification and characteristics of archegoniate

CO4 Identify the characteristics of algae

CO5 Understand the classification and characteristics of fungi.

Unit 1- Microbial diversity:

A. Virus **(4 Lectures)**

General structure, DNA virus (T_4-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance.

B. Bacteria **(5 Lectures)**

Definition, Classification (Based on Shape, Arrangement and flagellation) and Economic importance; ultra structure, Reproduction – vegetative (fission, Budding) asexual (Endospore) Sexual (Genetic recombination-Conjugation, Transformation and Transduction).

C. Algae **(14 Lectures)**

General characteristics; Classification, Reproduction and Economic importance of algae.
Type study- *Nostoc, Spirogyra, Sargassum.*

D. Fungi **(16 Lectures)**

1. General characteristics, classification , nutrition , reproduction and economic importance.
Type Study - *Rhizopus, saaccharomyces* (Yeast)*, Penicillium,*
2. Lichens: Distribution, classification and Economic importance, structure and reproduction.

Unit 2- Archegoniate:

A. Bryophytes **(7 Lectures)**

General characteristics, Classification and Economic importance . Type Study- *Marchantia* and *Polytrichum*

B. Pteridophytes **(7 Lectures)**

General characteristics and classification, Stelar evolution. Type Study - *Selaginella* and *Equisetum*.

C. Gymnosperms **(7 Lectures)**

General characteristics, classification and Economic importance. Type Study- *Cycas* and *Pinus.*

DMA2318/ DMA2317

I B.Sc., I Semester DSC-I

Biodiversity of Microbes and Archegoniate

Practical (Credits: 2)

Lectures: 60 Hours

(4 hours/week)

1. Study of TMV and of T_4- Phage through Microphotographs
2. Study of Bacteria.
3. Study of *Nostoc* (Specimen and permanent slides)
4. Study of *Spirogyra* (Specimen and permanent slides)
5. Study of *Sargassum* (Specimen and permanent slides)
6. Study of *Rhizopus*
7. Study of *Yeast*
8. Study of *Penicillium*
9. Study of Lichens
10. Study of *Marchantia*
11. Study of *Polytrichum*
12. Study of *Selaginella*
13. Study of *Equisetum*
14. Study of *Cycas*
15. Study of *Pinus*

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

I B.Sc., I Semester DSC-I
Scheme of theory question paper
Biodiversity of Microbes and Archegoniate

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit I :Microbial Diversity					
A&B.Virus and Bacteria	09	2X1=2	5X1=5	10X1=10	**17**
C. Algae	14	2X2=4	5X2=10	10X1=10	**24**
D. Fungi	16	2X1=2	5X3=15	10X1=10	**27**
Unit II: Archegoniate					
A. Bryophytes	07	2X1=2	-	10X1=10	**12**
B. Pteridophytes	07	2X1=2	-	10X1=10	**12**
C. Gymnosperms	07	2X2=4	-	10X1=10	**14**
Total	**60**	**8X2=16**	**4X6=30**	**6X6=60**	**106**

DMA23108/ DMA23107 **I B.Sc., I Semester DSC-I**

Biodiversity of Microbes and Archegoniate

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35(25+05+05)**

I. Identify the specimens 'A' and 'B' with reasons and labeled sketches
3x2=06 marks

(**A**-Algae and **B**-Microphotographs of virus/Bacteria/fungi)

Identification – 1 mark
Reasons with labelled sketch – 2 marks

II. Prepare a stained temporary slide of 'C'. Sketch, label and Identify with reasons. Leave the preparation for evaluation. **4x01=04 marks**

(C-*Nostoc/Rhizopus/Saccharomyces* (yeast) / *Penicillium*)

Identification – 1 marks
Preparation/staining and mounting– 2 marks
Reasons with labelled sketch – 1 marks

III. Write critical notes on 'D', 'E' and 'F' **3x3=09 marks**
(D-Algae/Fungi, E-Lichens/Bryophytes, F- Pteridophytes /Gymnosperms)

Identification _ 1 mark
Reasons with lablled sketch – 2 marks

IV. Identify the Microslides 'G', 'H', and 'I' with reasons and labeled Sketches **02x03=06 marks**

(G-Algae/Fungi, H-Lichens/Bryophytes, I- Pteridophytes /Gymnosperms)

Identification – 1 mark
Reasons with lablled sketch – 1 marks

V. Practical record **05marks**

VI. Viva- Voce **05marks**

Note: Each student should submit the **duly valued and certified practical record** at the time of practical examination.

***

DMA23108/ DMA23107 **I B.Sc., I Semester DSC-I**

Biodiversity of Microbes and Archegoniate

Practical Question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Identify the specimens ‘A’ and ‘B’ with reasons and labeled sketches 3x2=06 marks

II. Prepare a stained temporary slide of ‘C’. Sketch, label and Identify with Reasons leave the preparation for evaluation. 4x1=04 marks

III. Write critical notes on ‘D’, ‘E’ and ‘F’ 3x3=09 marks

IV. Identify the Microslides ‘G’, ‘H’ and ‘I’ and with reasons and labeled Sketches

2x3=06 marks

V. Practical record 05 marks

VI. Viva- Voce 05marks

***

I B.Sc., II Semester DSC-II

Plant Ecology, Morphology and Angiosperm Taxonomy

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Specify the characteristics of ecosystem

CO2 Learn the classification and characteristics of Plant communities

CO3 Understand in details with examples plant morphology

CO4 Understand in depth Herbarium

Unit 1- Plant Ecology:

A. Introduction to Ecology and Ecological factors: **(6 Lectures)**

Introduction to ecology, Climatic factors- Light, temperature and water. Edaphic factors- soil formation, types and profile. Shelford law of tolerance.

B. Ecosystem **(6 Lectures)**

Structure and components of an ecosystem, study of pond and forest ecosystem, energy flow and trophic levels; Food chains, food webs, Ecological pyramids. Biogeochemical cycles- Carbon, Nitrogen and Phosphorous.

C. Plant communities **(6 Lectures)**

Morphological Adaptations of hydrophytes and xerophytes. Plant Succession, Hydrosere and Xerosere.

Unit 2- Leaf and Floral Morphology: **(15 Lectures)**

A. Leaf- Structure, types and phyllotaxy.

B. Types of Inflorescence

C. Flower- structure of a typical flower (*Tribulus terrestris* / *Muntingia calabura*), Variation in floral morphology and floral organs in detail.

D. Types of Inflorescence

E. Types of fruits

Unit-3: Taxonomy:

A. Introduction to plant taxonomy **(8 Lectures)**

1. Taxonomic hierarchy
2. Types of classification (artificial, natural and phylogenetic)
3. Systems of classification- Bentham and Hooker, Engler and Prantl
4. Plant Nomenclature-Binomial system and ICBN principles.

B. Herbarium technique: **(5 Lectures)**

1. Herbarium- Techniques and importance
2. Botanical gardens

C. Angiosperm families: (14 Lectures)

Study of the following families according to Bentham and Hooker's system of classification.--Malvaceae, Leguminosae (Papilionaceae, Caesalpiniaceae and Mimosaceae), Apocynaceae Asteraceae and Arecaceae.

***

DMB23108/ DMB23107

I B.Sc., II Semester DSC-II

Plant Ecology, Morphology and Angiosperm Taxonomy

Practical (credits: 2) **Lectures: 60 Hours (4 hours/week)**

1. Study of Ecological instruments used to measure microclimatic variables: Soil thermometer, Maximum and Minimum Thermometer, Anemometer, Psychrometer/Hygrometer, Rain gauge.
2. Study of morphological adaptations of the following
   a. Hydrophytes Eg: ***Hydrilla. Pistia and Eichhornia***
   b. Xerophytes Eg: ***Opuntia, Euphorbia Tirucalli,Nerium and Casuarina***
3. Study of biotic interactions of the following:
   a.Stem parasite Eg: ***Cuscuta.***
   b.Root parasite Eg: ***Striga***.
   c.Epiphytes, Eg: ***Vanda***
   d. Predatary plants (Insectivorous plants) Eg: ***Nepenthes***.
4. Study of root modifications
5. Study of stem modifications
6. Study of leaf-structure, types, phyllotaxy and modifications.
7. Parts of a typical flower **(*Tribulus terrestris* / *Muntingia calabura*)**
8. Floral organs in detail with their variations.
9. Types of inflorescence
10. Types of fruits
11. Study of families Malvaceae, Apocynaceae
12. Study of families Leguminosae (Papilionaceae, Caesalpiniaceae and Mimosaceae)
13. Study of families and Asteraceae
14. Study of Solanaceae and Arecaceae
15. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label

Suggested Readings:

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi.

DMB23008/ DMB23007

I B.Sc., II Semester DSC-II

Plant Ecology, Morphology and Angiosperm Taxonomy

Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Units	**Hours Allotted**	**No. of questions from each category**			**Total Marks 70**
		2 marks (5/8)=10	**5marks (4/6)=20**	**10marks (4/6)=40**	
Unit 1: A. Plant Ecology	06	-	-	10x1=10	**10**
B. Ecosystem	06	-	5x2=10	-	**10**
C. Plant communities	06	2x1=2	-	10x1=10	**12**
Unit II: Leaf and Floral Morphology, Fruits	15	2x3=6	5x2=10	10x1=10	**26**
Unit III: Taxonomy A. Introduction to plant taxonomy	08	2x2=4	-	10x1=10	**14**
B. Herbarium technique	05	2x1=2	5x1=5	-	**07**
C.Angiosperm families	14	2x1=2	5x1=5	10x2=20	**27**
Total	**60**	**8x2=16**	**5x6=30**	**10x6=60**	**106**

DMB23108/ DMB23107

I B.Sc., II Semester DSC-II
Plant Ecology, Morphology and Angiosperm Taxonomy
Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled Sketches. **3x3=9 marks**

(A-Ecological instruments, B-Hydrophytes/xerophytes/parasites/epiphytes,
C-Underground root & stem modifications/Leaf phyllotaxy /leaf types/)

Identification – 1 mark
Labeled sketch with reasons – 2 marks

II. Assign the plant 'D' to its respective family giving reasons. **4x1=4 marks**

(D- Malvaceae/Apocynaceae/Asteraceae/Arecaceae
Family name – 1 mark
Salient features – 3 marks

III. Describe the plant 'E' in technical terms. **4x1=4 marks**

(Papilionaceae /Caesalpiniaceae)
Family name – 1 mark
Technical terms – 3 marks

IV. Draw the floral diagram and write the floral formula of the give plant 'F' **4x1=4 marks**

(Malvaceae, Solanaceae, Apocynaceae)
Floral formula -1mark
Floral diagram -3marks

V. Identify the specimen 'G' and 'H' **2x2=4marks**

(J-Inflorescence, H- Fruits)
Identification – 1 mark
Reasons – 1mark

VI. Practical **05marks**

VII. Viva- Voce **05marks**

Note: each student should submit the **duly valued and certified practical record** at the time of practical examination.

***

I B.Sc., II Semester DSC-II
Plant Ecology, Morphology and Angiosperm Taxonomy
Practical Question Paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled Sketches **3x3=9 marks**

II. Assign the plants 'D' to its respective family giving reasons. **4x1=4marks**

III. Describe the plant 'E' in technical terms. **4x1=4 marks**

IV. Draw the floral diagram and write the floral formula of the give plant 'F' **4x1=4marks**

V. Identify the specimen 'G' and 'H' **2x2=4marks**

VII. Practical record **05marks**

VIII. Viva-Voce **05marks**

***

DMC23008/DMC23007 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Theory (Credits: 4)

Lectures: 60 Hours
(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand the details of histology
CO2 Understand the details of anatomy
CO3 Understand the characteristics of secondary growth
CO4 Learn the details of embryology

Unit 1: Histology and Anatomy (18 Lectures)

Meristem- structure, classification, based on origin, position and function. Study of Simple and complex tissues.
Internal Structure of dicot and monocot root,stem and leaf.

Unit 2: Secondary Growth (4 Lectures)

Process of secondary growth in dicot stem.

Unit 3: Adaptive and protective systems (7 Lectures)

Anatomical adaptations in xerophytes (Nerium & Causarina) and Hydrophytes (Hydrilla & Eichhornia). Epidermis, cuticle, Stomata & Trichome. (Brief Account)

Unit 4: Embryology of Angiosperms (8 Lectures)

T.S of mature anther, Microsporogenesis, types of tetrads and Male gametophyte, Megasporogenesis- types of ovules, L.S of Anatropous ovule, Embryosac development-Monosporic (Polygonum), Bisporic (Allium), Tetrasporic (Frittilaria) structure of Mature Embryo sac.

Unit 5: Pollination and fertilization (11 Lectures)

Definition, types, contrivances for self and cross pollinations
Process of Double Fertilization, Post Fertilization changes

Unit 6: Embryo and endosperm (6 Lectures)

Structure and development of Dicot (Capsella) and Monocot embryo (Maize). Endosperm-nucellar, cellular, helobial and ruminate.

Unit 7: Experimental Embryology (6 Lectures)

Brief account of apomixis (recurrent and non-recurrent), apospory, polyembryony, parthenocarpy.

DMC23108/DMC23107 **II B.Sc., III Semester DSC-III**

Plant Anatomy and Embryology of Angiosperms

Practical (Credits: 2)

Lectures: 60 Hours
(4 hours/week)

1. Study of Meristems through permanent slides and photographs- apical, intercalary and lateral meristems.
2. Study of simple Tissues (parenchyma, collenchyma and sclerenchyma) through Permanent slides and photographs.
3. Study of complex Tissue (xylem and phloem) through Permanent slides and photographs.
4. Study of Anatomical characteristics of Root: Monocot- *Zea mays* and Dicot-*Helianthus*.
5. Study of Anatomical characteristics of Stem: Monocot- *Zea mays*; Dicot-*Helianthus*.
6. Study of Anatomical characteristics of Monocot and Dicot Leaf.
7. Adaptive anatomy: Xerophyte (*Nerium* & *Causaurina*); Hydrophyte (*Hydrilla* & *Eichhornia)*.
8. Structure of anther (young and mature) and mounting of Pollen grains.
9. Calculation of percentage of germinated pollen in a given medium (Hanging drop method).
10. Types of ovules: Anatropous, Orthotropous, Circinotropous, Amphitropous/ Campylotropous.
11. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development.
12. Pollination types and seed dispersal mechanisms. (Photographs and specimens).
13. Dissection/ mounting of embryo/endosperm from seeds.

***

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

***

DMC23008/DMC23007 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Histology and Anatomy	18	2X1=2	5X2=10	10X2=20	**32**
Unit 2: Secondary Growth	04	2X1=2	5X1=5	-	**07**
Unit 3: Adaptive and protective systems	07	2X1=2	5X2=10	-	**12**
Unit 4: Embryology	08	2X1=2	-	10X1=10	**12**
Unit 5: Pollination andfertilization	11	2X1=2	-	10X2=20	**22**
Unit 6: Embryo and endosperm	06	2X1=2	-	10X1=10	**12**
Unit 7: Experimental Embryology	06	2X2=4	5X1=5	-	**09**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

DMC23108/DMC23107 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Scheme of practical question paper

Time: 4 Hours Max. Marks: 35 (25+05+05)

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled sketches 2x3=6 marks

(A-Meristem- Apical, intercalary and lateral, B-Simple tissues, C-Complex tissues)

Identification – 1 mark
Labeled sketch with reasons – 1marks

II. Prepare a stained temporary slide of 'D. Sketch, label and identify with reasons Leave the preparation for evaluation 5x1=5 marks

(D-Dicot stem/ Monocot stem Anatomy)

Identification – 1 mark
Mounting and Preparation -2 marks
Labeled sketch with reasons – 2 marks

III. Identify the microslides/ photographs 'E' 'F' & 'G' sketch, label with reasons 3x3=09 marks

(E-root/ leaf, F-Xerophytes/ Hydrophytes, G-T.S of anther/ types of ovule

Identification – 1 mark
Labeled sketch with reasons – 2marks

IV. 'H'- Dissect Embryo/Endosperm, sketch label with reasons/ Mounting of Pollen grains / calculate the percentage of germinated pollen

5x1=5 marks

Identification – 1 mark
Labeled sketch with reasons – 4marks

V. Practical record 05 marks

VI. Viva-Voce 05 marks

Note: Each student should submit the **duly valued and certified practical record** at the time of practical examination.

***

DMC23108/DMC23107 II B.Sc., III Semester DSC-III

Plant Anatomy and Embryology of Angiosperms

Practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Write critical notes on 'A' 'B' and 'C' with reasons and labeled sketches 2x3=6 marks

II. Prepare a stained temporary slide of 'D. Sketch, label and identify with reasons.
Leave the preparation for evaluation 05marks

III. Identify the microslides/ photographs 'E' 'F'& 'G', sketch, label with reasons
3x3=9 marks

IV. 'H'- Dissect Embryo/Endosperm, sketch label with reasons/ Mounting of Pollen grains / calculate the percentage of germinated pollen.

V. Practical record 5 marks

VI. Viva-Voce 5 marks

***

DMD23008/DMD23007 **II B.Sc., IV Semester DSC-IV**

Plant Physiology and Metabolism

Theory (Credits: 4)

Lectures: 60 Hours

(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Learn in depth translocation in phloem

CO2 Specify the classification and characteristics of enzyme

CO3 Understand the details of photosynthesis

CO4 Identify the characteristics of plant response to light and temperature

UNIT 1 - Plant – Water Relations: **(20 Lectures)**

1. **Fundamental concepts:** Importance of water to plants, Diffusion, Imbibition, Osmosis, Endosmosis and Exosmosis, Plasmolysis, Osmotic Pressure, Water potential and its components.
2. **Short Distance Transport:** Absorption of water – Active and passive absorption, Absorption of minerals – Donnan's equilibrium (Passive absorption), Carrier-ion concept (Active absorption)
3. **Long distance Transport:** Ascent of sap; Root pressure theory (Vital theory), TCT Theory (Physical theory), Soil plant atomospheric continum (SPAC)
4. **Transpiration:** Types, Mechanism of stomatal movement; Starch-sugar interconversion theory, Potassium ion pump theory, Significance of transpiration, Antitranspirants, Guttation.
5. **Mineral nutrition:** Macro and Micro nutrients; Role of Nitrogen, Phosphorous, Potassium, Sulphur, Manganese and Zinc, Hydroponics.
6. **Translocation of solutes:** Path of translocation, Munch's mass flow hypothesis with merits and demerits.

UNIT 2 – Enzymes: **(4 Lectures)**

Properties, Classification and Mode of action (Lock & Key theory, Induced fit theory)

UNIT 3 – Bioenergetics: **(18 Lectures)**

1. Photosynthesis : Introduction, Photosynthetic apparatus, Mechanism – Light and Dark reactions (C_3 pathway/Calvin Cycle), C_4 pathway, Significance of Photosynthesis.

2.Respiration : Introduction,,Types, Ultrastructure of Mitochondrion, Mechanism of Aerobic respiration – Glycolysis, Krebs' cycle and Terminal Oxidation of reduced coenzymes , Anaerobic respiration – alcoholic & lactic acid fermentation, Significance .

UNIT 4 -Nitrogen Metabolism: **(6 Lectures)**

Nitrogen fixation (Symbiotic and Non Symbiotic), Nitrate reduction, Aminoacids & their synthesis
(Transamination & Reductive amination)

UNIT 5 - Plant Growth and Movements: **(12 Lectures)**

1. Growth: Definition, Phases of growth and Growth curve
2. Growth regulators Chemical nature, application of Auxins, Gibberellins, Cytokinins, Abcissic acid (ABA) & Ethylene.
3. Photoperiodism and Vernalisation : A brief account.
4. Plant movements : Tropisms & their types (Phototropism, Thigmotropism, Hydrotropism & Geotropism)

DMD23108/DMD23107 **II B.Sc., IV Semester DSC-IV**

Plant Physiology and Metabolism

Practicals (2 credits) **Lectures: 60 Hours (4 hours/week)**

I. Minor Experiments:

1. a) Root pressure experiment

   b) Ganong's Potometer experiment

2. c) Ganong's light screen experiment

   d) Mohl's half leaf experiment

3. f) Kuhne's experiment to demonstrate fermentation.

   g) Phototropism

4. h) Geotropism

   i) Arc Auxanometer experiment

5. j) Bolting.

   k) Effect of auxins on rooting.

II. Major Experiments:

1. Determination of Osmotic Potential by Plasmolytic method using *Rhoeo discolor (Epidermal peel)*
2. Experiment to demonstrate the Relationship between Absorption and Transpiration.
3. Experiment to demonstrate the Suction force due to transpiration.
4. Separation of photosynthetic pigments using paper Chromatography.
5. Evolution of Oxygen during photosynthesis
6. Calculation of stomatal index and stomatal frequency.

III. Biochemical tests:

Qualitative biochemical tests for Carbohydrates, fats and protein.

***

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.

2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

II B.Sc., IV Semester DSC-IV
Plant Physiology and Metabolism
Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Plant-water relations	20	2X3=6	5X2=10	10X2=20	**36**
Unit 2: Enzymes	4	2X1=2	5X1=5	-	**7**
Unit 3: Bioenergetics	18	2X2=4	5X1=5	10X2=20	**29**
Unit 4: Nitrogen metabolism	6		5X1=5	10X1=10	**15**
Unit 5: Plant Growth and Movements:	12	2X2=4	5X1=5	10X1=10	**19**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

DMD23108/DMD23107 II B.Sc., IV Semester DSC-IV

Plant Physiology and Metabolism

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Perform the major experiment 'A' write the principle, Requirements, Procedure and record the result with inference and leave the setup for evaluation 9x1 = 9 marks

(Determination of osmotic potential of plant cell sap by plasmolytic method. Study of plasmolysis and deplasmolysis on Rhoeo leaf

OR

Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophytes

OR

Experiment to demonstrate the Relationship between Absorption and Transpiration.

OR

Separation of photosynthetic pigments by paper chromatography

OR

Evolution of Oxygen during photosynthesis

OR

Experiment to demonstrate the Suction force due to transpiration

Principle	-2 marks	Procedure	-3 marks
Requirements	-1 mark	Result and inference	-1 marks
Setting	-2 marks		

II. Comment on 'B' &'C' (Minor experiments) 4x2 =8 marks

(Root pressure experiment/ Ganong's Potometer experiment / Ganong's light screen experiment/ Mohl's half leaf experiment/ Kuhne's experiment / Phototropism/ Arc Auxanometer experiment/ Bolting/ Effect of auxins on rooting)

Identification	-1 marks
Critical notes	-2 marks
Labeled sketch	-1 marks

III. Perform the biochemical test of the given sample 'D' & 'E'

Procedure -3marks Result-1 marks **4x2=8 marks**

IV. Practical record 05 marks

V. Viva-Voce 05 marks

***

DMD23108/DMD23107 II B.Sc., IV Semester DSC-IV

Plant Physiology and Metabolism

Practical Question Paper

Time: 4 Hours Max. Marks: 35 (25+05+05)

I. Perform the major experiment 'A' write the principle, Requirements, Procedure and record the result with inference and leave the setup for evaluation 9x1 =9 marks

II. Comment on 'B' & 'C' (Minor experiments) 4x2=8 marks

II. Perform the biochemical test of the given sample 'D' & 'E' 4x2=8 marks

IV. Practical record 05 marks

V. Viva-Voce 05 marks

***

DME23008/DME23007 III B.Sc., V Semester DSE-V

Cell and Molecular Biology

Theory (4 credits) Lectures: 60 Hours (4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand in depth microscopy
CO2 Learn the details of cell
CO3 Specify the details of DNA
CO4 Learn the details of gene regulation

Unit 1- Microscopy: (5 Lectures)

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM).

Unit 2- Cell: (4 Lectures)

Cell Theory; Ultra structure of Prokaryotic and eukaryotic cells;

Unit 3- Cell Wall and Cell Membrane: (4 Lectures)

Cell wall- Structure; Cell Membrane- Fluid mosaic model and functions

Unit 4- Cell Organelles: (13 Lectures)

Ultrastructure and functions of Nucleus, Mitochondrion, Chloroplast, Endoplasmic reticulum, Golgi bodies, Lysosomes, Ribosomes, Peroxisomes and Glyoxisomes

Morphology of chromosomes in general, Ultrastructure of Chromosome (Nucleosome concept), Karyotype and Ideogram

Unit 5-Cell Division: (6 Lectures)

Cell cycle, Mitosis and Meiosis and their significance

Unit 6- Nucleic acids: (12 Lectures)

A. **DNA**: Chemistry, Structure and Replication in Eukaryotes (semi- conservative method) DNA as a genetic material Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment.

B.RNA: Chemistry, Structure, Types (mRNA, tRNA, rRNA) and structure. Frankel Conrat's experiment

Unit 7-Gene concept: (12 Lectures)

A. Cistron, Recon, Muton- Prokaryotic and Eukaryotic gene structure, Split gene concept.

B. Genetic code- features, Wobble concept. Protein synthesis: Transcription, Splicing and Translation. Central dogma of molecular Biology.

Unit 8-Regulation of gene expression: (4 Lectures)

Lac operon and Tryp operon concepts.

DME23108/DME23107 **III B.Sc., V Semester DSE-V**

Cell and Molecular Biology

Practical (2 credits) **Lectures: 60 Hours**

(4 hours/week)

1. Preparation of fixatives and stains: FAA, Carnoy's fixative, safranine, acetocarmine and aceto-orcein.
2. Study of viruses, prokaryotic cell (bacteria) and eukaryotic cell with the help of light and electron micrographs.
3. Study of cell organelles through photographs.
4. Study of structure of plant cell through temporary mounts- Onion peeling and tomato pulp
5. Study of Mitosis (temporary mounts and permanent slides).
6. Study of Meiosis (temporary mounts and permanent slides).
7. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
8. Structure of DNA and RNA (mRNA, rRNA, tRNA).
9. Study DNA packaging through photographs- solenoid model.
10. Lac operon and Tryp operon concepts.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA. 4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

III B.Sc., V Semester DSE-V
Cell and Molecular Biology
Scheme of theory question paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Alloted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Microscopy	5	-	-	10X1=10	10
Unit 2: Cell	4	2X1=2	5X1=5	-	07
Unit 3: Cell Membrane and Cell Wall	4	2X1=2	5X1=5	-	07
Unit 4: Cell Organelles	13	2X1=2	-	10X2=20	22
Unit 5: Cell Division	06	2X1=2	-	10X1=10	12
Unit 6: Nucleic acid	12	2X1=2	5X2=10	10X1=10	22
Unit 7: Gene concept	12	2X2=4	5X1=5	10X1=10	19
Unit 8: Regulation of gene expression	04	2X1=2	5X1=5	-	07
Total	60	8X2=16	5X6=30	10X6=60	106

DME23108/DME23107 III B.Sc., V Semester DSE-I

Cell and Molecular Biology

Scheme of practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Prepare a temporary squash of given material 'A'. Sketch, label and identify with reasons. Leave the preparation for evaluation. **07 marks**

(Onion root tip/ flower bud)

Preparation - 4marks
Identification - 1mark
Sketch and label - 1mark
Reasons - 1mark

II. Identify the cytological slide/Photograph 'B' with labeled diagram and reasons. **04 marks**

(Mitosis/ Meiosis)

Identification - 1mark

Sketch and label - 1mark

Reasons - 2marks

III. Comment on 'C' and 'D' (charts/photographs) **3 X 2= 06marks**

C- Cell organelle **(**Identification - 1mark, labeled Sketch and Reason - 2marks)

D- Fixative/ stain **(**Identification - 1mark,labeled Sketch and Reason - 2marks,)

IV. Prepare a temporary mount of a plant cell 'E' **04 marks**

(Onion peeling/ tomato pulp)

Preparation - 2 marks

Sketch and label - 2 marks

V. Write critical notes on 'F and 'G' **2 X 2 = 04 marks**

F-DNA/ DNA packaging/RNA types
G- Nuclear pore complex/ Lac operon/Tryp operon

Identification - 1 mark
Reasons - 1 marks

VI. Practical record **05marks**

VII. Viva-voce **05marks**

***

DME23108/DME23107 III B.Sc., V Semester DSE-I

Cell and Molecular Biology

Practical question paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Prepare a temporary squash of given material 'A'. Sketch, label and identify with reasons. Leave the preparation for evaluation. **07 marks**

II. Identify the cytological slide/photograph 'B' with labeled diagram and reasons. **04 marks**

III. Comment on 'C' and 'D' (charts/photographs) **3 X 2= 06 marks**

IV. Prepare a temporary mount of a plant cell 'E' **04 marks**

V. Write critical notes on F and G **2 X 2 = 04 marks**

VI. Practical record **05 marks**

VII. Viva-voce **05marks**

***

DME23208/DME23207 **III B.Sc., V Semester DSE-II**

Economic Botany and Biotechnology

Theory (4 credits) **Lectures: 60 Hours**

(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO1 Understand in details with application, if applicable, economic botany
CO2 Specify the details of plant tissue culture
CO3 Understand in details with examples recombinant DNA technology

Unit 1: Cereals and Millets **(4 Lectures)**

Rice, Wheat, Maize, Ragi (Botanical name, family, part used, morphology and uses)

Unit 2: Legumes **(6 Lectures)**

General account with special reference to Pigeon pea, Green gram, Black gram, Bengal gram (Botanical name, family, part used, morphology and uses)

Unit 3: Spices and condiments **(8 Lectures)**

General account with special reference to clove, black pepper, cinnamom, cardamom, garlic, onion, chilli and coriander (Botanical name, family, part used, morphology and uses)

Unit 4: Beverages **(4 Lectures)**

Tea and coffee (Botanical name, family, part used, morphology and uses)

Unit 5: Oils and Fats **(4 Lectures)**

General description with special reference to groundnut, sunflower, mustard (Botanical name, family, part used, morphology and uses)

Unit 6: Fibre Yielding Plants **(4 Lectures)**

General description with special reference to Cotton, Jute, kapok and sunn hemp (Botanical name, family, part used, morphology and uses)

Unit 7: Introduction to biotechnology **(2 lecture)**

Unit 8: Plant tissue culture **(10 Lectures**)

Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

Unit 9: Recombinant DNA Techniques **(18 Lectures)**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection.

DME23308/DME23307

III B.Sc., V Semester DSE-II
Economic Botany and Biotechnology
Practical (2 credits)

Lectures: 60 Hours
(4 hours/week)

1. Study of Cereals and Millets
2. Study of Legumes
3. Study of Spices and condiments
4. Study of Beverages
5. Study of Oils and Fats
6. Study of Fibre Yielding Plants
7. Familiarization with basic equipments in tissue culture.
8. Study through photographs: Anther culture, somatic embryogenesis,
9. Study through photographs: endosperm and embryo culture; micropropagation.
10. Study of molecular techniques: PCR, Blotting techniques and PAGE.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.

2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

III B.Sc., V Semester DSE-II

Economic Botany and Biotechnology

Scheme of Theory Question Paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)=40	
Unit 1: Cereals and Millets	4		5X1=5	-	**07**
Unit 2Legumes	6	2X1=2	-	10X1=10	**12**
Unit 3: Spices and condiments	8	-	5X1=5	10X1=10	**15**
Unit 4: Beverages	4	-	5X1=5	-	**05**
Unit 5: Oils and Fats	4	2X1=2	5X1=5	-	**07**
Unit 6: Fibre Yielding Plants	4	2X1=2	-	10X1=10	**12**
Unit 7: Introduction to biotechnolog	2	2X1=2	-	-	**02**
Unit 8: Plant tissue culture	10	2X1=2	5X1=5	10X1=10	**17**
Unit 9: Recombinant DNA Techniques	18	2X2=4	5X1=5	10X2=20	**29**
Total		**8X2=16**	**5X6=30**	**10X6=60**	**106**

DME23608/ DME23607 **III B.Sc., V Semester SEC-I**

Floriculture

Theory (2 credits) **Lectures: 30 Hours**
(2 hours/week)

Course outcome:
After completion of the course the student is able to:

CO1	Specify the classification and characteristics of gardening
CO2	Understand in depth nursery management
CO3	Identify in details with examples ornamental plants

Unit 1- Establishment and management of Nurseries: **(7 Lectures)**

Definition, importance of nurseries, classification of nurseries, and management of nurseries

1. **Basic requirements for Nurseries**: Agro-climatic conditions, Topography, Selection of site Selection of soil, Seed bed preparation, Water supply and irrigation.

   Parts of nursery- a) Building structures, b) Propagating structures- raising of seedlings

2. **Management of nursery:** Irrigation, Nutrition, Weed control, Plant protection, Uprooting, packing and transplantation

Unit 2-Gardening and Landscaping **(8 Lectures)**

A. Features of a garden:

1. Introduction, living elements, hedges, edges, trees, flower beds, lawn, Shrubbery, climbers and creepers, paths, Steps, arches, pergola, rockery, Water garden, sunken garden, carpet beds, topiary, trophy, ,non living elements.

2. Gardening: Introduction, Formal style, Informal style, planning a garden, creating a garden, establishment of the garden.

3. Some Famous gardens of India

B. Landscaping:

1. Home garden, Public garden. Educational institution, commercial complexes and companies.

2. Importance, Scope of floriculture and landscape gardening.

Unit 3-Garden Plants: **(5 Lectures)**

Introduction, Annuals, Biennials, Perennials, Shrubs, Trees, Climbers(Divine Vines) Succulents, Cacti,Ferns, Gymnosperms, Palms, Orchids, Bulbous Ornamentals.

Unit 4- Commercial Floriculture: **(8 Lectures)**

Introduction, Importance of Floriculture from social, Economic, Health and Aesthetic point of view. Marketing and floristry in Indian scenario. Future and scope of Floriculture in India- Employment opportunities. Packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Rose, Chrysanthemum, Gerbera, Gladiolous, Marigold, Orchids).

Unit 5- Diseases and pests of ornamental plants: **(2 Lectures)**

***

References

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India Allied Publishers

DME23608/ DME23607 **III B.Sc., V Semester SEC-I**

Floriculture

Scheme of Theory Question Paper

Blue print: **Max. Marks: 50**

Units	Hours allotted	No. of questions from each category			Total Marks 50
		2 marks (5/8)=10	5marks (4/6)=20	10marks (2/4)=20	
Unit 1: Establishment and management of Nurseries.	7	2X2=4	5X1=5	10X1=10	**19**
Unit 2: Gardening and Landscaping:	8	2X2=4	5X2=10	10X1=10	**24**
Unit 3: Garden Plants:	5	2X2=4	5X2=10	-	**14**
Unit 4: Commercial Floriculture	8	2X1=2	-	10X2=20	**22**
Unit 5: Diseases and Pests of Ornamental Plants.	2	2X1=2	5X1=5	-	**07**
Total	**30**	**8X2=16**	**5X6=30**	**10X4=40**	**86**

DME23408 /DME23407 **III B.Sc., V Semester SEC-II**

Ethnobotany

Theory (Credits 2)

Lectures: 30 Hours
(2 hours/week)

Course outcome

After completion of the course the student is able to:

CO1. Understand the details of Ethnobotany

CO2. Learn the characteristics of traditional medicinal plants

Unit 1- Ethnobotany: **(6 Lectures)**

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit 2- Methodology of Ethnobotanical studies: **(6 Lectures)**

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3- Role of Ethnobotany in modern Medicine: **(10 Lectures)**

Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum*

c) *Vitex negundo* d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata*

g) *Cassia auriculata* h) *Indigofera tinctoria*

Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania.*

Role of ethnic groups in conservation of plant genetic resources Endangered taxa and forest management (participatory forest management).

Unit 4- Ethnobotany and legal aspects: **(8 Lectures)**

Ethnobotany as a tool to protect interests of ethnic groups.Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

References

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

3) Lone et al,. Palaeoethnobotany

4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.

6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester

7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-19969)

DME23408 /DME23407 III B.Sc., V Semester SEC-II

Ethnobotany

Scheme of Theory Question Paper

Blue print: **Max. Marks: 50**

Units	Hours allotted	No. of questions from each category			Total Marks 50
		2 marks (5/8)=10	5marks (4/6)=20	10marks (2/4)=20	
Unit 1: Ethnobotany	6	2X2=4	5X1=5	10X1=10	**19**
Unit 2: methodology of Ethanobotanical studies	6	2X3=6	5X2=10	-	**16**
Unit 3: role of ethonobotany in modern medicine	10	2X2=4	5X1=5	10X2=20	**29**
Unit 4: Ethnobotany and legal aspects	8	2X1=2	5X2=10	10X1=10	**22**
Total	**30**	**8X2=16**	**5X6=30**	**10X4=40**	**86**

DMF23008/ DMF23007 **III B.Sc., VI Semester DSE-III**

Genetics and Plant Breeding

Theory (4 credits) **Lectures: 60 Hours (4 hours/week)**

Course outcome:

After completion of the course the student is able to:

CO1	Specify the details of heredity
CO3	Write down the classification and characteristics of mutations
CO4	Learn the details of plant breeding
CO2	Identify in details with examples linkage

Unit 1- Heredity: **(24 Lectures)**

1. Brief life history of Mendel
2. Terminologies
3. Laws of Inheritance
4. Modified Mendelian Ratios: incomplete dominance; complementary factors; supplementary factors, Duplicate factors, Epistatis.
6. Pedigree Analysis
7. Cytoplasmic Inheritance: leaf variegation in *Mirabilis jalapa*, Male sterility.
8. Chromosome theory of Inheritance.
9. Quantitative inheritance-Concept, mechanism, examples. Monogenic vs polygenic Inheritance.

Unit 2- Sex-determination and Sex-linked Inheritance: **(6 Lectures)**

Sex – determination in *Melandrium album* by XX-XY method, Bridges Genic balance theory, Sex-linked Inheritance

Unit 3- Linkage and Crossing over: **(8 Lectures)**

Linkage: complete & incomplete linkage, coupling & repulsion, recombination frequency, linkage in Maize, two point test cross, linkage maps, Coincidence and interference. Crossing over: concept and significance.

Unit 4-Mutations and Chromosomal Aberrations: **(6 Lectures)**

Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

Unit 5- Plant breeding and Methods of crop improvement: **(12 lectures)**

Introduction, objectives and Methods: Plant introduction, selection, Hybridization- Emasculation and bagging. Mutation breeding, polyploidy breeding, genetic or molecular plant breeding. Methods of propagation– Procedure, advantages and limitations

Unit 6- Inbreeding depression and heterosis: **(4 lectures)**

Inbreeding depression and Heterosis; Applications. Germplasm maintenance, Pollen banks and Quarantine measures.

DMF23108/ DMF23107 **III B.Sc., VI Semester DSE-III**

Genetics and Plant Breeding

Practical (2 credits)

Lectures: 60 Hours
(4 hours/week)

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square.
2. Chromosome mapping using point test cross data.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
7. Hybridization techniques - Emasculation, Bagging (For demonstration only).
8. Induction of polyploidy conditions in plants (For demonstration only).

Suggested Readings

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. WileyIndia.

2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.

3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings

4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning 6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.

7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.

8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

III B.Sc., VI Semester DSE-III

Genetics and Plant Breeding

Scheme of Practical Question Paper

Time: 4 Hours **Max. Marks: 35 (25+05+05)**

I. Perform the experiment ‘A’. **6 marks**

(Emasculation and bagging)

Preparation -2 marks

Sketch and label - 2marks

Reasons - 2marks

II. Conduct experiment ‘B’. **4 marks**

(Induction of polyploidy)

Principle -1 marks
Requirements -1 marks
Procedure -1 marks
Result and inference -1 marks

III. Problems on Chromosome mapping using point test cross data‘C’. **4 marks**

IV. Comment on the given specimen ‘D’ **3 marks**

(Pedigree analysis)

Identification - 1mark

Reasons - 2marks

V. Problems on gene interaction ‘E’ **4 marks**

VI. Identify the given photographs ‘F’ & ‘G’ **2x2=4 marks**

(F- Aneuploidy & G- Translocation)

Identification - 1mark

Reasons - 1marks

VI. Practical record **5 marks**

VII. Viva-Voce **5 marks**

III B.Sc., VI Semester DSE-III

Genetics and Plant Breeding

Scheme of Theory Question Paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)40	
Unit 1:Heredity	24	2X3=6	5X1=5	10X3=30	**41**
Unit 2: Sex-determination and Sex-linked Inheritance	4	2X1=2	5X1=5	-	**7**
Unit 3: Linkage and Crossing over	8	2X1=2	-	10X1=10	**12**
Unit 4: Mutations and Chromosoma Aberrations	4	2X1=2	5X1=5	-	**7**
Unit 5: Plant Breeding	4	2X1=2	5X1=5	-	**07**
Unit 6: Methods of crop improvement	8	-	5X1=5	10X1=10	**15**
Unit 7: Inbreeding depression and heterosis	4	2X1=2	5X1=5	-	**02**
Unit 8: Crop improvement and breeding	4	-	-	10X1=10	**10**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

DMF23208/ DMF23207 III B.Sc., VI Semester DSE-IV

Analytical Techniques in Plant Science

Theory (4 credits) Lectures: 60 Hours

(4 hours/week)

Course outcome:

After completion of the course the student is able to:

CO2 Learn the details of Spectrophotometry

CO3 Write down the details of chromatography

CO1 Specify the details of cell fractioning

CO4 Identify in details with application, if applicable, biostatistics

Unit 1: Imaging and related techniques (15 Lectures)

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell fractionation (8 Lectures)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2 gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes (4 Lectures)

Use in biological research, auto-radiography, pulse chase experiment.

Unit 4: **Spectrophotometry (4 Lectures)**

Principle and its application in biological research.

Unit 5: Chromatography (8 Lectures)

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6: Characterization of proteins and nucleic acids (6 Lectures)

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit 7:Biostatistics (15 Lectures)

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

DMF23308/ DMF23307 **III B.Sc., VI Semester DSE-IV**

Analytical Techniques in Plant Science

Practicals (2 credits) **Lectures: 60 Hours (4 hours/week)**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition

III B.Sc., VI Semester DSE-IV
Genetics and Plant Breeding
Scheme of Theory Question Paper

Time: 3.00 Hours **Max. Marks: 70**

Blue print:

Units	Hours Allotted	No. of questions from each category			Total Marks 70
		2 marks (5/8)=10	5marks (4/6)=20	10marks (4/6)40	
Unit 1: Imaging and related techniques	15	2X2=4	5X2=10	10X1=10	**24**
Unit 2: Cell fractionation	8	2X1=2	5X1=5	10X1=10	**17**
Unit 3: Radioisotopes	4	2X2=4	-	-	**4**
Unit 4: Spectrophotometry	4	2X1=2	-	10X1=10	**12**
Unit 5: Chromatography	8	-	5X1=5	10X1=10	**15**
Unit 6: Characterization of proteins and nucleic acids	6	2X1=2	5X1=5	-	**7**
Unit 7: Biostatistics	15	2X1=2	5X1=5	10X2=20	**27**
Total	**60**	**8X2=16**	**5X6=30**	**10X6=60**	**106**

Botany Pattern of theory question paper (CBCS)
DSC I-DSC IV
(I semester to IV)

Time: 3 Hours **Max. Marks: 70**

Instructions to the candidates:
Draw neat labelled diagrams where ever necessary.

I. Explain / define any FIVE of the following. 2x5=10

1.
2.
3.
4.
5.
6.
7.
8.

II. Write short notes on any FOUR of the following. 5x4=20

9.
10.
11.
12.
13.
14.

III. Give comprehensive and detailed account of any FOUR of the following. 10x4=40

15.
16.
17.
18.
19.
20.

***

Botany Pattern of theory question paper (CBCS)
DSE
(V semester to VI)

Time: 3 Hours **Max. Marks: 70**

Instructions to the candidates:
Draw neat labelled diagrams where ever necessary.

II. Explain / define any FIVE of the following. **2x5=10**

1.
2.
3.
4.
5.
6.
7.
8.

II. Write short notes on any FOUR of the following. **5x4=20**

9.
10.
11.
12.
13.
14.

III. Give comprehensive and detailed account of any FOUR of the following. **10x4=40**

15.
16.
17.
18.
19.
20.

***

Botany Pattern of theory question paper (CBCS)
SEC
(V semester)

Time: 2 Hours **Max. Marks: 50**

Instructions to the candidates:
Draw neat labelled diagrams where ever necessary.

III. Explain / define any FIVE of the following. 2x5=10

1.
2.
3.
4.
5.
6.
7.
8.

II. Write short notes on any FOUR of the following. 5x4=20

9.
10.
11.
12.
13.
14.

III. Give comprehensive and detailed account of any TWO of the following. 10x2=20

15.
16.
17.
18.

***

Suggested Readings:

Author	Title of the Book	Publisher
VIRUSES AND		
BACTERIA		
R.C.Dubey and	A textbook of Microbiology	S. Chand & company, Ramnagar
D.K. Maheshwari		N.Delhi-110005.
	Microbiology	Rastogi Publications; Shivaji
P.D. Sharma		road Meerat; 250002; India
	Microbiology and Plant	Rastogi Publications; Shivaji
P. D. Sharma	pathology	road Meerat; 250002; India
		Vani Educational books , Vikas
H. C. Dube	Text book of fungi, Bacteria &	house 20/4, Industrial area,
	Virus	Sahidabad, 201010, Ghaziabad,
		UP.
		Himalaya Publishing house,
Power & Daginawala		Bombay
	General Microbiology. Vol. I	Himalaya Publishing house,
Power & Daginawala		Bombay
	General Microbiology. Vol. II	
Pelzar Michael.J		
Prescott, Lansing and	Text Book of Microbiology	Orient and Longman, New Delhi.
Others	Microbiology	
Ananthanarayana .R .	Text Book of Microbiology	Tata Mc graw Hill
Jayaram Panicker		
a) salle. A. J.	Functional Principles of	Himalaya Publishing house,
	Bacteriology	Bombay
Vinita Kale and Kishore	Applied Microbiology.	
Bhusari		ELBS Publisher , New Delhi
Frazier William. C.	Food Microbiology	Prentice Hall of India N.Delhi
Cruckishank	Text book of Medical	Vardaman Publishers ,
Rangaswamy.G.	Microbiology	Bangalore. Vol. III & Vol. IV.
Sundar Rajan	Diseases of crop plants in India.	Tata McGraw Hill Publishing
	College Microbiology	company.
William. C. Frazier and		
Dennis C. West hoff. 3rd	Food Microbiology	R. Chand & company,
Edn		Publishers, N.Delhi.
ALGAE		Pradeep Pub., Jalandhar.
K.N. Bhatia	A Treatise on Algae	Mc graw Hill , New york.
		Thomas, Nelson and Sons
Chopra. G.L	A Text book of Algae	Rastogi Publications
G. M. Smith	Cryptogamic Botany Vol. I	
Prescott, G.W	The Algae to Review	Cambridge University Press
Kumar, M.A and Kashyap.	Recent advances in physiology	

A.K.		Mac Milan, Publishing New
Fritsch. F. E.	Structure and Reproduction of	York.
	Algae Vol. I & Vol. II	Rastogi Publications; Shivaji
ChapmanV.J&Chapman	The Algae 2nd Edn.	road Meerat; 250002; India
D.J.	A text book of Botany	S. Chand & company, Ltd.
Singh, Pande , Jain.		Ramnagar N.Delhi-110005.
	Simplified course in Botany	Black well Publishers.
B. P. Pandey		
	Algal Biology	Mc Grawhill, New york.
Darley. M. W.		Wiley Eastern Ltd. New Delhi.
FUNGI	Cryptogamic Botany Vol. I	
Smith. G. M.	Introduction to Mycology	Pradeep publications, Jalandar
Allexopolos. C. J. and		Mac Milan & Co Calcutta
Mims. C. W.	Text book of Fungi	Prentice Hall of India New Delhi.
Chopra G. L. and Verma. V	Fungi & Plant diseases	Rastogi Publications
Mundkur, B. B.	Diseases of India 3rd Edition	S. Chand and Company, New
Rangaswamy, G.	The fungi	Delhi.
Sharma. P. D.	Fungi	
Vashista, R.R		S. Chand and Company, New
		Delhi.
BRYOPHYTA	Bryophyta	S. Chand and Company, New
Pandey. B.P.		Delhi.
	Bryophyta	Central book depot, Allahabad.
Vashista. B. P.		Mc Grawhill, New York
	Bryophyta	Pradeep Publications, Jalandar.
Parihar. N.S.	Cryptogamic Botany vol. I	
G. M. Smith	Class Book and Pteridophytes	
G. L. Chopra		
	Bryophytes and Pteridophytes	
Chauhan D.K.S		MC Graw Hill, New York.
ANATOMY	Introduction to Plant Anatomy	Wiley Eastern, New Delhi.
Eames A.J. and Mac		S. Chand and Company.
Daniels, L. H	Anatomy of seed plants	Rastogi publications, Meerat.
Katherien Esau	Introduction to Plant Anatomy	
Pandey. B. P	Anatomy of seed plants	Rastogi publications, Meerat.
Singh. V., Pandey, P.C and		
Jain, D.K.	Plant anatomy	
Tayal M. S.	College Botany Vol. I	
Ganguli Das L Datta	Cytology and Anatomy	
Venkateshvaralu		
EMBRYOLOGY OF		Vikas publishing HOUSE, New
ANGIOSPERMS &		Delhi.
TAXANOMY	The Embryology of Angiosperms	Rastogi publications, Shivaji
Bhojwani. S. S. &		Road, Meerat, 250002.
Bhatnagar, S. P.	The Embryology of Angiosperms	MC Graw Hill publishing

Singh, Pandey, Jain		Company, New Delhi.
	The Embryology of Angiosperms	Ind. Sci. Acad. Bull. No.41, New
Maheshwari , P		Delhi.
	Comparative Embryology of	MC Graw Hill, New York.
Johri, B.M.	Angiosperms	Narosa publishing House New
	Morphology of Angiosperms	Delhi.
Eames A. J.	Plant cell and Tissue culture.	
Reinert . J and Yeoman		
M.M	Plant Anatomy	
	Taxonomy of Vascular plants	
Vashishta	A Text book of systematic	
George H.M. Lawarance.	Botany	Harper C Row, New York.
R.N. sutaria	Botany for Degree Students.	
A. C. Dutta		Mc Graw Hill, New York.
PTERIDOPHYTA	Morphology of plants and Fungi	
Bold , H.C., Alexopoulos,		Central book depot. Allahabad.
C.J	Morphology of vascular plants	
& Delevoryas, T.	(lower groups).	
Eames, Arthur, J.	The Biology and Morphology of	Vikas publishing House, New
	Pteridophytes.	Delhi.
Parihar, N.S. 1977		Vani educational books, New
	Text book of Botany, Vol. II	Delhi.
	An introduction to Pteridophyta.	Hutchinson university library,
Pandey, S.N.& Others	The Morphology of Pteridophytes	London.
Rashid,A.1986		S. Chand and Co., New Delhi.
Sporne,K.R.1970	Pteridophyta	
		Asia publishing house, New
Vashista,P.C. 1987	An Introduction to	Delhi.
GYMNOSPERMS	Gymnosperms.	K. Nath and Co.
Datta, S.C.	Gymnosperms.	Prasaranga, University of
Pandey, B.P.	Anavrutha beeja sasyagalu	Mysore, Mysore.
Ramaswamy, S.N. 1984	(Gymnosperms)	Ratna Prakashana Mandir, Agra
	Text book of Botany Vol. II.	Hutchinson university library,
Saxena and Sarabhai 1993	The Morphology of	London.
Sporne, K.R.1969	Gymnosperms.	Shashidhar Malaviya Prakashan.
		S.Chand & Co. New Delhi.
Trivedi, B.S.& Singh, D.K	An Introduction to	Wiley, New York.
Vashista, B.R.	Gymnosperms.	Narosa, New Delhi.
Andrews, H.N. 1961	Gymnosperms.	
Biswas, C. & Johri, B.M.	Studies in palaeobotany.	
1997	The Gymnosperms.	Wiley-Estern, New Delhi.
PLANT PHYSIOLOGY		
Conn, E.E. and		Centar book Depot, Allahabad.
Stumpf,P.K.1976	Out line of Biochemistry	Affiliated East West, New Delhi.
Datta, S.C.		Affiliated East West, New Delhi.
Delvin, R.M. 1969	Plant physiology	

Delvin, R.M. & Barker,	Plant physiology	S.Chand & Co. New Delhi.
A.V. 1971	Photosynthesis	East West Press Pvt. Ltd. New
Jain, V.K. 1990		Delhi.
Kumar, H.D. & Singh, H.N	Fundamentals of Plant physiology	Atma Ram & Sons, New Delhi.
1975, 1993	Plant Metabolism I Edn. & II	
Krishnamurthy, H.N.	Edn.	
		Prentice Hall of India Pvt. Ltd.
Lehninger, A.L. 1978	Physiology of plant Growth and	
Noggle, G.R. and Fritz	Development.	S.Vishwanatha, Pvt. Ltd.
George, J. 1977.	Biochemistry	
Rao, K.N. Sudhakar Rao	Introductory Plant physiology	Wiley Eastern, New Delhi.
and Bharatan, S. 1987		
Rabinowitch, E. &	The function of plant.	First Indian Edn. CBZ Publishers
Govindjee. 1970		and Distributers, New Delhi.
Salisbury, E.E. & ross,	Photosynthesis	
C.W. 1986		
	Plant physiology	
ECOLOGY &		
ENVIRONMENTAL		Ann Arbor Science, Michigan.
BIOLOGY		
Aarne Vesilid, P & Jeffrey		McGraw Hill.
Pierce, J. 1983		John Wiley and Sons, New York.
BentonAllen.H &	Environmental Pollution and	Tata-McGraw Hill publishing Co.
Warner,WE	Control	New Delhi.
Colinvaux paul, A. 1973		S.Chand & Co, New Delhi.
Dash,M.C.	Field Biology an Ecology	
	Introduction to Ecology	Prentice Hall of india New Delhi.
Dara, S.S. 1993	Fundamentals of Ecology	Ratna Prakashan mandir, Agra.
		Vishal Publications, Jalandar.
Kormondy Edward, J. 1986	A Text book of Environmental	
Kochhar, P.L. 1990	Chemistry and Pollution Control.	Vikas, New Delhi.
Kotpal, R.L. 7 Bali, N.P.	Concept of Ecology	Macmllan Education Ltd.
1987	Plant Ecology	London.
Kumar,H.D. 1990	Concept of Ecology	Longman Inc., newe York.
Lloyd, J.R.1980		Oxford and IBH, New Delhi.
Mason, C.E.1981	Concept of Ecology	Saunders, W.B. Philadelphia
Misra.K.C. 1989	Man and the ecosystem.	Wiley, New York.
Odum,E.P. 1971	Biology of fresh water Pollution	
Odum,E.P. 1983	Manual of plant Ecology	Divyajyoti prakashan Jodhpur.
	Fundamentals of Ecology	
Pratap Mowli, P & Venkata	Basic Ecology	Rastogi Publications, Meerut
Subbaya, N. 1989.		I Edn. Rastogi
Sharma, P.D.	Air Pollution and Control	Publications,Meerut.
Sharma, P.D.		Anmol Publications, New Delhi.
Trivedi, R.N. 1993	Ecology and Environment	
	Environmental Biology	Vishal Publications jalandhar.

Vashista, P.C. 1989	Text book of Environmental	S.Chand & Co., New Delhi.
Verma, P.S. and Agarwal,	Sciences	
V.K. 1992	Plant Ecology	Macmillan, new York.
Whittaker, R.H. 1975	Principles of Ecology	
	Communities and Ecosystems	
CYTOLOGY,GENETIC	II Edn.	Wiley Eastern Ltd.
S AND ELOLUTION		
Ahluwalia Kavita, B. 1985.		Addiison Wesley Longman,
Booker, R.J 1999	Genetics	California.
	Genetics-Analysis and Principles	Oxford and IBH, New Delhi
Archana Sharma, 1990		Benjamin Cummings.
Ayala, F.J. and Klug, Jr.	The Chromosomes	
1984	Modern Genetics II Edn.	Tata mcGrawHill, New Delhi
Cherayil,J.D 1974		W.B.Saunders and Co.
De Robertis, E.D.P. Solez,	Gene and Genetics	Philadelphi
F.A & Nowinski,	Cell Biology	
W.W.1966		Surjeet publications, New Delhi
Dobzhansky, T., Ayala, J.,	Evolution	
Stebbins		Oxford and IBH publishing Co.,
Dobzhansky, T. 1951	Genetics and Origin of species	New Delhi
		Harper and Row publishers,
Dowben Robert, M 1971	Cell biology	John Wiley and Sons,
Gardner, E.J	Principles of Genetics	
&Snustad,D.P. 1984&1990		Rastogi publications,meerut.
Gupta, P.K 1987	Genetics	Prentice Hall of India.
Hexter, W and Yost Henry,	The Science of Genetics	New York.
T. 1977		Macmillan, India, New Delhi
Jha, A.P. 1993.	Genes and Evolution	George allen & Unwin, London.
Huxley, j. 1974	Evolution	
		15^{th} Edn. Rattan prakashan
Kochhar, P.L.1994	Genetics and Evolution	Mandir, Agar.
		Amerind Publishing co. New
Loewy ariel,g. & Philip	Cell structure and function	Delhi
Siekevitz. 1974		Holt, Rinehart and Winston, New
Marril David, j. 1962	Evolution and Genetics	York.
Nair, P.G.K. Prabhakar	A Text book of Genetics	Konark Publishers pvt.Ltd. A.
Achar, K.	& Evolution	149, Main Vikar Marg, New
Fair banks, D.J. and	Genetics – the community of life	Delhi
Anderson, W.R. 1999		Brooks-Cole, California.
Pawar, C.B.1983	Essentials of Cytology	
		Himalayan publishing house,
Savage, J.M. 1969	Evolution	Bombay.
Stansfields, W.D.1977	The Science of Evolution	Oxford and IBH, New Delhi
		Calif polytechnic state university
Sinnot, E.W., Dunn, L.C.,	Principles of Genetics	and Macmillan, New York.

& Dobzhansky, T 1958		McGraw Hill, New York
Snustad, D.P., Simmons,	Principles of Genetics	
M.J. & Jenkins, J.R. 1997		John Wiley, New York.
Swanson Carl, P. 1963	Cytology and Cytogenetics	
Swanson Carl, P &	The Cell	Macmillan & Co,. Ltd. London.
Webster Peter, L.		Prentice Hall of India Pvt. Ltd,.
Strickberger Monroe, W.	Genetics	New Delhi
1968		Macmillan Company, New York.
Strichberger Monroe, W.	Evolution	
1996		John & Bartlett Sandburry.
Winchester, A.M. 1966	Genetics	
PLANT BREEDING,		Oxford & IBH, New Delhi
ECONOMIC BOTANY		
AND TAXONONY		
Allard, R.W. 1960	Principles of Plant Breeding	
Bailey,L.H. 1966	Manual of cultivated plants	John Wiley, New York
Chandrasekharn, S.N.,	Cytogenetics and Plant Breeding	Macmillan & Co., New York.
Parthasarathy,S.V.1973		Varadachary and Co., Madras.
Chaudhari, H.K. 1980	Elementary principles of Plant	
	Breeding	Oxford and IBH publishing Co.,
Hartman, h.T. & Kester,	Plant Breeding	New Delhi.
D.E. 1976		Principles and practices, Prentice
Hill, Albert, F. 1983	Economic Botany	Hall of India Pvt. Ltd., New
Jain S.C.	Medicinal plants	Delhi.
Hutchison, J. 1973	The families of Flowering plants	.Tata-McGraw Hill publishing
Lawrence, George, H.M.	Taxanomy of Vascular plants	Co. New Delhi.
1964.		Oxford University Press, London.
Naik, V.N. 1984	Taxonomy of Angiosperms	Oxford and IBH publishing Co.,
		New Delhi
Johri, B.M.&	Taxonomy of Angiosperms	Tata-McGraw Hill publishing Co.
Bhatnagar,S.P.		New Delhi.
	Taxonomy of Angiosperms	Narosa publishing House New
Pullaiah, T.1998	Vascular Plant Systematics	Delhi.
Radford,A.E.,		Regency Publications, New
Dickison,W.C., Massey, Jr	Breeding Asian Field Crops	Delhi.
& Bell, C.R 1974		Harper & Row, New York.
Poehlman, J.M. &	Flora of Shimoga District	
Dhirendranath, B.		Oxford and IBH publishing Co.,
Ramaswamy, S.N.,		New Delhi
Radhakrishna Rao,M &	Flora of Bangalore District.	Prasaranga, University of
Govindappa.D.A.2001		Mysore, Mysore.
Ramaswamy, S.V.& Razi,	Classification of Flowering	
B.A. 1973	Monocotyledons Vol.I. (Indian	Prasaranga, University of
Rendle, A.B. 1979	Reprint Edition)	Mysore, Mysore.
	Classification of Flowering	Vikas Publishing house, New
	plants-Dicotyledons Vol. II.	Delhi.

Rendle, A.B. 1979	(Indian Reprint Edition)	
	Atext book of Economic Botany.	
		Vikas Publishing house, New
Samba Murthy,A.V.S.S.&		Delhi.
Subramanyam. N.S. 1973	Flora of Karanataka, Vol. I &	
	Vol.II	
Saldhana, Cecil, J. 1984		Tata-McGraw Hill publishing Co.
	Flora of Hassan district	New Delhi.
Saldhana, Cecil, J.,	(Karnataka, India)	
&Nicolson Dan, H. 1976	Text book of Botany, Vol. III.	Oxford and IBH publishing Co.,
Saxena and Sarabhai. 1993	Plant Taxonomy	New Delhi
O.P. Sharma		Amerind Publishing Co. Pvt.Ltd.,
	Flora of India series 2: Flora of	New Delhi.
Sharma, B.D., Singh, N.P.,	Karnataka.	Ratan Prakashan Mandir.Agra.
Raghavan, R.S. & Miss.		Tata-McGraw Hill publishing Co.
Deshpande,U.R. 1984	Taxonomy of Angiosperms	Ltd.4/12, Asif ali road, New
Singh, V.	Introduction toPrinciples of plant	Delhi.
Sivarajan, V.V. 1984	taxonomy	Botanical Survey of India &
	Dictionary of Economic plants in	Dept. of Environment, New
Umarao Singh,, Wadhwani,	India	Delhi.
A.M. & Johri, B.M. 1983	Taxonomy of Angiosperms	
Vashishta, P.C. 1976		Rastogi Publications.
GENERAL	A Text book of Practical Botany	Kalyani Publications,New Delhi.
Ashok Bendre and Ashok	Vol.I & II	ICAR,New Delhi.
Kumar	Practical Botany Vol.I & II	R.Chand & Co., New Delhi
Dr. H.M. Srivastava		Rastogi Publications, Shivaji
	College Botany Vol. I, II, III &IV	road, Meerut.
Sundararajan, S.	Medicinal Plants Vol. 1- 5	Pradeep publications opp. Sitta
Kottakkal Arya Vaidya		Mandhir, Jalandhar.
sala"s	Global Biodiversity Assesment	Subha's Publications, Bangalore.
BOOKS ON		Cambridge University press,
BIODIVERSITY	Biodiversity and Ecosystem	U.K.
Heywood, H & Watson,	functions	Springer-verlag, Berlin.
R.J. 1995	Biodiversity and Ecosystem	
Schulze,E.D.& Mooney, H	function, Scope.	John wiley, Chichester.
(eds.) 1992	Biodiversity: Implications for	
Mooney, H.A.et.al. (eds).	global food security	Macmillan India Ltd. Madras.
1996	Endemic plants of the Indian	BSI Calcutta
Swamynathan, M.S. &	region Vol. I.	
Jana, S. 1992	Threatened Plants of India- A	BSI Calcutta
Ahmedullh, M. &	State-of-the-Art report	
Nayar,M.P.1987	Indian plant red data book Vol.I	BSI Calcutta
Jain, S.K.& Sastry,A.R.K		
1980	Biodiversity Database projects in	Indira Ghandi Conservation
Puri, S.K.	India.	Monitory Centre, New Delhi.

LIST OF APPROVED PANEL OF EXAMINERS:

Sl. No	Name	Designation and DOB	Joining Date	Phone number
	Internal Examiners			
1.	Dr.Prathibha S JSS College, Ooty Road, Mysore	Asso. Prof. 28/04/1964	28/08/1986	9243707241
2.	Gayathri Devi N Jss College, Ooty Road, Mysore	Asst. Prof.	01-01-2005	8050684736
3.	Kiran B L JSS College, Ooty Road, Mysore	Asst. Prof.	23-09-2015	9638219347
4.	Pooja N JSS College, Ooty Road, Mysore	Asst. Prof.	30-08-2017	9844210414
	External Examiners			
5.	Dr. Ravikumar B S AVK College For Women, Hassan	Asso. Prof. 13/07/1962	16/07/1987	8861716456
6.	Mallikarjunamiah M N Maharani`s Science college For Women, Mysore	Asso. Prof. 05/11/1963	14/08/1992	9880006223
7.	Dr. Hemavathi C Govt. First grade college, Vijayanagar, Mysuru	Asso. Prof. 05/04/1966	17/08/1992	9980748813
8.	Dr. Vijay C R Maharani`s Science College For Women, Mysore	Asso. Prof. 01/10/1962	29/12/1992	9448028585
9.	Dr. Shivalingaiah Maharani`s Science College for Women, Mysore	Asst. Prof. 01/06/1968	08/01/1996	9036766869
10.	Dr. Purushotham S P Maharani`s Science College for Women, Mysore	Asst. Prof. 15/05/1967	02/08/1996	9448115524
11.	Dr. Lingaraju D P AVK College for Women, Hassan	Asst. Prof. 26/02/1965	23/10/2002	9108585024
12.	Dr. Basavaraju G L Govt College for Women, Mandya	Asst. Prof. 21/07/1976	30/01/2004	
13.	Dr. Devika M Saradavilas College, Mysore	Asst. Prof. 14/03/1970	14/12/2005	9880024483
14.	Dr. Pruthviraj Sri Mahadeshwara Govt. First grade college	Asso. Prof.		9448925262
15.	Dr. Nataraju Maharani`s Science College for Women, Mysore	Asso. Prof.		9448033901
16.	Dr. Suresh N S Maharani`s Science College for Women, Mysore	Asst. Prof. 25/02/1975	02/05/2006	9242243601
17.	Dr. Jayalakshmi B Maharani`s Science College for Women, Mysore	Asst. Prof. 18/11/1974	14/07/2006	9482640645
18.	Sowmya H K Govt Science College,Hassan	Asst. Prof. 18/06/1970	22/12/2007	7338466887
19.	Dr. Thoyajaksha Govt Science College, Hassan	Asst. Prof. 20/07/1970	24/12/2007	9743779983
20.	Sandhya Rani D Maharani`s Science College for Women, Mysore	Asst. Prof. 24/08/1972	24/12/2007	9448602597
21.	Dr. Pushpalatha H G Maharani`s Science College for Women, Mysore	Asst. Prof. 23/12/1979	26/12/2007	9480442844
22.	Dr. Ashok N Pyati Maharani`s Science College for Women, Mysore	Asst. Prof. 22/04/1970	28/12/2007	7204661365
23.	Dr. Deepa Hebbar Maharani`s Science College for Women, Mysore	Asso. Prof.		9632869690

24.	Indushree PES College, Mandya	Asst. Prof.		8151917465
25.	Dr. Lalitha V Maharani`s Science College for Women, Mysore	Asst. Prof.		8105004148
26.	Revanamaba B Maharani`s Science College for Women, Mysore	Asst. Prof.		9448528471
27.	Dr. Sharvani, K.A Yuvarajas college, Mysore.	Asst. Prof.		9845885896
28.	Dr. Krishna Yuvarajas college, Mysore.	Asst. Prof.		
29.	Dr. Krishnamurthy Yuvarajas college, Mysore.	Asst. Prof.		
30.	Kalpashree Yuvarajas college, Mysore	Asst. Prof.		8088413446
31.	Dr. Anil Kumar Yuvaraja College, Mysuru	Asst. Prof.		8970945497
32.	Dr. Girijamba Maharani`s Science College for Women, Mysore	Asst. Prof.		9945616792
33.	Dr. Netra Maharani`s Science College for Women, Mysore	Asst. Prof.		9620782198
34.	Dr. Poornima Yuvaraja College, Mysuru	Asst. Prof.		8217642534
35.	Nayana, K. N. Yuvaraja College, Mysuru	Asst. Prof.		9964041544
36.	Dr. Shamala Maharani`s Science College for Women, Mysore	Asst. Prof.		7019453250

Aims of Bachelor's degree programme in Botany

The broad aims of the bachelor's degree programme in Botany are:

1. To provide an environment that ensures the cognitive development of students in a holistic manner. A dialogue about plants and their significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects
2. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
3. To mould a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking and communication.
4. To enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET, and UPSC Civil Services Examination.

Program Learning Outcomes

The students graduating with the Degree B.Sc. Three years and B. Sc. (Honors) Botany should be able to acquire.

Core competency: Students will acquire core competency in the subject Botany, and allied subject areas.

1. The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants.
2. Students will be able to use the evidence-based comparative botany approach to explain the evolution of organisms and understand the genetic diversity on the earth. The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome, and how organism's function is influenced at the cell, tissue, and organ level.
3. Students will be able to understand the adaptation, development, and behavior of different forms of life.
4. The understanding of networked life on earth and tracing the energy pyramids

through nutrient flow is expected from the students.

5. Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.

Analytical ability:

The students will be able to demonstrate the knowledge in understanding research and addressing practical problems.

1. Application of various scientific methods to address different questions by formulating the hypothesis, data collection, and critically analyze the data to decipher the degree to which their scientific work supports their hypothesis.

Critical Thinking and problem-solving ability:

An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinkers and acquire problem-solving capabilities.

Digitally equipped:

Students will acquire digital skills and integrate the fundamental concepts with modern tools. **Ethical and Psychological strengthing:** Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

Team Player: Students will learn team workmanship in order to serve efficiently institutions, industry, and society

Independent Learner:

Apart from the subject-specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations, and employment. Learning outcomes-based curriculum would ensure equal academic standards across the country and a broader picture of their competencies. The Bachelor's program in Botany and Botany honors may be mono-disciplinary or multidisciplinary with following broad objectives.

1. Critically evaluation of ideas and arguments by collecting relevant information about the plants, to recognize the position of the plant in the broad classification and Phylogenetic level.
2. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
3. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of the plant in taxonomy.

4. Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses.
5. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.
6. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works.
7. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations.
8. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and other forms of life.
9. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
10. Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems
11. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

B. Sc. Botany Programme outcomes as per NEP 2020

Name of the Degree Program: B.Sc. **Discipline Core: Botany**

Total Credits for the Program: 176 **Starting year of implementation: 2021-22**

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history.

PO6: Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany..

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO 9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC, KPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO 12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career

B. Sc. Botany Programme specific outcomes as per NEP 2020

PSO1: The framework of curriculum for the Bachelor's program in Botany aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation of students.

PSO2: Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into their careers.

PSO3: Special attention is given to eliminate redundancy, discourage rote learning, and espouse a problem-solving, critical thinking, and inquisitive mindset among learners.

The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects, field studies, industrial visits, and internships.

PSO4: This updated syllabus, with modern technology, helps students stay informed on the leading- edge developments in plant sciences and promotes curiosity, innovation, and a passion for research, that will serve them well in their journey into scientific adventure and discovery beyond graduation.

PSO5: The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market.

SUGGESTED METHODOLOGY FOR TEACHING, LEARNING AND EVALUATION

TEACHING-LEARNING

The whole programme is an Outcome Based Education. Different methods are to be used for teaching learning evaluation; in order to attain the fixed outcomes.

Theory:

***Student**:* Review of Literature, Assignment, Presentation, e-learning, Discussion and Debate with peer group, teachers and experts.

Teacher: Lecture, Demonstration, Presentation, Discussion and Debate.

Practical:

Student: Identification, Comparison, Differentiation and Categorization of different plants and their parts by observing Permanent Slides, Hand sectioning etc., Demonstration, Experimentation, Field visit, Report Writing and Keeping records

Teacher: Demonstration, Experimentation, Field visit, Certification

Project: The finalization of the topic should be done at the beginning of the fourth semester and the list should be kept with the HOD for the perusal of the University Examination authorities. There should be at least three projects from a department. The selection of the topic and group should be student centered as far as possible. A project log book/register is to be maintained by each student and submitted along with the project report during the final submission.

Student: Suggestion of Topic, Discussion with the Project guide and Peer group, Review of Literature, Project planning and Designing, Experimentation, Data Analysis and Project Report Preparation and Presentation.

Teacher: Confirmation of Topic, Demonstration, Planning of Experimentation, Guidance and Correction and Certification.

Experiential Learning (Internships etc.):

Student should choose one of the topics for self-study from the beginning of the seventh semester. A report should be submitted by the end of Eighth Semester.

Suggested topics include: Studies on mangroves / Sacred groves / Campus flora; Cultivation of RET / Fruit / Vegetable / Medicinal plants / Mushroom; Topics related to Social responsibility- River restoration, PBR (People Biodiversity Register) preparation, Herbarium arrangement, VFC (Village Forest Committee), VNRC (Village Natural Resource Committee) formation, Landscaping and Green Auditing.

Field Study / Study Tour:

The plant diversity studies should be carried out with the support of Field Study / Study Tour. During each year there should be a field study of 1-5 days duration, with a minimum of 5 days for the completion of the programme.

EVALUATION

External Evaluation:

External assessment by the University level examinations on specified times announced by the University for all the courses, theory, practical and Project/Viva Voce. Each student should go through the evaluation process according to the University Regulations 2021-2022

End Semester Evaluation-Theory:

The components of external evaluation and their unit wise and each theory and practical course and the time of examination will be in accordance with the calendar prepared by the University for each academic year. At the end of each semester, there will be an examination for theory courses. The duration of examinations for all theory and practical courses in Botany will be three hours, except for the Generic Elective Course papers.

External –Practical:

Practical Courses have external examination for all semester. There will be an external practical examiner and an internal examiner / skilled assistant for every practical examination of three hour duration. The external evaluation should be carried out by the team of examiners.

EXTERNAL – PROJECT / FIELD STUDY / VIVA VOCE

The Project/Field Study/General Viva Voce will be conducted in I/II/III/IV/V/VI/VII/ VIII Semester Practical Examination.

Viva should be based on:

Project work

Experiential Learning (Internships

etc) Field Study

General Learning Activity of four years:

For the external evaluation the components and weightage of Project/Field Study/ Viva Voce can be discussed and determined finally by the Board of Examiners; the suggested components and their weightage is given below. The project viva should be based on the Project and importance should be given to the Scientific method undertaken in that project. The general viva should be on based the changes in the outlook of the student after the learning activity of the 4 year programme, field study and Experiential Learning (Internships etc.). Time taken for each practical batch should be 3 hrs, by giving nearly 10-15 minutes for each student. The project/field study/viva voce evaluation should be conducted by external examiners and internal examiner.

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION

1. 80% Attendance (All Sem.)
2. Certified Bona-fide Record (All Sem.)
3. Herbarium and Field Book (Respective Sem.)
4. Field Study Reports (Respective Sem.)
5. Certified Bona-fide Project Report (Eighth Sem.)
6. Report on Experiential Learning (Internships etc.) (Eighth Sem.)

CONTINUOUS INTERNAL EVALUATION

Internal evaluation is a continuous evaluation in all types of courses- theory/ practical / Project / Field study. The teacher has flexibility in deciding the components and their weightage in accordance with the University Regulations, 2021-22. Internal evaluation should be verytransparent to the students and the components and relative weightage should be announced at the beginning of each learning activity by the concerned teacher. Internal evaluation should be published in the notice board, one week before the closure of each semester.

INTERNAL –THEORY

The percentile system can be adopted for calculating the internal component, test paper.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
	Test Papers	**40**
2	**Assignment**	**20**
	Seminar	**20**
	Viva	**10**

INTERNAL – PRACTICAL

The internal evaluation may be regular internal assessment on hourly basis or unit wise, whichever is communicated with the student.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Regularity**	**25**
2	**Practical Skill**- (Sectioning, Drawing, Labeling, Record Keeping Etc)	**50**
3	**Regular Viva/Model Examination**	**25**

INTERNAL - PROJECT/FIELD STUDY/VIVA VOCE

Internal evaluation of the project should start with the beginning of the project and can be finalized by the project viva.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Participation**	**50**
2	**Viva**	**25**
3	**Field Study and other Assignment Reports**	**25**

Curriculum Structure for the Undergraduate Degree

Program B.Sc. BOTANY

Total Credits for the Program: 176

Starting year of implementation:

2021-22 Name of the Degree Program: B.Sc.

Discipline/Subject: BOTANY

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately.

Semester	Title / Name Of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy	Assessments
1	BOT A1 Microbial Diversity and Technology	PO1	---	Ex. MOOC	Quiz
2	BOT A2 Diversity of Non flowering Plants	PO2, PO3	BOT A1	Desk Work	Debate
3	BOT A3 Plant Anatomy and	PO4, PO5	BOT A1 and A2	Problem solving,	

	Developmental Biology			Book Chapter Seminar, Project based learning, Term paper Assignment, Group Discussion Research Project Instrumentation	Class work Class work Seminar Project writing Articles writing, Interpretation of results
4	BOT A4 Ecology and Conservation Biology	PO4, PO5	BOT A1 A2 A3		
5.	BOT A5 Plant Taxonomy and Resource Botany	PO6, PO7	BOT A1 A2 A3		
	BOT A6 Cell Biology and Genetics	PO6, PO7	BOT A6 A1 A2 A3 A4 A5		
6.	BOT A7 Plant Physiology and Biochemistry	PO6, PO7, PO9	BOT A5		
	BOT A8 Plant Biotechnology	PO8. PO9	BOT A5		
7.	BOT A9 Molecular Biology	PO8, PO9	BOT A6 A8		
	BOT A10 Seed Biology and Seed Technology	PO9, PO10	BOT A5 A8 A9		
	BOT A11 Plant Health Technology	PO9, PO10	BOT A5 A4 A8		

8.	BOT A12 Medicinal Plants and Phytochemistry	PO9, PO10	BOT A4 A5 A7 A8		
	BOT A13 Bioinformatics and Computational Biology	PO9, PO10	BOT A5 A8 A9		
	BOT A14 Research Methodology	PO9, PO10	BOT A13		

- Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project based learning/ case studies/self-study like seminar, term paper or MOOC

- Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/ Evaluating/ Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning).

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka Bachelor of Science (Basic/ Hons.) (Botany as Major)

Sem.	Discipline Core (DSC) (L+T+P)	Discipline Elective (DSE) / Open Elective (OE)	Ability Enhancement Compulsory Courses (AECC), Languages (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (L+T+P)	**Value based (L+T+P)**	
I	Discipline A 1(6) **Microbial Diversity and Technology** Discipline B 1(5)	**OE-1 (3)**	**L1-1 (3), L2-1(3) (3+1+0 each)**		SEC-1: Digital Fluency (2) (1+0+2)	Health and Wellness/ Social & Emotional Learning (2) (1+0+2)	24
II	Discipline A 2(5) **Diversity of non flowering plants** Discipline B 2(6)	**OE-2 (3)**	**L1-2(3), L2-2 (3) (3+1+0 each)**	Environmental Studies (2)		Sports/NCC/NSS etc. (2) (1+0+2)	24
Exit option with Certificate (48 credits)							
III	Discipline A 3(6) **Plant Anatomy and Developmental Biology** Discipline B 3(5)	**OE-3 (3)**	**L1-3 (3), L2-3(3) (3+1+0 each)**	Constitution of India (2)	SEC-2: Artificial Intelligence (2)(1+0+2)		24
IV	Discipline A 4(5) **Ecology and conservation biology** Discipline B 4(6)	**OE-4 (3)**	**L1-4 (3), L2-4(3) (3+1+0 each)**		SEC-3: Cyber Security (2) (1+0+2)	Sports/NCC/NSS etc. (2) (1+0+2)	24
Exit option with Diploma (96 credits)							
Choose any one Discipline as Major, the other as the Minor							
V	Discipline A 5(5) **Plant Taxonomy and resource botany** Discipline A 6(5) **Cell biology and Genetics** Discipline B 5(5)	DSE A-1 (3) **Algal and Fungal Biotechnology**			SEC-3: (2) (2+0+2)	Ethics & Self Awareness (2) (1+0+2)	20
VI	Discipline A 7(5) **Plant Physiology and biochemistry** Discipline A 8(5) **Plant Biotechnology** Discipline B 6(5)	DSE A-2 (3) **Herbal Technology**			SEC-4: Professional/ Societal Communication (2)		20
Exit option with Bachelor of Science, B. Sc. Basic Degree (136 credits)							
VII	Discipline A-9(5) **Molecular Biology** Discipline A-10(5) **Seed biology and seed Technology** Discipline A-11(4) **Plant Health Technology.**	DSE A-3 (3) **Plant Propagation and Tissue Culture (3)**					20
VIII	Discipline A-12(4) **Medicinal Plants and Phytochemistry** Discipline A-13(4) **Bioinformatics and Computational Biology** Discipline A-14(3) **Research Methodology**	DSE A-4 (3) **Landscaping, Gardening and Green House Technology**					20
Award of Bachelor of Bachelor of Science Honours, B.Sc. (Hons) degree in a discipline etc. (176 credits)							

DISCIPLINE CORE PAPERS (DSC)

Sl. No.	Semester Details	Subject	Paper No
1	Semester I	Microbial Diversity and Technology	**A-1**
2	Semester II	Diversity of Non Flowering Plants	**A-2**
3	Semester III	Plant Anatomy and Development Biology	**A-3**
4	Semester IV	Ecology and Conservation Biology	**A-4**
5	Semester V	Plant taxonomy and Resource Botany	**A-5**
		Genetics and Cell Biology	**A-6**
6	Semester VI	Plant Physiology and Biochemistry	**A-7**
		Plant Biotechnology	**A-8**
7	Semester VII	Molecular Biology	**A-9**
		Seed Biology and Seed Technology	**A-10**
		Plant Health Technology	**A-11**
8	Semester VIII	Medicinal Plants and Phytochemistry	**A-12**
		Bioinformatics and Computational Biology	**A-13**
		Research Methodology	**A-14**

CORESPECIFIC ELECTIVE PAPERS (DSE)

Sl No.	Semester Details	Subject: Botany	Credits	Paper No
1	Semester V	**DSE 1:** Algal and Fungal Biotechnology	03	E-1
2	Semester VI	**DSE 2:** Herbal Technology	03	E-2
3	Semester VII	**DSE 3:** Plant Propagation and Tissue Culture	03	E-3
4	Semester VIII	**DSE 4:** Landscaping, Gardening and Green House Technology	03	E-4

BOTANY COURSE OUTCOMES (COs):

At the end of the course the student should be able to:

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

Semester I (A-1): Microbial Diversity and Technology

1. Understand the fascinating diversity, evolution, and significance of microorganisms.
2. Comprehend the systematic position, structure, physiology and life cycles of microbes and their impact on humans and environment.
3. Gain laboratory skills such as microscopy, microbial cultures, staining, identification, preservation of microbes for their applications in research and industry.

Semester II (A-2): Diversity of Non- Flowering Plants

1. Understand the diversity and affinities among Algae, Bryophytes, Pteridophytes and Gymnosperms.
2. Understand the morphology, anatomy, reproduction and life cycle across Algae, Bryophytes, Pteridophytes and Gymnosperms, and their ecological and evolutionary significance.
3. Obtain laboratory skills/explore non-flowering plants for their commercial applications.

Semester III (A-3): Plant Anatomy and Developmental Biology

1. Observation of variations that exist in internal structure of various parts of a plant and as well as among different plant groups in support for the evolutionary concept.
2. Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
3. Understanding the basic concepts in plant morphogenesis, embryology and organ development.

Semester IV (A-4): Ecology & Conservation Biology

1. Understanding the fundamental concepts in ecology, environmental science and phyto geography.
2. Concept development in conservation, global ecological crisis, Sustainable development and pros and cons of human intervention.
3. Enable the student to appreciate bio diversity and the importance of various conservation strategies, laws and regulatory authorities and global issues related to climate change and sustainable development.

Semester V (A-5): Plant Taxonomy &Resource Botany

1. Ability to identify, classify and describe the plants in scientific terms. Identification of plants using dichotomous keys.
2. Recognition, processing and utilization of economically important plants.
3. Skill development in processing of biomass and plant products as source of food, healthcare, energy and natural products.

Semester V (A-6): Cell Biology & Genetics

1. Identify the basic principles and current trends in classical genetics and Cell biology.
2. Recognize the historical process of the evolution of molecular genetics from classical genetics.
3. Develop theoretical background on molecular genetics to provide a strong support for the student for future research and employability.

Semester VI (A-7): Plant Physiology & Biochemistry

1. Preliminary understanding of the basic functions and intermediary metabolism in a plant body.
2. Awareness on the interdisciplinary nature of botany, chemistry and physics by studying the principles of plant life, growth and reproduction.
3. Recognizing the wonderful mechanism of transport and the Interrelationships existing between metabolic pathways thereby gaining and idea about the importance of plants in the dynamicity of nature.

Semester VI (A-8): Plant Biotechnology

1. Learning of knowledge & skill in plant tissue culture, plant molecular biology and transgenic.
2. Application of plant biotechnology in plant genomics, phylogenetic studies and metabolic engineering.
3. Understanding of new molecular techniques in cell and metabolic manipulations.

Semester VII (A-9): **Molecular Biology**

1. Understanding the mechanism and concepts of life process at molecular level through central dogma concept.
2. Skill acquiring in the basic molecular biology techniques & characterization of micro- molecules.
3. Acquiring the emerging technology skills in plant genetic engineering & proteomics.

Semester VII (A-10): **Seed Biology & Seed Technology**

1. Understanding the seed structure and related functions, seed health and productivity.
2. Technology for assessing the seed pathology, purity, and preservation.
3. Learning the field and laboratory protocols ofseed production, certification and quality.

Semester VII (A-11): Plant Health Technology

1. Understanding & learning common diseases & control measures ofplant diseases.
2. Acquiring skills in plant disease diagnosis, control & management through IPM.
3. Learning of new skills in health clinic through biological methods.

Semester VIII (A-13): Medicinal Plants & Phytochemistry

1. Knowledge of Indian system of medicine with regard to medicinal plants.
2. Acquiring skills in identification, cultivation and preservation of medicinal plants.
3. Isolation, identification, characteristics ofactive principles in medicinal plants & drug formulations.

Semester VIII (A-14): Bioinformatics & Computational Biology

1. Learning of basic principles of application, ICT Technology in biological studies & research.
2. Acquiring skill to utilize the computational apps, active data basis and tools in analysis in genetics & proteomics.
3. Learning skills and software used for biological research & process understanding.

Semester VIII (A-15): Research Methodology

1. Understanding the working of science for further application in free, independent, individual needs and in designing scientific experimentation.
2. Acquire knowledge on the principles, components and applications of various scientific equipment in biology.
3. Foundation knowledge in the basic concepts, components and functions of informatics and the importance of statistical principles in biological research.

Job opportunities in Botany

Exit after ONE Year: Certificate Course

I Sem. - A1: Microbial Diversity and Technology

II Sem. – A2: Diversity and Conservation of Non- Flowering plants

Job opportunities in Botany
• *Preparation of algal, fungal microbial, bryophyte*, pteridophyte, and gymnosperm slides for educational institutions and other line departments (Entrepreneurship). • Providing algal, fungal microbial, bryophyte, pteridophyte, and gymnosperm materials for educational institutions and other line departments (Entrepreneurship). • Developing Nursery (Entrepreneurship). • Nursery supervisor/manager • Mushroom cultivation (Entrepreneurship). • Cyanobaterial, algal and microbial culture (Entrepreneurship). • Fermentation industries. Dairy farming industries. Dairy products industries. Spice Industries (Lichens) • Quarantine dept., Quality control/analyst, packaging, Lab. assistant

Job opportunities in Botany

Exit After **TWO** Year: **Diploma Course**

I Semester-A3: Plant Anatomy and Developmental Biology

IV Semester-A4: Ecology and Conservation Biology

Job opportunities in Botany
In Addition to one year certificate • Preparation of Anatomy embryology and Ecological slides for educational institutions and other line departments (Entrepreneurship). • Providing Anatomy embryology and Ecological materials for educational institutions and other line departments (Entrepreneurship). • Lab technician • Garden / nursery supervisor • Developing his/her own nursery (Entrepreneurship). • Forest guard, Wild life watch guard. • Forest nursery (Entrepreneurship).

Job opportunities in Botany

Exit After **THREE** Year: **Degree Course**

V Semester-A5: Plant Taxonomy and Resource Botany

V Semester-A6: Genetics and Cell Biology

VISemester-A7: Plant Physiology and Biochemistry

VI Semester-A8: Plant Biotechnology

Job opportunities in Botany
In Addition to two year diploma • Supplying the angiosperm plants and cytological slides to the educational institutions and other line departments (Entrepreneurship). • Advisor for Health department • Marketing NTFPs species (Entrepreneurship). • RFO/ forest officers • Biochemical Laboratory (Soil, Water, Air testing etc). (Entrepreneurship). • Adviser to grow advanced crop (Biotech crop). • Farmer friendly liaison officer. • Advisor for crop improvement programme.

Job opportunities in Botany

Exit After FOUR Year: Degree Course (Honors)

VII Semester-A9: Molecular Biology

VII Semester-A10: Seed Biology and Seed Technology

VII Semester-A11: Plant Health Technology

VIII Semester-A12: Medicinal Plants and Phytochemistry

VIII Semester-A13: Bioinformatics & Computational Biology

VIII Semester-A14: Research Methodology

Jobs opportunities in Botany
In Addition to three year degree
• Assisting for Ayurvedic doctors. • Medicinal plants Marketing (Entrepreneurship). • R & D Botany, Biotechnology, Ayurvedic and Pharmaceutical Lab. • Laboratory on checking food adulteration (Entrepreneurship). • Soil and water assessment laboratory (Entrepreneurship). • Biological material analysis Laboratory (Entrepreneurship). • Teacher in primary and High Schools. • Prepare for joining Research institution for Ph.D. programmes. • Wild life photographer • Separation and Analyzing phytochemical compounds. • Seed technician. • Plant health manager

SUGGESTED DISCIPLINE SPECIFIC ELECTIVE PAPERS (DSE): UG - BOTANY

Srl No	Subject
1.	Aquatic Botany
2.	Bio-analytical techniques.
3.	Stress Biology
4.	Introduction to plant breeding
5.	Biostatistics
6.	Biofuels & Technology
7.	Horticulture post-harvest practices
8.	Reproductive biology of Angiosperms.
9.	Agroforestry
10.	Food Science
11.	Plant Microbe interaction
12.	IPR
13.	Good laboratory practices
14.	Forensic Botany
15.	Botanical garden, landscaping & Greenhouse technology
16.	Herbal Technology
17.	Plant tissue culture
18.	Genetic Engineering in plants and biosafety
19.	Fermentation Technology
20.	Palynology
21.	Organic Farming
22.	Plant Genomics and proteomics
23	Mushroom Cultivation
24	Global Climate Change
25	Dendrology and Arboriculture

.

I B.Sc., I- Semester DSC-1

Microbial Diversity and Technology

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
4	56	2	56

Content of Theory Course 1	56 Hrs
Unit –1	15
Chapter No. 1: Microbial diversity-Introduction to microbial diversity; Methods of estimation; Hierarchical organization and positions of microbes in the living world. Whittaker's five-kingdom system and Carl Richard Woese's three-domain system. Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature	5
Chapter No. 2 History and developments of microbiology-Microbiologists and their contributions **(**Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich**)**	5
Chapter No. 3 Microscopy-Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining.	5

Unit – 2	15
Chapter No. 4. Culture media for Microbes-Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media.	5
Chapter No. 5. Sterilization methods -Principle of disinfection, antiseptic, tyndallisation and Pasteurization, **Sterilization-**Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents.	5
Chapter No. 6. Microbial Growth-Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.	5
Unit – 3	11
Chapter No. 7 Microbial cultures and preservation-Microbial cultures. Pure culture and axenic cultures, subculturing, Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture collections and their importance. A brief account on ITCC, MTCC and ATCC.	5
Chapter No. 8. Viruses- General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. Vaccines and types.	4
Chapter No. 9. Viroids- general characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characters and Prion diseases**.** Economic importance of viruses.	2

Unit – 4	15
Chapter No. 10. Bacteria- General characteristics and classification. Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications. A brief account of Actinomycetes and Cyanobacteria. Mycoplasmas and Phytoplasmas- Generalcharacteristics and diseases. Economic importance of Bacteria.	5
Chapter No. 11. Fungi-General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of *Phytophthora, Rhizopus, Neurospora, Puccinia, Penicillium and Trichoderma***.** Economic importance of Fungi.	6
Chapter No. 12. Lichens – Structure and reproduction. **VAM Fungi** and their significance. **Plant diseases**-Late Blight of Potato, Black stem rust of wheat; Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike, Citrus Canker, Root Knot Disease of Mulberry.	4

Text Books

1. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman ltd. New Delhi.
2. Arora DR. 2004. Textbook of Microbiology, CBS, NewDelhi.
3. William CG.1989. Understanding microbes. A laboratory text book for Microbiology. W.H. Freeman and Company. New York.
4. Dubey RC and Maheshwari DK. 2007. A textbook of Microbiology, S. Chand and Company, NewDelhi.
5. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
6. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
7. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
8. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.

References

1. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., NewDelhi.
2. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.
3. Brook TD, Smith DW and Madigan MT. 1984. Biology of Microorganisms, 4th ed. Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.
4. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge UniversityPress. Cambridge.
5. Jayaraman J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.
6. Ketchum PA. 1988. Microbiology, concepts and applications. John Wiley and Sons. New York.
7. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, NewDelhi.
8. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house,Bombay.
9. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.
10. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.
11. Schlegel HG. 1986. General Microbiology. Cambridge. University Press. London, 587pp.
12. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
13. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, NewDelhi.

I B.Sc., I- Semester DSC-1

MICROBIAL DIVERSITY AND TECHNOLOGY

PRACTICALS **Lectures: 56 Hours**

(4 Hours/week)

Practical 1: Safety measures in microbiology laboratory and study of equipment/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, LAF, Colony counter, Haemo cytometer, Micrometer etc.).

Practical 2: Enumeration of soil/food /seed microorganisms by serial dilution technique.

Practical 3: Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of *E coli / B. subtilis/* Fungi and study of cultural characteristics.

Practical 4: Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer.

Practical 5: Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria.

Practical 6: Isolation and study of morphology of *Rhizobium* from root nodules of legumes

Practical 7: Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.

Practical 8: Study of vegetative structures and reproductive structures - *Albugo, Phytophthora, Rhizopus, Saccharomyces, Puccinia, Agaricus, Lycoperdon, Penicillium,(Depending on local availability)*

Practical 9: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 10: Study of late blight of Potato, Downy mildew of Bajra, Citrus canker, Tobacco mosaic disease, Sandal spike disease.

Practical 11: Study of well-known microbiologists and their contributions through charts and photographs (As mentioned in theory).

Practical-12: Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life.

(**Note:** Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

SCHEME OF BOTANY THEORY EXAMINATION
I SEMESTER
MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 2.5 Hours **Max Marks-** 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following: 2X4=8 Marks

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following: 5X4=20 Marks

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following: 8X4=32 Marks

13.
14.
15.
16.
17.
18.

***

BLUE PRINT OF BOTANY THEORY EXAMINATION

I SEMESTER-BLUE PRINT

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 2.5 Hours **Max Marks- 60**

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	2X2=4	5X2=10	8X1=08	22
II	2X1=2	5X1=05	8X2=16	23
III	2X2=4	5X1=05	8X1=08	17
IV	2X1=2	5X2=10	8X2=16	28
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

I SEMESTER: PAPER A-1

SCHEME OF PRACTICAL QUESTION PAPER

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 3 Hours **Max Marks**- 25

I. Write critical notes on A, B & C **3X2=6 Marks**

A and B- Microbial Instruments (As mentioned in the syllabus)
C- Microbiologists (As mentioned in the Syllabus)
(Identification- 1 mark, Application/Contribution- 1Mark)

II. Bacterial staining D -Simple / Gram's staining **5 Marks**

(Preparation- 3 Marks Flow chart- 2 Marks)

III. Prepare a temporary stained slide E of the given material and leave the preparation for evaluation. **5 Marks**

(Rhizobium, Rhizopus, Saccharomyces, Penicillium)
(Identification- 1 Mark, Mounting- 2 Marks, Diagram with reasons- 2 Marks)

IV. Identify the Specimens F & G **2X3=6 Marks**

(F- Albugo, Phytophthora, Agaricus, Lycoperdon)
(G - Plant Diseases (As Mentioned in the Syllabus)
(Identification with Diagram - 2 Marks, Reason – 1Mark

V. Identify the Permanent Slide J **3 Marks**

(Fungi/Pathology)
(Identification & Diagram- 2 Marks, reasons- 1 Marks)

****

I SEMESTER: PAPER A-1

PRACTICAL QUESTION PAPER

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 3 Hours **Max Marks**- 25

I. Write critical notes on **A, B** & **C** **6 Marks**

II. Bacterial staining **D -**Simple / Gram's staining **5 Marks**

III. Prepare a temporary stained slide **E** of the given material and leave the preparation for evaluation. **5 Marks**

IV. Identify the Specimens **F & G** **2X3=6 Marks**

V. Identify the Permanent Slide **J** **3 Marks**

NOTE: Duly valued, Certified practical record & Submissions/ Assignments/ Tour or field visit reports are compulsorily to be submitted by the student.

****

B.Sc. BOTANY: Open Elective Course (OE-1.1)

Semester I

OE-1.1: PLANTS AND HUMAN WELFARE

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with economic importance of diverse plants that offer resources to human life.
2. To make the students known about the plants used as-food, medicinal value and also plant source of different economic value.
3. To generate interest amongst the students on plants importance in day today life, conservation, ecosystem and sustainability.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory Course OE-1.1: PLANTS AND HUMAN WELFARE	39 Hrs
Unit I	13
Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation. **Cereals**: Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance. **Legumes:** General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	
Unit II	13
Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing. **Spices:** Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, clove, black pepper and cardamom. **Fruits:** Mango, grapes and Citrus (Origin, morphology, cultivation ,processing and uses) **Beverages:** Tea, Coffee (morphology, processing&uses)	.
Unit III	13
Oils and fats: General description, classification, extraction, their uses and health implications; groundnut, coconut, sunflower and mustered (Botanical name, family & uses). Non edible oil yielding trees and importance as biofuel. Neem oil and applications.	

Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents. **Drug-yielding plants:** Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Aloe vera and Cannabis. **Fibers:** Classification based on the origin of fibers; Cotton and jute (origin morphology, processing and uses).	

Text Books and References

1. Kochhar, S.L. (2012). Economic Botany in Tropics. MacMillan & Co. New Delhi.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. The Netherlands: Kluwer Academic Publishers. Netherland.
3. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett - Publishers. Lincoln, United Kingdom

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

B.Sc. BOTANY: Open Elective Course (OE-1.2)

Semester I
OE 1.2: BOTANY FOR THE BEGINNERS

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with importance of Botany: plants as natural resources.
2. To make the students known about the plants used as-food, medicinal value and economic value for sustainable development.
3. To generate interest amongst the students to know the importance of plants in day today life, ecosystem restoration.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory OE 1.2: BOTANY FOR THE BEGINNERS	39 hrs
UNIT I: Living World	**13 hrs.**
Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation. Concept of Living and Non Living: Viruses, Bacteria, Fungi, Plants and Animals; Five kingdom Classification- Classification of plants- Eichler's system – general characters of groups- An introduction to the Life cycle of plants. Cell Structure-Prokaryote and eukaryote	
UNIT II: Morphology of Angiosperms, Origin and Evolution of Life	**13 hrs**
Typical angiosperm plant: Functions of each organ viz. Root, Stem, leaves, inflorescence, flowers, fruit and seed. Flower: Basic structure - essential and non essential whorls. Definition, Ancient Concepts and Modern Concepts. Origin of Life – Geological Time scale – Variation in Hydrosphere, Lithosphere, Atmosphere and Biosphere from Pre Cambrian to Coenozoic era. Darwin's Natural Selection theory and Modern evidences at molecular and organismic level in support of Darwin's theroy	
UNIT III: Interaction between plants and animals	**13 hrs**
General concept on Interaction between plants, microbes and animals. Ecological Significance of Plants – Solar energy fixing Producers, Nitrogen fixation, biofertilisers, biopesticides, Symbiotic relationships-Mutualism, Commensalism, Protoco-operation, Parasitism.	

Plants and Animals for pollination and seed/fruit dispersal- Pollination- Entomophily, Chiropterophily, Myrmecophily Seed Dispersal: Zoochory, Specific case studies on examples for co evolution- Dodo and Calvaria, Butterflies and plants; Wasps and Ficus, mimicking for pollinators. Medicinal uses of plants – traditional knowledge and scientific knowledge – a brief account	

Text Books and References

1. Agarwal, S. K. (2009), Foundation Course in Biology, Ane Books Pvt. Ltd., New Delhi.
2. Datta, A C Class Book of Botany. New Delhi.
3. Mamatha Rao, Microbes and Non flowering plants-impacts and applications, Ane Books, Pvt Ltd, New Delhi.
4. Pandey, B. P. 2001.College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
5. Prithipal Singh (2007), An introduction to Biodiversity. Ane Books India, New Delhi
6. Raven, P.H; Johnson, G.B; Losos, J.B; Singer, S.R (2005), Biology, seventh edition, Tata McGraw Hill, New Delhi
7. Robert A Wallace. Biology: The world of life. Harper Collins Publishers

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

B.Sc. BOTANY: Open Elective Course (OE-1.3)

Semester I

OE 1.3: MUSHROOM CULTIVATION

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with mushroom cultivation for commercial exploitation.
2. To make the students known about the *Agaricus* (mushroom) used as-food, medicine and economic value for sustainable development.
3. To generate interest amongst the students to know the importance of mushroom in day today life.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory Course OE 1.3: MUSHROOM CULTIVATION	39 hrs
UNIT-I . Mycology and Mushroom Biology	**13 hrs**.
Five kingdom classification of organisms. Kingdom fungi. General characters of form, function, reproduction and relationship with other organisms. Importance of fungi in human welfare. Morphology (range of form, macro-morphology, micro-morphology), life cycle of a typical mushroom and biological function. Edible, non-edible and poisonous species. Domestication of mushroom. Importance of mushroom in human nutrition, sustainable livelihood, ecosystem function and quality of the environment.	
UNIT II. Applied Mushroom Biology	**13 hrs**
Mushroom cultivation and production. Lab scale, pilot plant and large scale cultivation of commercial species. Crop cycle- spawn, substrate, substrate processing, spawning, spawn run, cropping, harvesting, environment requirement, post harvest practices, shelf life, preservation, storage, transport and marketing. Value-added products of mushroom. Constraints and environment management. Economics of mushroom cultivation. Designs of mushroom facility. Economics of mushroom cultivation and marketing.	
UNIT IV. Mushroom Biotechnology.	**13 hrs**
Concept. Preparation of flavours, appetizers, neutraceuticals, dietary supplements and cosmetics. Mushroom bioremediation. Cleaning of polluted sites. Utilization of mushroom mycelium or enzymes in recycling biological materials. Mycofiltration and applications of the process. Mycorrhiza applications. Biopulping, biobleaching and biotransformations. Biodetergents.	

References.

1. Harandar Singh 1991. Mushrooms: the art of Cultivation. Sterling Publishers.
2. Kaul, T.N.2001. Biology and conservation of Mushrooms. Oxford and IBH Publishing Company. New Delhi.
3.Tripathi, M. Mushroom Cultivation. Oxford and IBH Publishing Company. New Delhi.
4. Suman B.C. and Sharma V P.2007. Mushroom Cultivation in India. Eastern Book Corporation. New Delhi.
5. Singh R. and U.C.Singh 2005. Modern Mushroom Cultivation. Agrobios. New Delhi.

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

OPEN ELECTIVE
SCHEME OF BOTANY THEORY EXAMINATION I SEMESTER
MODEL QUESTION PAPER

Time: 2.5 Hours **Max Marks**- 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following 2X4=8 Marks

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following 5X4=20 Marks

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following 8X4=32 Marks

13.
14.
15.
16.
17.
18.

***

OPEN ELECTIVE

BLUE PRINT OF BOTANY THEORY EXAMINATION I SEMESTER

Time: 2.5 Hours **Max Marks- 60**

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	**2X2=4**	**5X2=10**	**8X2=16**	**30**
II	**2X2=4**	**5X2=10**	**8X2=16**	**30**
III	**2X2=4**	**5X2=10**	**8X2=16**	**30**
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

I B.Sc., II- Semester DSC-2

Diversity of Non- Flowering Plants

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	56	2	56

Content of Theory Course 2	56Hrs
Unit –1	15
Chapter No. 1 Algae –Introduction and historical development in algology. General characteristics and classification of algae, Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae.	5
Chapter No. 2 Morphology and reproduction and life-cycles of Nostoc, *Oedogonium, Chara, Sargassum and Batrachospermum*. Diatoms and their importance. Blue-green algae-A general account. Algal blooms and toxins.	5
Chapter No. 3 Algal cultivation- Cultivation of microalgae-*Spirulina* and *Dunaliella;* Algal cultivation methods in India. Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses.	5

Unit – 2	15
Chapter No. 4. Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, thallus structure, Gametophytes and sporophytes.	5
Chapter No. 5 Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia, Anthoceros*, and *Funaria.* Ecological and economic importance of Bryophytes. Fossil Bryophytes.	5
Chapter No. 6. . Pteridophytes- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in *Selaginella*, *Equisetum*, *Pteris* and *Salvinia*.	5
Unit – 3	15
Chapter No. 7 A brief account of heterospory and seed habit. Stelar evolution in Pteridophytes. Affinities and evolutionary significance of Pteridophytes. Ecological and economic importance.	5
Chapter No. 8. Gymnosperms- General characteristics. Distribution and classification of Gymnosperms. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in Cycas, Pinus and Gnetum.	5
Chapter No. 9. Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines.	5

Unit – 4	11
Chapter No. 10. Origin and evolution of Plants: Origin and evolution of plants through Geological Time scale.	2
Chapter No. 11. Paleobotany- Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts. Radiocarbon dating.	5
Chapter No. 12. Fossil taxa- *Rhynia, Lepidodendron, Lepidocarpon,Lyginopteris and Cycadeoidea*. Exploration of fossil fuels. Birbal Sahni Institute of Paleosciences.	4

Text Books

1) Chopra, G.L. A text book of Algae. Rastogi & Co., Meerut, Co., New Delhi, Depot.Allahabad.
2) Johri, Lata anf Tyagi, 2012, A Text Book of, Vedam e Books, New Delhi.
3) Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi.
4) Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi.
5) Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany.Rastogi Publication, Meerut.

References

1. Sambamurty, A.V.S.S.. A Text Book of Algae. I.K. International Private Ltd., New Delhi.
2. Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
3. Anderson R.A. 2005, Algal cultural Techniques, Elsievier, London.
4. Publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi.

5. Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew- Hill Publishing Co. New Delhi, Freeman & Co., New York.
6. Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press.
7. Goffinet B and Shaw A.J. 2009, Bryophyte Biology, 2nd ed. Cambridge Unversity Press, Cambridge.Gymnosperms.
8. Srivastava, H N, 2003. Algae Pradeep Publication, Jalandhar, India.
9. Kakkar, R.K. and B.R.Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.
10. Kumar H. D., 1999, Introductory Phycology, Affiliated East-West Press, Delhi.
11. Lee, R.E., 2008, Phycology, Cambridge Unversity Press, Cambridge. 4th edition.McGraw Hill Publishing Co., New Delhi.
12. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allhabad.
13. Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allhabad.
14. Parihar, N.S. 1977. The Morphology of Pteridophytes. Central Book Depot., Allahabad.Press, Cambridge.
15. Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.
16. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata Tata McGraw Hill Publishing, New Delhi.
17. Smith, G.M. 1971. Cryptogamic Botny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.
18. Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.
19. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.
20. Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.
21. Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.
22. Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

I B.Sc., II- Semester DSC-2

Diversity of Non- Flowering Plants

PRACTICALS **Lectures: 56 Hours**

(4 Hours/week)

Practical-1: Study of morphology, classification, reproduction and lifecycle of

Nostoc.

Practical-2: Study of morphology, classification, reproduction and life-cycle of

*Oedogonium & Chara,*Sargassum, *Batrachospermum/ Polysiphonia*.

Practical-3: Study of morphology, classification, reproduction and life-cycle of

Riccia/Marchantia &Anthoceros.

Practical-4: Study of morphology, classification, anatomy, reproduction and life-cycle of

Selaginella and Equisetum.

Practical -5: Study of morphology, classification, anatomy, reproduction and life-cycle of

Pteris, Azolla..

Practical -6: Study of morphology, classification, anatomy and reproduction

in *Cycas*.

Practical -7: Study of morphology, classification & anatomy, reproduction in

Pinus.

Practical -8: Study of morphology, classification & anatomy, reproduction in

Gnetum.

Practical -9: Study of imporratnt blue green algae causing water blooms in

the lakes.

Practical -10: Study of different methods of cultivation of ferns in a nursery.

Practical -11: Preparation of natural media and cultivation of *Azolla* in artificial ponds.

Practical -12: Media preparation and cultivation of *Spirulina*.

Practical -13: Study different algal products and fossils impressions and slides/Photographs.

Practical-14: Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/Geology museum/lab to study plant fossils.

(**Note**: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

SCHEME OF BOTANY THEORY EXAMINATION
II SEMESTER
MODEL QUESTION PAPER
DIVERSITY OF NON FLOWERING PLANTS

Time: 2.5 Hours **Max Marks-** 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following: **2X4=8 Marks**

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following: **5X4=20 Marks**

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following: **8X4=32 Marks**

13.
14.
15.
16.
17.
18.

***

BLUE PRINT OF BOTANY THEORY EXAMINATION II SEMESTER

DIVERSITY OF NON FLOWERING PLANTS

Time: 2.5 Hours **Max Marks-** 60

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	2X2=4	5X2=10	8X1=08	22
II	2X1=2	5X2=10	8X2=16	28
III	2X1=2	5X1=05	8X2=16	23
IV	2X2=4	5X1=05	8X1=08	17
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

II SEMESTER

SCHEME OF PRACTICAL QUESTION PAPER

DIVERSITY OF NON- FLOWERING PLANTS

Time: 3 Hours **Max Marks**- 25

I. Prepare a temporary stained slide of the given material A and leave the preparation for evaluation `5 Marks

Algae (Nostoc, Oedogonium, Chara, Batrachospermum / Polysiphonia)

(Preparation - 2 Mark, Diagram-1 Marks, Identification with Reasons- 2 Marks)

II. Identify the given specimens B & C 2X3=6 Marks

B- Bryophytes (Marchantia and Anthoceros)
C- Pteridophytes (Selaginella, Equisetum, Pteris , Azolla,)

(Identification- 1 Mark, Diagram with reasons- 2 Marks)

III. Identify the Permanent Slides D, E, F & G 4X2=8 Marks

(One each from Algae, Bryophyte, Pteridophyte and Gymnosperms)

(Identification- 1 Mark, Diagram with Reasons-1 Marks)

IV. Comment on H & I 2X3=6 Marks

H- Gymnosperm
I – Fossils

(Identification- 1 Mark, Diagram with Reasons- 2 Marks)

****

II SEMESTER

PRACTICAL QUESTION PAPER

DIVERSITY OF NON- FLOWERING PLANTS

Time: 3 Hours **Max Marks**- 25

I. Prepare a temporary stained slide of the given material **A** and leave the preparation for evaluation `

5 Marks

II. Identify the given specimens **B &C** **2X3=6 Marks**

III. Identify the Permanent Slides **D, E, F & G** **4X2=8 Marks**

IV. Comment on **H & I** **2X3=6 Marks**

NOTE: Duly valued, Certified practical record & Submissions/ Assignments/ Tour or field visit reports are compulsorily to be submitted by the student.

****

Open Elective Course (OE-2.1)
I B.Sc., Semester II

PLANT PROPAGATION, NURSERY MANAGEMENT AND GARDENING

Paper Outcome:

On completion of this course, the students will be able to

1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants.
2. To get knowledge of new and modern techniques of plant propagation.
3. To develop interest in nature and plant life.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Unit I :Nursery and Vegetative propagation	13
Definition, objectives and scope and general practices and building up of infrastructure for nursery, planning and seasonal activities. Planting - direct seeding and transplants, Soil free/soilless/ synthetic growth mediums for pots and nursery. Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants .Green house, mist chamber, shed root, shade house and glass house.	
Unit II :Gardening	13
Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening, parks and its components. Plant materials and design. Computer applications in landscaping, Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	
Unit III: Seed, Sowing/raising of seeds and seedlings	13
Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification. Transplanting of seedlings - Study of cultivation of different vegetables and flowering plants: cabbage, brinjal, lady's finger, tomatoes, carrots, bougainvillea, roses, geranium, ferns, petunia, orchids etc. Storage and marketing procedures. Developing and maintence of different types of lawns. Bonsai technique.	

Text Books and References

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. Dept. of Agriculture and Cooperation, National Seed Corporation Ltd. New Delhi.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. Oxford & IBH Publishing Co. New Delhi.
3. Jules, J. (1979). Horticultural Science, 3rd edition. W.H. Freeman and Co. San Francisco, California.
4. Kumar, N. (1997). Introduction to Horticulture. Rajalakshmi Publications. Nagercoil, Tamil Nadu.
5. Musser E., Andres. (2005). Fundamentals of Horticulture. McGraw Hill Book Co. New Delhi
6. Sandhu, M.K. (1989). Plant Propagation. Walle Eastern Ltd. Bangalore.

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Open Elective Course (OE-2.2)

I B.Sc., Semester II

BIO-FUELS

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with Bio-fuel plant species cultivation for commercial exploitation.
2. To make the students known about the Bio-fuel used in automobile industries and solving fuel problems in feature.
3. To generate interest amongst the students to know the importance of Bio-fuel in day today life and economic wellbeing.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

UNIT-I	**10 hrs**.
Introduction, definition, scope and Importance of Bio-fuel with respect to climate change and environmental issues. Public awareness. Biofuels scenario in India and world. History of Biofuels. Advantages and disadvantages of biofuels. Developmental generation of biofuels: first, second, third and fourth generation of biofuels and present status.	
UNIT II	**16 hrs**
Biofuel feed stocks: Agricultural waste, farm waste, forestry waste, organic wastes from the residential, institutional and industrial waste and its importance.(Biomass-plant, animal and microbial based waste). Algal biofuel. Biodiesel species: *Pongamia pinnata, Simarouba gluca, Jatropha curcas, Azardirachta india, Madhuca indica* and *Callophyllum innophyllum* . Seed harvesting, processing, oil extraction, and characterization.	
UNIT III	**13 hrs**
Introduction to biodiesel, bioethanol, biogas and bio hydrogen. Production technology of biofuels (Biodiesel, ehanol and biogas). Quality analysis of biodiesel, bioethanol and biogas and its comparison with national and international standards. Biofuel sustainability; Biofuel Policy in Karnataka and India. Biofuel production statistics. Fuel against food security concepts.	

Text Books and References

1) The Biodiesel Handbook (2005). Jurgen Krahl, Jon Harlan Van Gerpen.AOCS Press.
2) Bioenergy and Biofuels (2017).Ozcan Konur. CRC Press, Taylor & Franci's group.
3) https://mnre.gov.in/biofuels

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Open Elective Course (OE-2.3)

I B.Sc., Semester II

BIOFERTILISERS

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with bio-fertilizer plant species cultivation for commercial exploitation.
2. To make the students known about the bio-fertilizer used in agriculture forming and industries and solving problems erupted by synthetic fertilizer.
3. To generate interest amongst the students to know the importance of bio-fertilizer in day today agricultural practices and economic wellbeing.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	**39**	**0**	**00**

Content of Theory Course 2.3: BIOFERTILISERS	39 hrs
UNIT-I . General account, isolation and mass multiplication	**13 hrs.**
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. *Azospirillum:* isolation and mass multiplication – carrier based inoculants, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication	
UNIT II. Association of Cyanobacteria and Fungi	**13hrs**
Cyanobacteria (blue green algae), *Azolla* and *Anabaena Azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM –its influence on growth and yield of crop plants	
UNIT III. Applications of Cyanobacteria and Fungi	**13 hrs**
Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – bio-compost making methods, types and method of vermin-composting – field Application.	

Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya Publishers. New Delhi.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

PEDAGOGY:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

OPEN ELECTIVE
SCHEME OF BOTANY THEORY EXAMINATION II SEMESTER
MODEL QUESTION PAPER

Time: 2.5 Hours **Max Marks**- 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following 2X4=8 Marks

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following 5X4=20 Marks

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following 8X4=32 Marks

13.
14.
15.
16.
17.
18.

***

OPEN ELECTIVE
BLUE PRINT OF BOTANY THEORY EXAMINATION II SEMESTER

Time: 2.5 Hours **Max Marks- 60**

Weightage of Marks				
Units	2 marks	5 marks	8 marks	Total Mks.
I	2X2=4	5X2=10	8X2=16	30
II	2X2=4	5X2=10	8X2=16	30
III	2X2=4	5X2=10	8X2=16	30
	12 Marks	30Marks	48 Marks	90 Marks

LIST OF APPROVED PANEL OF EXAMINERS:

Sl. No	Name	Designation and DOB	Joining Date	Phone number
	Internal Examiners			
1.	Dr.Prathibha S JSS College, Ooty Road, Mysore	Asso. Prof. 28/04/1964	28/08/1986	9243707241
2.	Gayathri Devi N Jss College, Ooty Road, Mysore	Asst. Prof.	01-01-2005	8050684736
3.	Kiran B L JSS College, Ooty Road, Mysore	Asst. Prof.	23-09-2015	9638219347
4.	Pooja N JSS College, Ooty Road, Mysore	Asst. Prof.	30-08-2017	9844210414
	External Examiners			
5.	Dr. Ravikumar B S AVK College For Women, Hassan	Asso. Prof. 13/07/1962	16/07/1987	8861716456
6.	Mallikarjunamiah M N Maharani`s Science college For Women, Mysore	Asso. Prof. 05/11/1963	14/08/1992	9880006223
7.	Dr. Hemavathi C Govt. First grade college, Vijayanagar, Mysuru	Asso. Prof. 05/04/1966	17/08/1992	9980748813
8.	Dr. Vijay C R Maharani`s Science College For Women, Mysore	Asso. Prof. 01/10/1962	29/12/1992	9448028585
9.	Dr. Shivalingaiah Maharani`s Science College for Women, Mysore	Asst. Prof. 01/06/1968	08/01/1996	9036766869
10.	Dr. Purushotham S P Maharani`s Science College for Women, Mysore	Asst. Prof. 15/05/1967	02/08/1996	9448115524
11.	Dr. Lingaraju D P AVK College for Women, Hassan	Asst. Prof. 26/02/1965	23/10/2002	9108585024
12.	Dr. Basavaraju G L Govt College for Women, Mandya	Asst. Prof. 21/07/1976	30/01/2004	
13.	Dr. Devika M Saradavilas College, Mysore	Asst. Prof. 14/03/1970	14/12/2005	9880024483
14.	Dr. Pruthviraj Sri Mahadeshwara Govt. First grade college	Asso. Prof.		9448925262
15.	Dr. Nataraju Maharani`s Science College for Women, Mysore	Asso. Prof.		9448033901
16.	Dr. Suresh N S Maharani`s Science College for Women, Mysore	Asst. Prof. 25/02/1975	02/05/2006	9242243601
17.	Dr. Jayalakshmi B Maharani`s Science College for Women, Mysore	Asst. Prof. 18/11/1974	14/07/2006	9482640645
18.	Sowmya H K Govt Science College,Hassan	Asst. Prof. 18/06/1970	22/12/2007	7338466887
19.	Dr. Thoyajaksha Govt Science College, Hassan	Asst. Prof. 20/07/1970	24/12/2007	9743779983
20.	Sandhya Rani D Maharani`s Science College for Women, Mysore	Asst. Prof. 24/08/1972	24/12/2007	9448602597
21.	Dr. Pushpalatha H G Maharani`s Science College for Women, Mysore	Asst. Prof. 23/12/1979	26/12/2007	9480442844
22.	Dr. Ashok N Pyati Maharani`s Science College for Women, Mysore	Asst. Prof. 22/04/1970	28/12/2007	7204661365
23.	Dr. Deepa Hebbar Maharani`s Science College for Women, Mysore	Asso. Prof.		9632869690

24.	Indushree PES College, Mandya	Asst. Prof.		8151917465
25.	Dr. Lalitha V Maharani`s Science College for Women, Mysore	Asst. Prof.		8105004148
26.	Revanamaba B Maharani`s Science College for Women, Mysore	Asst. Prof.		9448528471
27.	Dr. Sharvani, K.A Yuvarajas college, Mysore.	Asst. Prof.		9845885896
28.	Dr. Krishna Yuvarajas college, Mysore.	Asst. Prof.		
29.	Dr. Krishnamurthy Yuvarajas college, Mysore.	Asst. Prof.		
30.	Kalpashree Yuvarajas college, Mysore	Asst. Prof.		8088413446
31.	Dr. Anil Kumar Yuvaraja College, Mysuru	Asst. Prof.		8970945497
32.	Dr. Girijamba Maharani`s Science College for Women, Mysore	Asst. Prof.		9945616792
33.	Dr. Netra Maharani`s Science College for Women, Mysore	Asst. Prof.		9620782198
34.	Dr. Poornima Yuvaraja College, Mysuru	Asst. Prof.		8217642534
35.	Nayana, K. N. Yuvaraja College, Mysuru	Asst. Prof.		9964041544
36.	Dr. Shamala Maharani`s Science College for Women, Mysore	Asst. Prof.		7019453250

Aims of Bachelor’s degree programme in Botany

The broad aims of the bachelor's degree programme in Botany are:

1. To provide an environment that ensures the cognitive development of students in a holistic manner. A dialogue about plants and their significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects
2. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
3. To mould a responsible citizen who is aware of the most basic domain-independent knowledge, including critical thinking and communication.
4. To enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET, and UPSC Civil Services Examination.

Program Learning Outcomes

The students graduating with the Degree B.Sc. Three years and B. Sc. (Honors) Botany should be able to acquire.

Core competency: Students will acquire core competency in the subject Botany, and allied subject areas.

1. The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants.
2. Students will be able to use the evidence-based comparative botany approach to explain the evolution of organisms and understand the genetic diversity on the earth. The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome, and how organism’s function is influenced at the cell, tissue, and organ level.
3. Students will be able to understand the adaptation, development, and behavior of different forms of life.
4. The understanding of networked life on earth and tracing the energy pyramids

through nutrient flow is expected from the students.

5. Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.

Analytical ability:

The students will be able to demonstrate the knowledge in understanding research and addressing practical problems.

1. Application of various scientific methods to address different questions by formulating the hypothesis, data collection, and critically analyze the data to decipher the degree to which their scientific work supports their hypothesis.

Critical Thinking and problem-solving ability:

An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinkers and acquire problem-solving capabilities.

Digitally equipped:

Students will acquire digital skills and integrate the fundamental concepts with modern tools. **Ethical and Psychological strengthing:** Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

Team Player: Students will learn team workmanship in order to serve efficiently institutions, industry, and society

Independent Learner:

Apart from the subject-specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations, and employment. Learning outcomes-based curriculum would ensure equal academic standards across the country and a broader picture of their competencies. The Bachelor's program in Botany and Botany honors may be mono-disciplinary or multidisciplinary with following broad objectives.

1. Critically evaluation of ideas and arguments by collecting relevant information about the plants, to recognize the position of the plant in the broad classification and Phylogenetic level.
2. Identify problems and independently propose solutions using creative approaches, acquired through interdisciplinary experiences, and a depth and breadth of knowledge/expertise in the field of Plant Identification.
3. Accurately interpretation of collected information and use taxonomical information to evaluate and formulate a position of the plant in taxonomy.

4. Students will be able to apply the scientific method to questions in botany by formulating testable hypotheses, collecting data that address these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their hypotheses.
5. Students will be able to present scientific hypotheses and data both orally and in writing in the formats that are used by practicing scientists.
6. Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works.
7. Students will be able to apply fundamental mathematical tools (statistics, calculus) and physical principles (physics, chemistry) to the analysis of relevant biological situations.
8. Students will be able to identify the major groups of organisms with an emphasis on plants and be able to classify them within a phylogenetic framework. Students will be able to compare and contrast the characteristics of plants, algae, and fungi that differentiate them from each other and other forms of life.
9. Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth. They will be able to use specific examples to explicate how descent with modification has shaped plant morphology, physiology, and life history.
10. Students will be able to explain the ecological interconnectedness of life on earth by tracing energy and nutrient flow through the environment. They will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems
11. Students will be able to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization within biology.

B. Sc. Botany Programme outcomes as per NEP 2020

Name of the Degree Program: B.Sc. **Discipline Core: Botany**

Total Credits for the Program: 176 **Starting year of implementation: 2021-22**

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

PO1: Skill development for the proper description using botanical terms, identification, naming and classification of life forms especially plants and microbes.

PO2: Acquisition of knowledge on structure, life cycle and life processes that exist among plant and microbial diversity through certain model organism studies.

PO3: Understanding of various interactions that exist among plants and microbes; to develop the curiosity on the dynamicity of nature.

PO4: Understanding of the major elements of variation that exist in the living world through comparative morphological and anatomical study.

PO5: Ability to explain the diversity and evolution based on the empirical evidences in morphology, anatomy, embryology, physiology, biochemistry, molecular biology and life history.

PO6: Skill development for the collection, preservation and recording of information after observation and analysis- from simple illustration to molecular database development.

PO7: Making aware of the scientific and technological advancements- Information and Communication, Biotechnology and Molecular Biology for further learning and research in all branches of Botany..

PO8: Internalization of the concept of conservation and evolution through the channel of spirit of inquiry.

PO 9: To enable the graduates to prepare for national as well as international level competitive examinations like UGC-CSIR, UPSC, KPSC etc.

PO10: To enable the students for practicing the best teaching pedagogy as a biology teacher including the latest digital modules.

PO 11: The graduates should be knowledgeable and competent enough to appropriately deliver on aspects of global importance like climate change, SDGs, green technologies etc at the right opportunity.

PO 12: The graduate should be able to demonstrate sufficient proficiency in the hands-on experimental techniques for their area of specialization within biology during research and in the professional career

B. Sc. Botany Programme specific outcomes as per NEP 2020

PSO1: The framework of curriculum for the Bachelor's program in Botany aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation of students.

PSO2: Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into their careers.

PSO3: Special attention is given to eliminate redundancy, discourage rote learning, and espouse a problem-solving, critical thinking, and inquisitive mindset among learners.

The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects, field studies, industrial visits, and internships.

PSO4: This updated syllabus, with modern technology, helps students stay informed on the leading- edge developments in plant sciences and promotes curiosity, innovation, and a passion for research, that will serve them well in their journey into scientific adventure and discovery beyond graduation.

PSO5: The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market.

SUGGESTED METHODOLOGY FOR TEACHING, LEARNING AND EVALUATION

TEACHING-LEARNING

The whole programme is an Outcome Based Education. Different methods are to be used for teaching learning evaluation; in order to attain the fixed outcomes.

Theory:

***Student**:* Review of Literature, Assignment, Presentation, e-learning, Discussion and Debate with peer group, teachers and experts.

Teacher: Lecture, Demonstration, Presentation, Discussion and Debate.

Practical:

Student: Identification, Comparison, Differentiation and Categorization of different plants and their parts by observing Permanent Slides, Hand sectioning etc., Demonstration, Experimentation, Field visit, Report Writing and Keeping records

Teacher: Demonstration, Experimentation, Field visit, Certification

Project: The finalization of the topic should be done at the beginning of the fourth semester and the list should be kept with the HOD for the perusal of the University Examination authorities. There should be at least three projects from a department. The selection of the topic and group should be student centered as far as possible. A project log book/register is to be maintained by each student and submitted along with the project report during the final submission.

Student: Suggestion of Topic, Discussion with the Project guide and Peer group, Review of Literature, Project planning and Designing, Experimentation, Data Analysis and Project Report Preparation and Presentation.

Teacher: Confirmation of Topic, Demonstration, Planning of Experimentation, Guidance and Correction and Certification.

Experiential Learning (Internships etc.):

Student should choose one of the topics for self-study from the beginning of the seventh semester. A report should be submitted by the end of Eighth Semester.

Suggested topics include: Studies on mangroves / Sacred groves / Campus flora; Cultivation of RET / Fruit / Vegetable / Medicinal plants / Mushroom; Topics related to Social responsibility- River restoration, PBR (People Biodiversity Register) preparation, Herbarium arrangement, VFC (Village Forest Committee), VNRC (Village Natural Resource Committee) formation, Landscaping and Green Auditing.

Field Study / Study Tour:

The plant diversity studies should be carried out with the support of Field Study / Study Tour. During each year there should be a field study of 1-5 days duration, with a minimum of 5 days for the completion of the programme.

EVALUATION

External Evaluation:

External assessment by the University level examinations on specified times announced by the University for all the courses, theory, practical and Project/Viva Voce. Each student should go through the evaluation process according to the University Regulations 2021-2022

End Semester Evaluation-Theory:

The components of external evaluation and their unit wise and each theory and practical course and the time of examination will be in accordance with the calendar prepared by the University for each academic year. At the end of each semester, there will be an examination for theory courses. The duration of examinations for all theory and practical courses in Botany will be three hours, except for the Generic Elective Course papers.

External –Practical:

Practical Courses have external examination for all semester. There will be an external practical examiner and an internal examiner / skilled assistant for every practical examination of three hour duration. The external evaluation should be carried out by the team of examiners.

EXTERNAL – PROJECT / FIELD STUDY / VIVA VOCE

The Project/Field Study/General Viva Voce will be conducted in I/II/III/IV/V/VI/VII/ VIII Semester Practical Examination.

Viva should be based on:

Project work

Experiential Learning (Internships

etc) Field Study

General Learning Activity of four years:

For the external evaluation the components and weightage of Project/Field Study/ Viva Voce can be discussed and determined finally by the Board of Examiners; the suggested components and their weightage is given below. The project viva should be based on the Project and importance should be given to the Scientific method undertaken in that project. The general viva should be on based the changes in the outlook of the student after the learning activity of the 4 year programme, field study and Experiential Learning (Internships etc.). Time taken for each practical batch should be 3 hrs, by giving nearly 10-15 minutes for each student. The project/field study/viva voce evaluation should be conducted by external examiners and internal examiner.

ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION

1. 80% Attendance (All Sem.)
2. Certified Bona-fide Record (All Sem.)
3. Herbarium and Field Book (Respective Sem.)
4. Field Study Reports (Respective Sem.)
5. Certified Bona-fide Project Report (Eighth Sem.)
6. Report on Experiential Learning (Internships etc.) (Eighth Sem.)

CONTINUOUS INTERNAL EVALUATION

Internal evaluation is a continuous evaluation in all types of courses- theory/ practical / Project / Field study. The teacher has flexibility in deciding the components and their weightage in accordance with the University Regulations, 2021-22. Internal evaluation should be verytransparent to the students and the components and relative weightage should be announced at the beginning of each learning activity by the concerned teacher. Internal evaluation should be published in the notice board, one week before the closure of each semester.

INTERNAL –THEORY

The percentile system can be adopted for calculating the internal component, test paper.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Attendance**	**10**
	Test Papers	**40**
2	**Assignment**	**20**
	Seminar	**20**
	Viva	**10**

INTERNAL – PRACTICAL

The internal evaluation may be regular internal assessment on hourly basis or unit wise, whichever is communicated with the student.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Regularity**	**25**
2	**Practical Skill**- (Sectioning, Drawing, Labeling, Record Keeping Etc)	**50**
3	**Regular Viva/Model Examination**	**25**

INTERNAL - PROJECT/FIELD STUDY/VIVA VOCE

Internal evaluation of the project should start with the beginning of the project and can be finalized by the project viva.

Sl. No.	COMPONENTS	WEIGHTAGE
1	**Participation**	**50**
2	**Viva**	**25**
3	**Field Study and other Assignment Reports**	**25**

Curriculum Structure for the Undergraduate Degree

Program B.Sc. BOTANY

Total Credits for the Program: 176

Starting year of implementation:

2021-22 Name of the Degree Program: B.Sc.

Discipline/Subject: BOTANY

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately.

Semester	Title / Name Of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy	Assessments
1	BOT A1 Microbial Diversity and Technology	PO1	---	Ex. MOOC	Quiz
2	BOT A2 Diversity of Non flowering Plants	PO2, PO3	BOT A1	Desk Work	Debate
3	BOT A3 Plant Anatomy and	PO4, PO5	BOT A1 and A2	Problem solving,	

	Developmental Biology			Book Chapter	Class work
4	BOT A4 Ecology and Conservation Biology	PO4, PO5	BOT A1 A2 A3	Seminar,	
5.	BOT A5 Plant Taxonomy and Resource Botany	PO6, PO7	BOT A1 A2 A3	Project based learning,	Class work
	BOT A6 Cell Biology and Genetics	PO6, PO7	BOT A6 A1 A2 A3 A4 A5		Seminar
6.	BOT A7 Plant Physiology and Biochemistry	PO6, PO7, PO9	BOT A5	Term paper Assignment,	Project writing
	BOT A8 Plant Biotechnology	PO8. PO9	BOT A5	Group Discussion	Articles writing,
7.	BOT A9 Molecular Biology	PO8, PO9	BOT A6 A8	Research Project Instrumentation	Interpretation of results
	BOT A10 Seed Biology and Seed Technology	PO9, PO10	BOT A5 A8 A9		
	BOT A11 Plant Health Technology	PO9, PO10	BOT A5 A4 A8		

8.	BOT A12 Medicinal Plants and Phytochemistry	PO9, PO10	BOT A4 A5 A7 A8		
	BOT A13 Bioinformatics and Computational Biology	PO9, PO10	BOT A5 A8 A9		
	BOT A14 Research Methodology	PO9, PO10	BOT A13		

- Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project based learning/ case studies/self-study like seminar, term paper or MOOC

- Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/ Evaluating/ Creating). However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning).

IIA. Model Program Structures for the Under-Graduate Programs in Universities and Colleges in Karnataka Bachelor of Science (Basic/ Hons.) (Botany as Major)

Sem.	Discipline Core (DSC) (L+T+P)	Discipline Elective (DSE) / Open Elective (OE)	Ability Enhancement Compulsory Courses (AECC), Languages (L+T+P)		Skill Enhancement Courses (SEC)		Total Credits
					Skill based (L+T+P)	Value based (L+T+P)	
I	Discipline A 1(6) **Microbial Diversity and Technology** Discipline B 1(5)	**OE-1 (3)**	**L1-1 (3), L2-1(3) (3+1+0 each)**		SEC-1: Digital Fluency (2) (1+0+2)	Health and Wellness/ Social & Emotional Learning (2) (1+0+2)	24
II	Discipline A 2(5) **Diversity of non flowering plants** Discipline B 2(6)	**OE-2 (3)**	**L1-2(3), L2-2 (3) (3+1+0 each)**	Environmental Studies (2)		Sports/NCC/NSS etc. (2) (1+0+2)	24
Exit option with Certificate (48 credits)							
III	Discipline A 3(6) **Plant Anatomy and Developmental Biology** Discipline B 3(5)	**OE-3 (3)**	**L1-3 (3), L2-3(3) (3+1+0 each)**	Constitution of India (2)	SEC-2: Artificial Intelligence (2)(1+0+2)		24
IV	Discipline A 4(5) **Ecology and conservation biology** Discipline B 4(6)	**OE-4 (3)**	**L1-4 (3), L2-4(3) (3+1+0 each)**		SEC-3: Cyber Security (2) (1+0+2)	Sports/NCC/NSS etc. (2) (1+0+2)	24
Exit option with Diploma (96 credits)							
Choose any one Discipline as Major, the other as the Minor							
V	Discipline A 5(5) **Plant Taxonomy and resource botany** Discipline A 6(5) **Cell biology and Genetics** Discipline B 5(5)	DSE A-1 (3) **Algal and Fungal Biotechnology**			SEC-3: (2) (2+0+2)	Ethics & Self Awareness (2) (1+0+2)	20
VI	Discipline A 7(5) **Plant Physiology and biochemistry** Discipline A 8(5) **Plant Biotechnology** Discipline B 6(5)	DSE A-2 (3) **Herbal Technology**			SEC-4: Professional/ Societal Communication (2)		20
Exit option with Bachelor of Science, B. Sc. Basic Degree (136 credits)							
VII	Discipline A-9(5) **Molecular Biology** Discipline A-10(5) **Seed biology and seed Technology** Discipline A-11(4) **Plant Health Technology.**	DSE A-3 (3) **Plant Propagation and Tissue Culture (3)**					20
VIII	Discipline A-12(4) **Medicinal Plants and Phytochemistry** Discipline A-13(4) **Bioinformatics and Computational Biology** Discipline A-14(3) **Research Methodology**	DSE A-4 (3) **Landscaping, Gardening and Green House Technology**					20
Award of Bachelor of Bachelor of Science Honours, B.Sc. (Hons) degree in a discipline etc. (176 credits)							

DISCIPLINE CORE PAPERS (DSC)

Sl. No.	Semester Details	Subject	Paper No
1	Semester I	Microbial Diversity and Technology	**A-1**
2	Semester II	Diversity of Non Flowering Plants	**A-2**
3	Semester III	Plant Anatomy and Development Biology	**A-3**
4	Semester IV	Ecology and Conservation Biology	**A-4**
5	Semester V	Plant taxonomy and Resource Botany	**A-5**
		Genetics and Cell Biology	**A-6**
6	Semester VI	Plant Physiology and Biochemistry	**A-7**
		Plant Biotechnology	**A-8**
7	Semester VII	Molecular Biology	**A-9**
		Seed Biology and Seed Technology	**A-10**
		Plant Health Technology	**A-11**
8	Semester VIII	Medicinal Plants and Phytochemistry	**A-12**
		Bioinformatics and Computational Biology	**A-13**
		Research Methodology	**A-14**

CORESPECIFIC ELECTIVE PAPERS (DSE)

Sl No.	Semester Details	Subject: Botany	Credits	Paper No
1	Semester V	**DSE 1:** Algal and Fungal Biotechnology	03	E-1
2	Semester VI	**DSE 2:** Herbal Technology	03	E-2
3	Semester VII	**DSE 3:** Plant Propagation and Tissue Culture	03	E-3
4	Semester VIII	**DSE 4:** Landscaping, Gardening and Green House Technology	03	E-4

BOTANY COURSE OUTCOMES (COs):

At the end of the course the student should be able to:

(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and values acquired in this course)

Semester I (A-1): Microbial Diversity and Technology

1. Understand the fascinating diversity, evolution, and significance of microorganisms.
2. Comprehend the systematic position, structure, physiology and life cycles ofmicrobes and their impact on humans and environment.
3. Gain laboratory skills such as microscopy, microbial cultures, staining, identification, preservation of microbes for their applications in research and industry.

Semester II (A-2): Diversity of Non- Flowering Plants

1. Understand the diversity and affinities among Algae, Bryophytes, Pteridophytes and Gymnosperms.
2. Understand the morphology, anatomy, reproduction and life cycle across Algae, Bryophytes, Pteridophytes and Gymnosperms, and their ecological and evolutionary significance.
3. Obtain laboratory skills/explore non-flowering plants for their commercial applications.

Semester III (A-3): Plant Anatomy and Developmental Biology

1. Observation of variations that exist in internal structure of various parts of a plant and as well as among different plant groups in support for the evolutionary concept.
2. Skill development for the proper description of internal structure using botanical terms, their identification and further classification.
3. Understanding the basic concepts in plant morphogenesis, embryology and organ development.

Semester IV (A-4): Ecology & Conservation Biology

1. Understanding the fundamental concepts in ecology, environmental science and phyto geography.
2. Concept development in conservation, global ecological crisis, Sustainable development and pros and cons of human intervention.
3. Enable the student to appreciate bio diversity and the importance of various conservation strategies, laws and regulatory authorities and global issues related to climate change and sustainable development.

Semester V (A-5): Plant Taxonomy &Resource Botany

1. Ability to identify, classify and describe the plants in scientific terms. Identification of plants using dichotomous keys.
2. Recognition, processing and utilization of economically important plants.
3. Skill development in processing of biomass and plant products as source of food, healthcare, energy and natural products.

Semester V (A-6): Cell Biology & Genetics

1. Identify the basic principles and current trends in classical genetics and Cell biology.
2. Recognize the historical process of the evolution of molecular genetics from classical genetics.
3. Develop theoretical background on molecular genetics to provide a strong support for the student for future research and employability.

Semester VI (A-7): Plant Physiology & Biochemistry

1. Preliminary understanding of the basic functions and intermediary metabolism in a plant body.
2. Awareness on the interdisciplinary nature of botany, chemistry and physics by studying the principles of plant life, growth and reproduction.
3. Recognizing the wonderful mechanism of transport and the Interrelationships existing between metabolic pathways thereby gaining and idea about the importance of plants in the dynamicity of nature.

Semester VI (A-8): Plant Biotechnology

1. Learning of knowledge & skill in plant tissue culture, plant molecular biology and transgenic.
2. Application of plant biotechnology in plant genomics, phylogenetic studies and metabolic engineering.
3. Understanding of new molecular techniques in cell and metabolic manipulations.

Semester VII (A-9): **Molecular Biology**

1. Understanding the mechanism and concepts of life process at molecular level through central dogma concept.
2. Skill acquiring in the basic molecular biology techniques & characterization of micro- molecules.
3. Acquiring the emerging technology skills in plant genetic engineering & proteomics.

Semester VII (A-10): **Seed Biology & Seed Technology**

1. Understanding the seed structure and related functions, seed health and productivity.
2. Technology for assessing the seed pathology, purity, and preservation.
3. Learning the field and laboratory protocols ofseed production, certification and quality.

Semester VII (A-11): Plant Health Technology

1. Understanding & learning common diseases & control measures ofplant diseases.
2. Acquiring skills in plant disease diagnosis, control & management through IPM.
3. Learning of new skills in health clinic through biological methods.

Semester VIII (A-13): Medicinal Plants & Phytochemistry

1. Knowledge of Indian system of medicine with regard to medicinal plants.
2. Acquiring skills in identification, cultivation and preservation of medicinal plants.
3. Isolation, identification, characteristics ofactive principles in medicinal plants & drug formulations.

Semester VIII (A-14): Bioinformatics & Computational Biology

1. Learning of basic principles of application, ICT Technology in biological studies & research.
2. Acquiring skill to utilize the computational apps, active data basis and tools in analysis in genetics & proteomics.
3. Learning skills and software used for biological research & process understanding.

Semester VIII (A-15): Research Methodology

1. Understanding the working of science for further application in free, independent, individual needs and in designing scientific experimentation.
2. Acquire knowledge on the principles, components and applications of various scientific equipment in biology.
3. Foundation knowledge in the basic concepts, components and functions of informatics and the importance of statistical principles in biological research.

Job opportunities in Botany

Exit after ONE Year: Certificate Course

I Sem. - A1: Microbial Diversity and Technology

II Sem. – A2: Diversity and Conservation of Non- Flowering plants

Job opportunities in Botany
• *Preparation of algal, fungal microbial, bryophyte*, pteridophyte, and gymnosperm slides for educational institutions and other line departments (Entrepreneurship). • Providing algal, fungal microbial, bryophyte, pteridophyte, and gymnosperm materials for educational institutions and other line departments (Entrepreneurship). • Developing Nursery (Entrepreneurship). • Nursery supervisor/manager • Mushroom cultivation (Entrepreneurship). • Cyanobaterial, algal and microbial culture (Entrepreneurship). • Fermentation industries. Dairy farming industries. Dairy products industries. Spice Industries (Lichens) • Quarantine dept., Quality control/analyst, packaging, Lab. assistant

Job opportunities in Botany

Exit After **TWO** Year: **Diploma Course**

I Semester-A3: Plant Anatomy and Developmental Biology

IV Semester-A4: Ecology and Conservation Biology

Job opportunities in Botany
In Addition to one year certificate • Preparation of Anatomy embryology and Ecological slides for educational institutions and other line departments (Entrepreneurship). • Providing Anatomy embryology and Ecological materials for educational institutions and other line departments (Entrepreneurship). • Lab technician • Garden / nursery supervisor • Developing his/her own nursery (Entrepreneurship). • Forest guard, Wild life watch guard. • Forest nursery (Entrepreneurship).

Job opportunities in Botany

Exit After **THREE** Year: **Degree Course**

V Semester-A5: Plant Taxonomy and Resource Botany

V Semester-A6: Genetics and Cell Biology

VISemester-A7: Plant Physiology and Biochemistry

VI Semester-A8: Plant Biotechnology

Job opportunities in Botany
In Addition to two year diploma • Supplying the angiosperm plants and cytological slides to the educational institutions and other line departments (Entrepreneurship). • Advisor for Health department • Marketing NTFPs species (Entrepreneurship). • RFO/ forest officers • Biochemical Laboratory (Soil, Water, Air testing etc). (Entrepreneurship). • Adviser to grow advanced crop (Biotech crop). • Farmer friendly liaison officer. • Advisor for crop improvement programme.

Job opportunities in Botany

Exit After FOUR Year: Degree Course (Honors)

VII Semester-A9: Molecular Biology

VII Semester-A10: Seed Biology and Seed Technology

VII Semester-A11: Plant Health Technology

VIII Semester-A12: Medicinal Plants and Phytochemistry

VIII Semester-A13: Bioinformatics & Computational Biology

VIII Semester-A14: Research Methodology

Jobs opportunities in Botany
In Addition to three year degree
• Assisting for Ayurvedic doctors. • Medicinal plants Marketing (Entrepreneurship). • R & D Botany, Biotechnology, Ayurvedic and Pharmaceutical Lab. • Laboratory on checking food adulteration (Entrepreneurship). • Soil and water assessment laboratory (Entrepreneurship). • Biological material analysis Laboratory (Entrepreneurship). • Teacher in primary and High Schools. • Prepare for joining Research institution for Ph.D. programmes. • Wild life photographer • Separation and Analyzing phytochemical compounds. • Seed technician. • Plant health manager

SUGGESTED DISCIPLINE SPECIFIC ELECTIVE PAPERS (DSE): UG - BOTANY

Srl No	Subject
1.	Aquatic Botany
2.	Bio-analytical techniques.
3.	Stress Biology
4.	Introduction to plant breeding
5.	Biostatistics
6.	Biofuels & Technology
7.	Horticulture post-harvest practices
8.	Reproductive biology of Angiosperms.
9.	Agroforestry
10.	Food Science
11.	Plant Microbe interaction
12.	IPR
13.	Good laboratory practices
14.	Forensic Botany
15.	Botanical garden, landscaping & Greenhouse technology
16.	Herbal Technology
17.	Plant tissue culture
18.	Genetic Engineering in plants and biosafety
19.	Fermentation Technology
20.	Palynology
21.	Organic Farming
22.	Plant Genomics and proteomics
23	Mushroom Cultivation
24	Global Climate Change
25	Dendrology and Arboriculture

.

I B.Sc., I- Semester DSC-1

Microbial Diversity and Technology

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
4	56	2	56

Content of Theory Course 1	56 Hrs
Unit –1	15
Chapter No. 1: Microbial diversity-Introduction to microbial diversity; Methods of estimation; Hierarchical organization and positions of microbes in the living world. Whittaker's five-kingdom system and Carl Richard Woese's three-domain system. Distribution of microbes in soil, air, food and water. Significance of microbial diversity in nature	5
Chapter No. 2 History and developments of microbiology-Microbiologists and their contributions **(**Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Dmitri Iwanowski, Sergius Winogradsky and M W Beijerinck and Paul Ehrlich**)**	5
Chapter No. 3 Microscopy-Working principle and applications of light, dark field, phase contrast and electron microscopes (SEM and TEM). Microbiological stains (acidic, basic and special) and Principles of staining. Simple, Gram's and differential staining.	5

Unit – 2	15
Chapter No. 4. Culture media for Microbes-Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media.	5
Chapter No. 5. Sterilization methods -Principle of disinfection, antiseptic, tyndallisation and Pasteurization, **Sterilization-**Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization-phenolic compounds, anionic and cationic detergents.	5
Chapter No. 6. Microbial Growth-Microbial growth and measurement. Nutritional types of Microbes- autotrophs and heterotrophs, phototrophs and chemotrophs; lithotrophs and organotrophs.	5
Unit – 3	11
Chapter No. 7 Microbial cultures and preservation-Microbial cultures. Pure culture and axenic cultures, subculturing, Preservation methods-overlaying cultures with mineral oils, lyophilisation. Microbial culture collections and their importance. A brief account on ITCC, MTCC and ATCC.	5
Chapter No. 8. Viruses- General structure and classification of Viruses; ICTV system of classification. Structure and multiplication of TMV, SARS-COV-2, and Bacteriophage (T2). Cultivation of viruses. Vaccines and types.	4
Chapter No. 9. Viroids- general characteristics and structure of Potato Spindle Tuber Viroid (PSTVd); Prions - general characters and Prion diseases**.** Economic importance of viruses.	2

Unit – 4	15
Chapter No. 10. Bacteria- General characteristics and classification. Archaebacteria and Eubacteria. Ultrastructure of Bacteria; Bacterial growth and nutrition. Reproduction in bacteria- asexual and sexual methods. Study of *Rhizobium* and its applications. A brief account of Actinomycetes and Cyanobacteria. Mycoplasmas and Phytoplasmas- Generalcharacteristics and diseases. Economic importance of Bacteria.	5
Chapter No. 11. Fungi-General characteristics and classification. Thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Heterothallism and parasexuality. Type study of *Phytophthora, Rhizopus, Neurospora, Puccinia, Penicillium and Trichoderma***.** Economic importance of Fungi.	6
Chapter No. 12. Lichens – Structure and reproduction. **VAM Fungi** and their significance. **Plant diseases**-Late Blight of Potato, Black stem rust of wheat; Downy Mildew of Bajra, Grain smut of Sorghum, Sandal Spike, Citrus Canker, Root Knot Disease of Mulberry.	4

Text Books

1. Ananthnarayan R and Panikar JCK. 1986. Text book of Microbiology. Orient Longman ltd. New Delhi.
2. Arora DR. 2004. Textbook of Microbiology, CBS, NewDelhi.
3. William CG.1989. Understanding microbes. A laboratory text book for Microbiology. W.H. Freeman and Company. New York.
4. Dubey RC and Maheshwari DK. 2007. A textbook of Microbiology, S. Chand and Company, NewDelhi.
5. Dubey RC and Maheshwari DK. 2002. A Text book of Microbiology, S.C.Chand and Company, Ltd. Ramnagar, New Delhi.
6. Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi. 305pp.
7. Sharma PD. 1999. Microbiology and Plant Pathology. Rastogi publications. Meerut, India.
8. Vasanthkumari R. 2007. A textbook of Microbiology, BI Publications Pvt. Ltd., New Delhi.

References

1. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., NewDelhi.
2. Allas RM. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.
3. Brook TD, Smith DW and Madigan MT. 1984. Biology of Microorganisms, 4th ed. Eaglewood Cliffts. N.J.Prentice- Hall. New Delhi.
4. Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge UniversityPress. Cambridge.
5. Jayaraman J. 1985. Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.
6. Ketchum PA. 1988. Microbiology, concepts and applications. John Wiley and Sons. New York.
7. Michel J, Pelczar Jr.EC and Krieg CR. 2005. Microbiology, Mc.Graw-Hill, NewDelhi.
8. Powar CB and Daginawala. 1991. General Microbiology, Vol – I and Vol – II Himalaya publishing house,Bombay.
9. Reddy S and Ram. 2007. Microbial Physiology. Scientific Publishers, Jodhpur, 385pp.
10. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co.Pvt.Ltd. New Delhi.
11. Schlegel HG. 1986. General Microbiology. Cambridge. University Press. London, 587pp.
12. Roger S, Ingrahan Y, Wheelis JL, Mark L and Page PR. 1990. Microbial World 5th edition. Prentice-Hall India, Pvt. Ltd. New Delhi.
13. Sullia SB. and Shantharam S. 2005. General Microbiology, Oxford and IBH, NewDelhi.

I B.Sc., I- Semester DSC-1

MICROBIAL DIVERSITY AND TECHNOLOGY

PRACTICALS **Lectures: 56 Hours**

(4 Hours/week)

Practical 1: Safety measures in microbiology laboratory and study of equipment/appliances used for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, LAF, Colony counter, Haemo cytometer, Micrometer etc.).

Practical 2: Enumeration of soil/food /seed microorganisms by serial dilution technique.

Practical 3: Preparation of culture media (NA/PDA) sterilization, inoculation, incubation of *E coli / B. subtilis/* Fungi and study of cultural characteristics.

Practical 4: Determination of cell count by using Haemocytometer and determination of microbial cell dimension by using Micrometer.

Practical 5: Simple staining of bacteria (Crystal violet /Nigrosine blue) / Gram's staining of bacteria.

Practical 6: Isolation and study of morphology of *Rhizobium* from root nodules of legumes

Practical 7: Preparation of spawn and cultivation of paddy straw (Oyster) mushroom.

Practical 8: Study of vegetative structures and reproductive structures - *Albugo, Phytophthora, Rhizopus, Saccharomyces, Puccinia, Agaricus, Lycoperdon, Penicillium,(Depending on local availability)*

Practical 9: Preparation of agar slants, inoculation, incubation, pure culturing and preservation of microbes by oil overlaying.

Practical 10: Study of late blight of Potato, Downy mildew of Bajra, Citrus canker, Tobacco mosaic disease, Sandal spike disease.

Practical 11: Study of well-known microbiologists and their contributions through charts and photographs (As mentioned in theory).

Practical-12: Visit to water purification units/Composting/ microbiology labs/dairy and farms to understand role of microbes in day today life.

(**Note:** Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

SCHEME OF BOTANY THEORY EXAMINATION
I SEMESTER
MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 2.5 Hours **Max Marks-** 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following: **2X4=8 Marks**

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following: **5X4=20 Marks**

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following: **8X4=32 Marks**

13.
14.
15.
16.
17.
18.

***

BLUE PRINT OF BOTANY THEORY EXAMINATION

I SEMESTER-BLUE PRINT

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 2.5 Hours **Max Marks- 60**

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	2X2=4	5X2=10	8X1=08	22
II	2X1=2	5X1=05	8X2=16	23
III	2X2=4	5X1=05	8X1=08	17
IV	2X1=2	5X2=10	8X2=16	28
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

I SEMESTER: PAPER A-1

SCHEME OF PRACTICAL QUESTION PAPER

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 3 Hours **Max Marks**- 25

I. Write critical notes on A, B & C **3X2=6 Marks**

A and B- Microbial Instruments (As mentioned in the syllabus)
C- Microbiologists (As mentioned in the Syllabus)
(Identification- 1 mark, Application/Contribution- 1Mark)

II. Bacterial staining D -Simple / Gram's staining **5 Marks**

(Preparation- 3 Marks Flow chart- 2 Marks)

III. Prepare a temporary stained slide E of the given material and leave the preparation for evaluation. **5 Marks**

(Rhizobium, Rhizopus, Saccharomyces, Penicillium)
(Identification- 1 Mark, Mounting- 2 Marks, Diagram with reasons- 2 Marks)

IV. Identify the Specimens F & G **2X3=6 Marks**

(F- Albugo, Phytophthora, Agaricus, Lycoperdon)
(G - Plant Diseases (As Mentioned in the Syllabus)
(Identification with Diagram - 2 Marks, Reason – 1Mark

V. Identify the Permanent Slide J **3 Marks**

(Fungi/Pathology)
(Identification & Diagram- 2 Marks, reasons- 1 Marks)

****

I SEMESTER: PAPER A-1

PRACTICAL QUESTION PAPER

MICROBIAL DIVERSITY AND TECHNOLOGY

Time: 3 Hours **Max Marks**- 25

I. Write critical notes on **A, B** & **C** **6 Marks**

II. Bacterial staining **D -**Simple / Gram's staining **5 Marks**

III. Prepare a temporary stained slide **E** of the given material and leave the preparation for evaluation. **5 Marks**

IV. Identify the Specimens **F & G** **2X3=6 Marks**

V. Identify the Permanent Slide **J** **3 Marks**

NOTE: Duly valued, Certified practical record & Submissions/ Assignments/ Tour or field visit reports are compulsorily to be submitted by the student.

****

B.Sc. BOTANY: Open Elective Course (OE-1.1)

Semester I

OE-1.1: PLANTS AND HUMAN WELFARE

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with economic importance of diverse plants that offer resources to human life.
2. To make the students known about the plants used as-food, medicinal value and also plant source of different economic value.
3. To generate interest amongst the students on plants importance in day today life, conservation, ecosystem and sustainability.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory Course OE-1.1: PLANTS AND HUMAN WELFARE	39 Hrs
Unit I	13
Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation. **Cereals**: Wheat and Rice (origin, evolution, morphology, post-harvest processing & uses).Green revolution. Brief account of millets and their nutritional importance. **Legumes:** General account (including chief pulses grown in Karnataka- red gram, green gram, chick pea, soybean). Importance to man and ecosystem.	
Unit II	13
Cash crops: Morphology, new varieties and processing of sugarcane, products and by-products of sugarcane industry. Natural Rubber –cultivation, tapping and processing. **Spices:** Listing of important spices, their family and parts used, economic importance with special reference to Karnataka. Study of fennel, clove, black pepper and cardamom. **Fruits:** Mango, grapes and Citrus (Origin, morphology, cultivation ,processing and uses) **Beverages:** Tea, Coffee (morphology, processing&uses)	.
Unit III	13
Oils and fats: General description, classification, extraction, their uses and health implications; groundnut, coconut, sunflower and mustered (Botanical name, family & uses). Non edible oil yielding trees and importance as biofuel. Neem oil and applications.	

Essential Oils: General account. Extraction methods of sandal wood oil, rosa oil and eucalyptus oil. Economic importance as medicine, perfumes and insect repellents. **Drug-yielding plants:** Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Aloe vera and Cannabis. **Fibers:** Classification based on the origin of fibers; Cotton and jute (origin morphology, processing and uses).	

Text Books and References

1. Kochhar, S.L. (2012). Economic Botany in Tropics. MacMillan & Co. New Delhi.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. The Netherlands: Kluwer Academic Publishers. Netherland.
3. Chrispeels, M.J. and Sadava, D.E. (1994) Plants, Genes and Agriculture. Jones & Bartlett - Publishers. Lincoln, United Kingdom

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

B.Sc. BOTANY: Open Elective Course (OE-1.2)

Semester I

OE 1.2: BOTANY FOR THE BEGINNERS

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with importance of Botany: plants as natural resources.
2. To make the students known about the plants used as-food, medicinal value and economic value for sustainable development.
3. To generate interest amongst the students to know the importance of plants in day today life, ecosystem restoration.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory OE 1.2: BOTANY FOR THE BEGINNERS	39 hrs
UNIT I: Living World	**13 hrs**.
Origin of Cultivated Plants. Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions. Crop domestication and loss of genetic diversity (Only conventional plant breeding methods). Importance of plant bio- diversity and conservation. Concept of Living and Non Living: Viruses, Bacteria, Fungi, Plants and Animals; Five kingdom Classification- Classification of plants- Eichler's system – general characters of groups- An introduction to the Life cycle of plants. Cell Structure-Prokaryote and eukaryote	
UNIT II: Morphology of Angiosperms, Origin and Evolution of Life	**13 hrs**
Typical angiosperm plant: Functions of each organ viz. Root, Stem, leaves, inflorescence, flowers, fruit and seed. Flower: Basic structure - essential and non essential whorls. Definition, Ancient Concepts and Modern Concepts. Origin of Life – Geological Time scale – Variation in Hydrosphere, Lithosphere, Atmosphere and Biosphere from Pre Cambrian to Coenozoic era. Darwin's Natural Selection theory and Modern evidences at molecular and organismic level in support of Darwin's theroy	
UNIT III: Interaction between plants and animals	**13 hrs**
General concept on Interaction between plants, microbes and animals. Ecological Significance of Plants – Solar energy fixing Producers, Nitrogen fixation, biofertilisers, biopesticides, Symbiotic relationships-Mutualism, Commensalism, Protoco-operation, Parasitism.	

Plants and Animals for pollination and seed/fruit dispersal- Pollination- Entomophily, Chiropterophily, Myrmecophily Seed Dispersal: Zoochory, Specific case studies on examples for co evolution- Dodo and Calvaria, Butterflies and plants; Wasps and Ficus, mimicking for pollinators. Medicinal uses of plants – traditional knowledge and scientific knowledge – a brief account	

Text Books and References

1. Agarwal, S. K. (2009), Foundation Course in Biology, Ane Books Pvt. Ltd., New Delhi.
2. Datta, A C Class Book of Botany. New Delhi.
3. Mamatha Rao, Microbes and Non flowering plants-impacts and applications, Ane Books, Pvt Ltd, New Delhi.
4. Pandey, B. P. 2001.College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
5. Prithipal Singh (2007), An introduction to Biodiversity. Ane Books India, New Delhi
6. Raven, P.H; Johnson, G.B; Losos, J.B; Singer, S.R (2005), Biology, seventh edition, Tata McGraw Hill, New Delhi
7. Robert A Wallace. Biology: The world of life. Harper Collins Publishers

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

B.Sc. BOTANY: Open Elective Course (OE-1.3)

Semester I

OE 1.3: MUSHROOM CULTIVATION

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with mushroom cultivation for commercial exploitation.
2. To make the students known about the *Agaricus* (mushroom) used as-food, medicine and economic value for sustainable development.
3. To generate interest amongst the students to know the importance of mushroom in day today life.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory Course OE 1.3: MUSHROOM CULTIVATION	39 hrs
UNIT-I . Mycology and Mushroom Biology	**13 hrs**.
Five kingdom classification of organisms. Kingdom fungi. General characters of form, function, reproduction and relationship with other organisms. Importance of fungi in human welfare. Morphology (range of form, macro-morphology, micro-morphology), life cycle of a typical mushroom and biological function. Edible, non-edible and poisonous species. Domestication of mushroom. Importance of mushroom in human nutrition, sustainable livelihood, ecosystem function and quality of the environment.	
UNIT II. Applied Mushroom Biology	**13 hrs**
Mushroom cultivation and production. Lab scale, pilot plant and large scale cultivation of commercial species. Crop cycle- spawn, substrate, substrate processing, spawning, spawn run, cropping, harvesting, environment requirement, post harvest practices, shelf life, preservation, storage, transport and marketing. Value-added products of mushroom. Constraints and environment management. Economics of mushroom cultivation. Designs of mushroom facility. Economics of mushroom cultivation and marketing.	
UNIT IV. Mushroom Biotechnology.	**13 hrs**
Concept. Preparation of flavours, appetizers, neutraceuticals, dietary supplements and cosmetics. Mushroom bioremediation. Cleaning of polluted sites. Utilization of mushroom mycelium or enzymes in recycling biological materials. Mycofiltration and applications of the process. Mycorrhiza applications. Biopulping, biobleaching and biotransformations. Biodetergents.	

References.

1. Harandar Singh 1991. Mushrooms: the art of Cultivation. Sterling Publishers.
2. Kaul, T.N.2001. Biology and conservation of Mushrooms. Oxford and IBH Publishing Company. New Delhi.
3.Tripathi, M. Mushroom Cultivation. Oxford and IBH Publishing Company. New Delhi.
4. Suman B.C. and Sharma V P.2007. Mushroom Cultivation in India. Eastern Book Corporation. New Delhi.
5. Singh R. and U.C.Singh 2005. Modern Mushroom Cultivation. Agrobios. New Delhi.

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

OPEN ELECTIVE
SCHEME OF BOTANY THEORY EXAMINATION I SEMESTER
MODEL QUESTION PAPER

Time: 2.5 Hours **Max Marks**- 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following 2X4=8 Marks

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following 5X4=20 Marks

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following 8X4=32 Marks

13.
14.
15.
16.
17.
18.

***

OPEN ELECTIVE
BLUE PRINT OF BOTANY THEORY EXAMINATION I SEMESTER

Time: 2.5 Hours **Max Marks- 60**

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	**2X2=4**	**5X2=10**	**8X2=16**	**30**
II	**2X2=4**	**5X2=10**	**8X2=16**	**30**
III	**2X2=4**	**5X2=10**	**8X2=16**	**30**
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

I B.Sc., II- Semester DSC-2

Diversity of Non- Flowering Plants

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	56	2	56

Content of Theory Course 2	56Hrs
Unit –1	15
Chapter No. 1 Algae –Introduction and historical development in algology. General characteristics and classification of algae, Diversity- habitat, thallus organization, pigments, reserve food, flagella types, life-cycle and alternation of generation in Algae. Distribution of Algae.	5
Chapter No. 2 Morphology and reproduction and life-cycles of Nostoc, *Oedogonium, Chara, Sargassum and Batrachospermum*. Diatoms and their importance. Blue-green algae-A general account. Algal blooms and toxins.	5
Chapter No. 3 Algal cultivation- Cultivation of microalgae-*Spirulina* and *Dunaliella;* Algal cultivation methods in India. Algal products- Food and Nutraceuticals, Feed stocks, food colorants; fertilizers, aquaculture feed; therapeutics and cosmetics; medicines; dietary fibres from algae and uses.	5

Unit – 2	15
Chapter No. 4. Bryophytes – General characteristics and classification of Bryophytes, Diversity-habitat, thallus structure, Gametophytes and sporophytes.	5
Chapter No. 5 Distribution, morphology, anatomy, reproduction and life-cycles of *Riccia, Anthoceros*, and *Funaria.* Ecological and economic importance of Bryophytes. Fossil Bryophytes.	5
Chapter No. 6. . Pteridophytes- General characteristics and classification; Structure of sporophytes and life-cycles. Distribution, morphology, anatomy, reproduction and life-cycles in *Selaginella*, *Equisetum*, *Pteris* and *Salvinia*.	5
Unit – 3	15
Chapter No. 7 A brief account of heterospory and seed habit. Stelar evolution in Pteridophytes. Affinities and evolutionary significance of Pteridophytes. Ecological and economic importance.	5
Chapter No. 8. Gymnosperms- General characteristics. Distribution and classification of Gymnosperms. Study of the habitat, distribution, habit, anatomy, reproduction and life-cycles in Cycas, Pinus and Gnetum.	5
Chapter No. 9. Affinities and evolutionary significance of Gymnosperms. Economic importance of Gymnosperms - food, timber, industrial uses and medicines.	5

Unit – 4	11
Chapter No. 10. Origin and evolution of Plants: Origin and evolution of plants through Geological Time scale.	2
Chapter No. 11. Paleobotany- Paleobotanical records, plant fossils, Preservation of plant fossils - impressions, compressions, petrification's, moulds and casts, pith casts.	5
Radiocarbon dating. **Chapter No. 12.** Fossil taxa- *Rhynia, Lepidodendron, Lepidocarpon,Lyginopteris and Cycadeoidea*. Exploration of fossil fuels. Birbal Sahni Institute of Paleosciences.	4

Text Books

1) Chopra, G.L. A text book of Algae. Rastogi & Co., Meerut, Co., New Delhi, Depot.Allahabad.
2) Johri, Lata anf Tyagi, 2012, A Text Book of, Vedam e Books, New Delhi.
3) Sharma, O.P. 1990. Text Book of Pteridophyta. McMillan India Ltd. New Delhi.
4) Sharma, O.P. 1992. Text Book of Thallophytes. McGraw Hill Publishing Co. New Delhi.
5) Sharma, O.P., 2017, Algae Singh-Pande-Jain 2004-05. A Text Book of Botany.Rastogi Publication, Meerut.

References

1. Sambamurty, A.V.S.S.. A Text Book of Algae. I.K. International Private Ltd., New Delhi.
2. Agashe, S.N. 1995. Paleobotany. Plants of the past, their evolution, paleoenvironment and Allied plants. Hutchinson & Co., Ltd., London.
3. Anderson R.A. 2005, Algal cultural Techniques, Elsievier, London.
4. Publication, Application in exploration of fossil fuels. Oxford & IBH., New Delhi.

5. Eams, A.J., (1974) Morphology of vascular plants - Lower groups. Tata Mc Grew- Hill Publishing Co. New Delhi, Freeman & Co., New York.
6. Fritze, R.E. 1977. Structure and reproduction of Algae. Cambridge University Press.
7. Goffinet B and Shaw A.J. 2009, Bryophyte Biology, 2nd ed. Cambridge Unversity Press, Cambridge.Gymnosperms.
8. Srivastava, H N, 2003. Algae Pradeep Publication, Jalandhar, India.
9. Kakkar, R.K. and B.R.Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.
10. Kumar H. D., 1999, Introductory Phycology, Affiliated East-West Press, Delhi.
11. Lee, R.E., 2008, Phycology, Cambridge Unversity Press, Cambridge. 4th edition.McGraw Hill Publishing Co., New Delhi.
12. Parihar, N.S. 1970. An Introduction to Embryophyta. Vol. I. Bryophyta. Central Book, Allhabad.
13. Parihar, N.S. (1976) An Introduction to Pteridophytes, Central Book Depot, Allhabad.
14. Parihar, N.S. 1977. The Morphology of Pteridophytes. Central Book Depot., Allahabad.Press, Cambridge.
15. Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New Delhi.
16. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata Tata McGraw Hill Publishing, New Delhi.
17. Smith, G.M. 1971. Cryptogamic Botny. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.
18. Sporne, K.R. 1965. The Morphology of Gymnosperms. Hutchinson & Co., Ltd., London.
19. Stewart, W.M. 1983. Paleobotany and the Evolution of Plants, Cambridge University Cambridge.
20. Sundarajan, S. 1997. College Botany Vol. I. S Chand & Co. Ltd., New Delhi.
21. Vanderpoorten, A. and Goffinet, B. 2009, Introduction to Bryophytes, Cambridge Unversity Press, Cambridge.
22. Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.

I B.Sc., II- Semester DSC-2

Diversity of Non- Flowering Plants

PRACTICALS **Lectures: 56 Hours**

(4 Hours/week)

Practical-1: Study of morphology, classification, reproduction and lifecycle of *Nostoc*.

Practical-2: Study of morphology, classification, reproduction and life-cycle of *Oedogonium & Chara,*Sargassum, *Batrachospermum/ Polysiphonia*.

Practical-3: Study of morphology, classification, reproduction and life-cycle of *Riccia/Marchantia &Anthoceros.*

Practical-4: Study of morphology, classification, anatomy, reproduction and life-cycle of *Selaginella and Equisetum.*

Practical -5: Study of morphology, classification, anatomy, reproduction and life-cycle of *Pteris, Azolla..*

Practical -6: Study of morphology, classification, anatomy and reproduction in *Cycas*.

Practical -7: Study of morphology, classification & anatomy, reproduction in *Pinus*.

Practical -8: Study of morphology, classification & anatomy, reproduction in *Gnetum*.

Practical -9: Study of imporratnt blue green algae causing water blooms in the lakes.

Practical -10: Study of different methods of cultivation of ferns in a nursery.

Practical -11: Preparation of natural media and cultivation of *Azolla* in artificial ponds.

Practical -12: Media preparation and cultivation of *Spirulina*.

Practical -13: Study different algal products and fossils impressions and slides/Photographs.

Practical-14: Visit to algal cultivation units/lakes with algal blooms/Fern house/ Nurseries/Geology museum/lab to study plant fossils.

(**Note**: Botanical study tour to a floristic rich area for 1-2 days and submission of study report is compulsory)

SCHEME OF BOTANY THEORY EXAMINATION
II SEMESTER
MODEL QUESTION PAPER
DIVERSITY OF NON FLOWERING PLANTS

Time: 2.5 Hours **Max Marks-** 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following: **2X4=8 Marks**

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following: **5X4=20 Marks**

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following: **8X4=32 Marks**

13.
14.
15.
16.
17.
18.

***

BLUE PRINT OF BOTANY THEORY EXAMINATION II SEMESTER

DIVERSITY OF NON FLOWERING PLANTS

Time: 2.5 Hours **Max Marks-** 60

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	2X2=4	5X2=10	8X1=08	22
II	2X1=2	5X2=10	8X2=16	28
III	2X1=2	5X1=05	8X2=16	23
IV	2X2=4	5X1=05	8X1=08	17
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

II SEMESTER

SCHEME OF PRACTICAL QUESTION PAPER

DIVERSITY OF NON- FLOWERING PLANTS

Time: 3 Hours **Max Marks**- 25

I. Prepare a temporary stained slide of the given material A and leave the preparation for evaluation `5 Marks

Algae (Nostoc, Oedogonium, Chara, Batrachospermum / Polysiphonia)

(Preparation - 2 Mark, Diagram-1 Marks, Identification with Reasons- 2 Marks)

II. Identify the given specimens B & C 2X3=6 Marks

B- Bryophytes (Marchantia and Anthoceros)
C- Pteridophytes (Selaginella, Equisetum, Pteris , Azolla,)

(Identification- 1 Mark, Diagram with reasons- 2 Marks)

III. Identify the Permanent Slides D, E, F & G 4X2=8 Marks

(One each from Algae, Bryophyte, Pteridophyte and Gymnosperms)

(Identification- 1 Mark, Diagram with Reasons-1 Marks)

IV. Comment on H & I 2X3=6 Marks

H- Gymnosperm
I – Fossils

(Identification- 1 Mark, Diagram with Reasons- 2 Marks)

****

II SEMESTER

PRACTICAL QUESTION PAPER

DIVERSITY OF NON- FLOWERING PLANTS

Time: 3 Hours **Max Marks**- 25

I. Prepare a temporary stained slide of the given material **A** and leave the preparation for evaluation `

5 Marks

II. Identify the given specimens **B &C** **2X3=6 Marks**

III. Identify the Permanent Slides **D, E, F & G** **4X2=8 Marks**

IV. Comment on **H & I** **2X3=6 Marks**

NOTE: Duly valued, Certified practical record & Submissions/ Assignments/ Tour or field visit reports are compulsorily to be submitted by the student.

****

Open Elective Course (OE-2.1)
I B.Sc., Semester II

PLANT PROPAGATION, NURSERY MANAGEMENT AND GARDENING

Paper Outcome:

On completion of this course, the students will be able to

1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants.
2. To get knowledge of new and modern techniques of plant propagation.
3. To develop interest in nature and plant life.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Unit I :Nursery and Vegetative propagation	13
Definition, objectives and scope and general practices and building up of infrastructure for nursery, planning and seasonal activities. Planting - direct seeding and transplants, Soil free/soilless/ synthetic growth mediums for pots and nursery. Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants .Green house, mist chamber, shed root, shade house and glass house.	
Unit II :Gardening	13
Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening, parks and its components. Plant materials and design. Computer applications in landscaping, Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	
Unit III: Seed, Sowing/raising of seeds and seedlings	13
Structure and types - Seed dormancy; causes and methods of breaking dormancy. Seed storage: Seed banks, factors affecting seed viability, genetic erosion Seed production technology. Seed testing and certification. Transplanting of seedlings - Study of cultivation of different vegetables and flowering plants: cabbage, brinjal, lady's finger, tomatoes, carrots, bougainvillea, roses, geranium, ferns, petunia, orchids etc. Storage and marketing procedures. Developing and maintence of different types of lawns. Bonsai technique.	

Text Books and References

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. Dept. of Agriculture and Cooperation, National Seed Corporation Ltd. New Delhi.
2. Bose T.K., Mukherjee, D. (1972). Gardening in India. Oxford & IBH Publishing Co. New Delhi.
3. Jules, J. (1979). Horticultural Science, 3rd edition. W.H. Freeman and Co. San Francisco, California.
4. Kumar, N. (1997). Introduction to Horticulture. Rajalakshmi Publications. Nagercoil, Tamil Nadu.
5. Musser E., Andres. (2005). Fundamentals of Horticulture. McGraw Hill Book Co. New Delhi
6. Sandhu, M.K. (1989). Plant Propagation. Walle Eastern Ltd. Bangalore.

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Open Elective Course (OE-2.2)

I B.Sc., Semester II

BIO-FUELS

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with Bio-fuel plant species cultivation for commercial exploitation.
2. To make the students known about the Bio-fuel used in automobile industries and solving fuel problems in feature.
3. To generate interest amongst the students to know the importance of Bio-fuel in day today life and economic wellbeing.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

UNIT-I	**10 hrs**.
Introduction, definition, scope and Importance of Bio-fuel with respect to climate change and environmental issues. Public awareness. Biofuels scenario in India and world. History of Biofuels. Advantages and disadvantages of biofuels. Developmental generation of biofuels: first, second, third and fourth generation of biofuels and present status.	
UNIT II	**16 hrs**
Biofuel feed stocks: Agricultural waste, farm waste, forestry waste, organic wastes from the residential, institutional and industrial waste and its importance.(Biomass-plant, animal and microbial based waste). Algal biofuel. Biodiesel species: *Pongamia pinnata, Simarouba gluca, Jatropha curcas, Azardirachta india, Madhuca indica* and *Callophyllum innophyllum* . Seed harvesting, processing, oil extraction, and characterization.	
UNIT III	**13 hrs**
Introduction to biodiesel, bioethanol, biogas and bio hydrogen. Production technology of biofuels (Biodiesel, ehanol and biogas). Quality analysis of biodiesel, bioethanol and biogas and its comparison with national and international standards. Biofuel sustainability; Biofuel Policy in Karnataka and India. Biofuel production statistics. Fuel against food security concepts.	

Text Books and References

1) The Biodiesel Handbook (2005). Jurgen Krahl, Jon Harlan Van Gerpen.AOCS Press.
2) Bioenergy and Biofuels (2017).Ozcan Konur. CRC Press, Taylor & Franci's group.
3) https://mnre.gov.in/biofuels

Pedagogy:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

Open Elective Course (OE-2.3)

I B.Sc., Semester II

BIOFERTILISERS

Course Outcome:

On completion of this course, the students will be able to

1. To make the students familiar with bio-fertilizer plant species cultivation for commercial exploitation.
2. To make the students known about the bio-fertilizer used in agriculture forming and industries and solving problems erupted by synthetic fertilizer.
3. To generate interest amongst the students to know the importance of bio-fertilizer in day today agricultural practices and economic wellbeing.

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours / semester
3	39	0	00

Content of Theory Course 2.3: BIOFERTILISERS	39 hrs
UNIT-I . **General account, isolation and mass multiplication**	**13 hrs.**
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. *Azospirillum:* isolation and mass multiplication – carrier based inoculants, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication	
UNIT II. Association of Cyanobacteria and Fungi	**13hrs**
Cyanobacteria (blue green algae), *Azolla* and *Anabaena Azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM –its influence on growth and yield of crop plants	
UNIT III. Applications of Cyanobacteria and Fungi	**13 hrs**
Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – bio-compost making methods, types and method of vermin-composting – field Application.	

Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S. Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya Publishers. New Delhi.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

PEDAGOGY:

Lectures, Practicals, Field and laboratory visits, Participatory Learning, Seminars, Assignments, specimen submission etc

OPEN ELECTIVE
SCHEME OF BOTANY THEORY EXAMINATION II SEMESTER
MODEL QUESTION PAPER

Time: 2.5 Hours **Max Marks**- 60

Instructions: Draw neat labelled diagrams wherever necessary

I. Define/Explain any Four of the following 2X4=8 Marks

1.
2.
3.
4.
5.
6.

II. Answer any Four of the following 5X4=20 Marks

7.
8.
9.
10.
11.
12.

III. Answer any Four of the following 8X4=32 Marks

13.
14.
15.
16.
17.
18.

***

OPEN ELECTIVE
BLUE PRINT OF BOTANY THEORY EXAMINATION II SEMESTER

Time: 2.5 Hours **Max Marks- 60**

Weightage of Marks				
Units	**2 marks**	**5 marks**	**8 marks**	**Total Mks.**
I	**2X2=4**	**5X2=10**	**8X2=16**	**30**
II	**2X2=4**	**5X2=10**	**8X2=16**	**30**
III	**2X2=4**	**5X2=10**	**8X2=16**	**30**
	12 Marks	**30Marks**	**48 Marks**	**90 Marks**

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

I Sem Practicals: CHEMISTRY-DSE 1 LAB

PART-A Inorganic Chemistry

1. Preparation of standard sodium carbonate solution and standardization of hydrochloricacid solution (methyl orange indicator). Estimation of sodium hydroxide present in the solution using phenolphthalein indicator.
2. Determination of carbonate and hydroxide present in amixture.
3. Determination of oxalic acid and sodium oxalate in a given mixture usingstandard$KMnO4$/NaOHsolution
4. Estimation of ferrous and ferric iron in a given mixture using standard potassiumdichromate solution
5. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of hydrogen peroxide present in thesolution.
6. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of ferrous ammonium sulphate present in thesolution.

PART-B Organic Chemistry

1. Preparation of acetanilide from aniline using Zn/acetic acid (Greenmethod).
2. Synthesis of p-nitro acetanilide from acetanilide using nitratingmixture.
3. Bromination ofacetanilide
4. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventionalmethod)
5. Synthesis of diazoaminobenzene from aniline (conventionalmethod).
6. Preparation of dibenzalacetone (Greenmethod).

JSS COLLEGE FO ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

CHEMISTRY DSE2 LAB

PART-A Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald'sviscometer(Ethylacetate,Toluene,Chloroform,Chlorobenzeneoranyothernon- hazardousliquids)
2. Determinationofthedensityusingspecificgravitybottleandsurfacetensionofliquidsusing Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardousliquids
3. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water &Sucrose)
4. Determination of partition/distribution coefficient - i) Acetic acid in waterandcyclohexane.
   ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.
5. Determination of rate constant of decomposition of H2O2 catalyzed byFeCl3
6. Determination of percentage composition of NaCl solution by determining miscibility temperature of phenol-watersystem.

PART-B Analytical Chemistry

1. Determination of alkali present in soaps/detergents using standardHCl
2. Determination of iron(II) using potassiumdichromate
3. Determination of oxalic acid using standard potassium permanganate solution
4. Determination of hardness of water Standardized EDTAsolution
5. Determination of alkali content in antacids using standard HClsolution.
6. Determination of chlorine in bleeching powder by iodometry (standard solution to begiven)

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

I Sem Practicals: CHEMISTRY-DSE 1 LAB

PART-A Inorganic Chemistry

1. Preparation of standard sodium carbonate solution and standardization of hydrochloricacid solution (methyl orange indicator). Estimation of sodium hydroxide present in the solution using phenolphthalein indicator.
2. Determination of carbonate and hydroxide present in amixture.
3. Determination of oxalic acid and sodium oxalate in a given mixture usingstandard$KMnO4$/NaOHsolution
4. Estimation of ferrous and ferric iron in a given mixture using standard potassiumdichromate solution
5. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of hydrogen peroxide present in thesolution.
6. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of ferrous ammonium sulphate present in thesolution.

PART-B Organic Chemistry

1. Preparation of acetanilide from aniline using Zn/acetic acid (Greenmethod).
2. Synthesis of p-nitro acetanilide from acetanilide using nitratingmixture.
3. Bromination ofacetanilide
4. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventionalmethod)
5. Synthesis of diazoaminobenzene from aniline (conventionalmethod).
6. Preparation of dibenzalacetone (Greenmethod).

JSS COLLEGE FO ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

CHEMISTRY DSE2 LAB

PART-A Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald'sviscometer(Ethylacetate,Toluene,Chloroform,Chlorobenzeneoranyothernon- hazardousliquids)
2. Determinationofthedensityusingspecificgravitybottleandsurfacetensionofliquidsusing Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardousliquids
3. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water &Sucrose)
4. Determination of partition/distribution coefficient - i) Acetic acid in waterandcyclohexane.
   ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.
5. Determination of rate constant of decomposition of H2O2 catalyzed byFeCl3
6. Determination of percentage composition of NaCl solution by determining miscibility temperature of phenol-watersystem.

PART-B Analytical Chemistry

1. Determination of alkali present in soaps/detergents using standardHCl
2. Determination of iron(II) using potassiumdichromate
3. Determination of oxalic acid using standard potassium permanganate solution
4. Determination of hardness of water Standardized EDTAsolution
5. Determination of alkali content in antacids using standard HClsolution.
6. Determination of chlorine in bleeching powder by iodometry (standard solution to begiven)

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

I Sem Practicals: CHEMISTRY-DSE 1 LAB

PART-A Inorganic Chemistry

1. Preparation of standard sodium carbonate solution and standardization of hydrochloricacid solution (methyl orange indicator). Estimation of sodium hydroxide present in the solution using phenolphthalein indicator.
2. Determination of carbonate and hydroxide present in amixture.
3. Determination of oxalic acid and sodium oxalate in a given mixture usingstandard$KMnO_4$/NaOHsolution
4. Estimation of ferrous and ferric iron in a given mixture using standard potassiumdichromate solution
5. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of hydrogen peroxide present in thesolution.
6. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of ferrous ammonium sulphate present in thesolution.

PART-B Organic Chemistry

1. Preparation of acetanilide from aniline using Zn/acetic acid (Greenmethod).
2. Synthesis of p-nitro acetanilide from acetanilide using nitratingmixture.
3. Bromination ofacetanilide
4. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventionalmethod)
5. Synthesis of diazoaminobenzene from aniline (conventionalmethod).
6. Preparation of dibenzalacetone (Greenmethod).

JSS COLLEGE FO ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

CHEMISTRY DSE2 LAB

PART-A Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald'sviscometer(Ethylacetate,Toluene,Chloroform,Chlorobenzeneoranyothernon- hazardousliquids)
2. Determinationofthedensityusingspecificgravitybottleandsurfacetensionofliquidsusing Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardousliquids
3. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water &Sucrose)
4. Determination of partition/distribution coefficient - i) Acetic acid in waterandcyclohexane. ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.
5. Determination of rate constant of decomposition of H_2O_2 catalyzed by$FeCl_3$
6. Determination of percentage composition of NaCl solution by determining miscibility temperature of phenol-watersystem.

PART-B Analytical Chemistry

1. Determination of alkali present in soaps/detergents using standardHCl
2. Determination of iron(II) using potassiumdichromate
3. Determination of oxalic acid using standard potassium permanganate solution
4. Determination of hardness of water Standardized EDTAsolution
5. Determination of alkali content in antacids using standard HClsolution.
6. Determination of chlorine in bleeching powder by iodometry (standard solution to begiven)

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

I Sem Practicals: CHEMISTRY-DSE 1 LAB

PART-A Inorganic Chemistry

1. Preparation of standard sodium carbonate solution and standardization of hydrochloricacid solution (methyl orange indicator). Estimation of sodium hydroxide present in the solution using phenolphthalein indicator.
2. Determination of carbonate and hydroxide present in amixture.
3. Determination of oxalic acid and sodium oxalate in a given mixture usingstandard$KMnO4$/NaOHsolution
4. Estimation of ferrous and ferric iron in a given mixture using standard potassiumdichromate solution
5. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of hydrogen peroxide present in thesolution.
6. Preparation of standard oxalic acid solution and standardization of potassiumpermanganate solution. Estimation of ferrous ammonium sulphate present in thesolution.

PART-B Organic Chemistry

1. Preparation of acetanilide from aniline using Zn/acetic acid (Greenmethod).
2. Synthesis of p-nitro acetanilide from acetanilide using nitratingmixture.
3. Bromination ofacetanilide
4. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventionalmethod)
5. Synthesis of diazoaminobenzene from aniline (conventionalmethod).
6. Preparation of dibenzalacetone (Greenmethod).

JSS COLLEGE FO ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

CHEMISTRY DSE2 LAB

PART-A Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald'sviscometer(Ethylacetate,Toluene,Chloroform,Chlorobenzeneoranyothernon- hazardousliquids)
2. Determinationofthedensityusingspecificgravitybottleandsurfacetensionofliquidsusing Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardousliquids
3. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water &Sucrose)
4. Determination of partition/distribution coefficient - i) Acetic acid in waterandcyclohexane.
   ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.
5. Determination of rate constant of decomposition of H_2O_2 catalyzed by$FeCl_3$
6. Determination of percentage composition of NaCl solution by determining miscibility temperature of phenol-watersystem.

PART-B Analytical Chemistry

1. Determination of alkali present in soaps/detergents using standardHCl
2. Determination of iron(II) using potassiumdichromate
3. Determination of oxalic acid using standard potassium permanganate solution
4. Determination of hardness of water Standardized EDTAsolution
5. Determination of alkali content in antacids using standard HClsolution.
6. Determination of chlorine in bleeching powder by iodometry (standard solution to begiven)

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

V Semester Practical 5A

Part 1: Gravimetric estimation

1. Gravimetric estimation of Barium as Barium sulphate.
2. Gravimetric estimation of Iron as Iron(III) oxide
3. Gravimetric estimation of copper as copper thiocyanate
4. Gravimetric estimation of Nickel as nickel dimethyl glyoximate
5. Gravimetric estimation of magnesium as magnesium hydroxyl quinolate

Part 2 : Volumetric estimations

1. Estimastion of iron in the given sample of haematite by dichromate method.
2. Estimation of percentage of calcium in limestone by oxalate method
3. Estimation of manganese in the given sample of pyrolusite.
4. Estimation of magnesium in the given sample of dolomite by EDTA method.
5. Determination of % purity of copper in the given sample of copper wire.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

V Semester: Practical 5B 3 hours per week

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).

6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

VI SEMESTER, PRACTICAL 6A

Part 1: Physical chemistry experiments (instrumental)

1. Determination of Equivalent conductance of the given electrolyte(both strong and weak electrolyte)
2. Determination of percentage composition of benzene and carbon tetra chloride by using Abbe's refractrometer.
3. Determination of concentration of an acid/ base by conductometric method.
4. Potentiometric titration of Ferrous ammonium sulphate and $K_2Cr_2O_7$.
5. Determination of PKa of weak acid by potentiometric method
6. PH titration of strong acid and strong base.
7. Calorimetric estimation of Fe3+ ion using Ammonium thiocyanate
8. Calorimetric estimation of Cu2+ ion using NH_4OH
9. Calorimetric estimation of Asprin using $FeCl_3$

Part 2 : Isolation of organic compounds from natural products

1. Isolation of hesperidins from orange peels
2. Isolation of caffeine from Tea leaves
3. Isolation of Nicotine from Tobacco leaves.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

VI Semester : Practical 6B

1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1 , cm -1, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
   i. Colourimetry
4. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration
5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
6. Study the kinetics of iodination of propanone in acidic medium
7. Determine the amount of iron present in a sample using 1,10-phenathroline.
8. Determine the dissociation constant of an indicator (phenolphthalein).
9. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
10. Analyse the given vibration-rotation spectrum of HCl(g)

Reference:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.

Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

V Semester Practical 5A

Part 1: Gravimetric estimation

1. Gravimetric estimation of Barium as Barium sulphate.
2. Gravimetric estimation of Iron as Iron(III) oxide
3. Gravimetric estimation of copper as copper thiocyanate
4. Gravimetric estimation of Nickel as nickel dimethyl glyoximate
5. Gravimetric estimation of magnesium as magnesium hydroxyl quinolate

Part 2 : Volumetric estimations

1. Estimastion of iron in the given sample of haematite by dichromate method.
2. Estimation of percentage of calcium in limestone by oxalate method
3. Estimation of manganese in the given sample of pyrolusite.
4. Estimation of magnesium in the given sample of dolomite by EDTA method.
5. Determination of % purity of copper in the given sample of copper wire.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

V Semester: Practical 5B 3 hours per week

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).

6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

VI Semester : Practical 6 A **3 hours per week**

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

VI SEMESTER, PRACTICAL 6A

Part 1: Physical chemistry experiments (instrumental)

1. Determination of Equivalent conductance of the given electrolyte(both strong and weak electrolyte)
2. Determination of percentage composition of benzene and carbon tetra chloride by using Abbe's refractrometer.
3. Determination of concentration of an acid/ base by conductometric method.
4. Potentiometric titration of Ferrous ammonium sulphate and $K_2Cr_2O_7$.
5. Determination of PKa of weak acid by potentiometric method
6. PH titration of strong acid and strong base.
7. Calorimetric estimation of Fe3+ ion using Ammonium thiocyanate
8. Calorimetric estimation of Cu2+ ion using NH_4OH
9. Calorimetric estimation of Asprin using $FeCl_3$

Part 2 : Isolation of organic compounds from natural products

1. Isolation of hesperidins from orange peels
2. Isolation of caffeine from Tea leaves
3. Isolation of Nicotine from Tobacco leaves.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

VI Semester : Practical 6B

1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1 , cm -1, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
    i. Colourimetry
4. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration
5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
6. Study the kinetics of iodination of propanone in acidic medium
7. Determine the amount of iron present in a sample using 1,10-phenathroline.
8. Determine the dissociation constant of an indicator (phenolphthalein).
9. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
10. Analyse the given vibration-rotation spectrum of HCl(g)

Reference:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.

Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

V Semester Practical 5A

Part 1: Gravimetric estimation

1. Gravimetric estimation of Barium as Barium sulphate.
2. Gravimetric estimation of Iron as Iron(III) oxide
3. Gravimetric estimation of copper as copper thiocyanate
4. Gravimetric estimation of Nickel as nickel dimethyl glyoximate
5. Gravimetric estimation of magnesium as magnesium hydroxyl quinolate

Part 2 : Volumetric estimations

1. Estimastion of iron in the given sample of haematite by dichromate method.
2. Estimation of percentage of calcium in limestone by oxalate method
3. Estimation of manganese in the given sample of pyrolusite.
4. Estimation of magnesium in the given sample of dolomite by EDTA method.
5. Determination of % purity of copper in the given sample of copper wire.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

V Semester: Practical 5B 3 hours per week

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$ and potassium chromate).

6. Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
7. Measurement of dissolved CO_2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.

VI Semester : Practical 6 A   3 hours per week

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

VI SEMESTER, PRACTICAL 6A

Part 1: Physical chemistry experiments (instrumental)

1. Determination of Equivalent conductance of the given electrolyte(both strong and weak electrolyte)
2. Determination of percentage composition of benzene and carbon tetra chloride by using Abbe's refractrometer.
3. Determination of concentration of an acid/ base by conductometric method.
4. Potentiometric titration of Ferrous ammonium sulphate and $K_2Cr_2O_7$.
5. Determination of PKa of weak acid by potentiometric method
6. PH titration of strong acid and strong base.
7. Calorimetric estimation of Fe3+ ion using Ammonium thiocyanate
8. Calorimetric estimation of Cu2+ ion using NH_4OH
9. Calorimetric estimation of Asprin using $FeCl_3$

Part 2 : Isolation of organic compounds from natural products

1. Isolation of hesperidins from orange peels
2. Isolation of caffeine from Tea leaves
3. Isolation of Nicotine from Tobacco leaves.

JSS COLLEGE OF ARTS,COMMERCE AND SCIENCE, OOTY ROAD, MYSURU

DEPARTMENT OF CHEMISTRY

VI Semester : Practical 6B

1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1 , cm -1, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
   i. Colourimetry
4. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration
5. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
6. Study the kinetics of iodination of propanone in acidic medium
7. Determine the amount of iron present in a sample using 1,10-phenathroline.
8. Determine the dissociation constant of an indicator (phenolphthalein).
9. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
10. Analyse the given vibration-rotation spectrum of HCl(g)

Reference:

- A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.

Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960

UG_B.COM_ Adverting Skills -2021-2022

ModuleNo.1:Introduction	**10**
CommunicationProcess;Advertisingasa toolofcommunication;Meaning,natureand importance of advertising;Typesof advertising;Advertisingobjectives.Audience analysis;Setting of advertising budget: Determinants and major methods.	
ModuleNo.2:MediaDecisions	**07**
Major media types - their characteristics, internet as an advertising media, merits and demerits;Factorsinfluencingmediachoice;mediaselection,mediascheduling,Advertising through the Internet-media devices.	
ModuleNo.3:**MessageDevelopment**	**08**
Advertisingappeals,Advertisingcopyandelements,Preparingadsfordifferentmedia	
ModuleNo.4:Measuring Advertising Effectiveness	**10**
Evaluatingcommunicationandsaleseffects;Pre-andPost-testingtechniques	
ModuleNo.5:AdvertisingAgency	**07**
.	

UG_B.COM_ BUSINESS RESEARCH METHODS-2021-2022

Unit 1: **Introduction To Business Research**

Meaning, Types, Criteria Of Good Research, Scientific Approach To Research In Physical And Management Science, Limitations Of Applying Scientific Methods In Business Research Problems, Ethical Issues In Business Research, Research Process, Problem Formulation, Preparation Of Business Research Plan/Proposal.

Unit 2: **Business Research Design**

Types Of Business Research, Exploratory, Descriptive, And Causal Research, Exploratory Research: Meaning, Suitability, Collection, Hypothesis, Formulation, Descriptive Research: Meaning, Types Of Descriptive Studies, Data Collection Methods, Causal Research: Meaning, Various Types Of Experimental Designs, Types Of Errors Affecting Research Design.

Unit 3: **Data Collection**

Primary And Secondary Data – Sources – Advantages/Disadvantages, Data Collection Methods – Observations, Survey, Interview And Questionnaire Design, Qualitative Techniques Of Data Collection. Measurement And Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Rating Scale, Criteria For Good Measurement, Attitude Measurement.

Unit 4: **Sampling And Hypothesis Testing**

Sampling: Meaning, Steps In Sampling Process, Types Of Sampling – Probability And Non Probability Sampling Techniques, Errors In Sampling. Hypothesis: Meaning, Types, Characteristics, Sources, Formulation Of Hypothesis, Errors In Hypothesis Testing.

Unit 5: **Data Analysis**

Editing, Coding, Classification, Tabulation, Univariate, Bivariate And Multivariate Analysis, Interpretation.

Unit 6: **Research Report**

Types, Advantages, Disadvantages, Components Of Research Reports, Format, Chapterisation, Language, Referencing.

UG_B.COM_ GOODS AND SERVICES TAX AND CUSTOM DUTY-2021-2022

Unit 1: Value of taxable supply

Conditions, inclusions, Consideration not wholly in money, Supply between two related persons, Supply through agent, cost based value, Residual valuation, specific supplies, Service of pure agent. Problems on determination of value of supply.

Unit 2: Input tax credit

Meaning, conditions for taking credit, ineligible input tax credit, availability of credit in special circumstances, Input tax credit and change in constitution of registered person, Taking input tax credit in respect of inputs and capital goods sent for job work, Manner of Distribution of Credit by Input Service Distributor (ISD)

Unit 3: Tax Invoice, Credit and Debit Notes

Tax invoice; Prohibition of un authorised collection of tax; Amount of tax to be indicated in tax invoice and other documents ; Credit and debit notes.

Unit 4: Registration under GST

Persons liable for registration, compulsory registration, Procedure for Registration, Rejection of application for registration, cancellation of Registration

Unit 5: Returns

Brief introduction to various GSTRS-procedure for filing various returns.

Unit 6: Customs Act 1962

Meaning- Notified goods –specified goods- Prohibition of importation and exportation under sec 11- types of customs duty- Basic customs duty, Education Cess, Anti dumping duty, Safeguard Duty, IGST, GST Compensation Cess- Computation of Assessable value and applicable duties. Exports – Meaning- zero rated supply.

UG_B.COM_Entrepreneurship skills-2021-2022

ModuleNo.1: Introduction	**10**
Need of becoming entrepreneur- ways to become a good entrepreneur-Enabling environmentavailabletobecomeanentrepreneur. Self-discovery,IdeaGeneration-Idea Evaluation-Feasibilityanalysis- Finding team-Preparation of business model.	
ModuleNo.2:Promoting Entrepreneur	**08**
Introduction-DifferentGovernment institutions/schemespromotingentrepreneurs: Graminbanks,PMMY-MUDRALoan,DIC,SIDA,SISI,NSIC,andSIDO,etc.,	
ModuleNo.3:EnterpriseSet-up	**08**
Introduction–Waystosetupanenterpriseanddifferentaspectsinvolved:legal compliances,marketingaspect,budgetingetc.,	
ModuleNo.4:MonitoringandMaintainingan Enterprise	**10**
Introduction–Daytodaymonitoringmechanismformarinatinganenterprise-Different GovernmentSchemessupportingentrepreneurship.	
ModuleNo.5:CaseletsDiscussion	**0**
Examplesofsuccessful andunsuccessfulentrepreneurshipofMUDRA Loan,Gramin banks, SISI and NSIC etc.,	

UG_B.COM_Laws and practice of Banking-2021-2022

Module No. 1: Introduction to Banking	**12**
Introduction- Meaning – Need – Importance – Primary, Secondary & Modern functions of banks - Origin of banking- Banker and Customer Relationship (General and special relationship) - Origin and growth of commercial banks in India – Types of Banks in India– Banks' Lending - changing role of commercial banks. RBI: History-Role & Functions.	
Module No. 2: Paying and Collecting Banker	**12**
Paying banker: Introduction - Meaning – Role – Functions - Duties - Precautions and Statutory Protection and rights - Dishonor of Cheques – Grounds of Dishonor – Consequences of wrongful dishonor of Cheques; **Collecting Banker**: Introduction - Meaning – Legal status of collecting banker - Holder for value -Holder in due course – Duties & Responsibilities - Precautions and Statutory Protection to Collecting Banker.	
Module No. 3: Customers and Account Holders	**10**
Introduction - Types of Customers and Account Holders - Procedure and Practice in opening and operating accounts of different customers: Minors - Joint Account Holders-Partnership Firms - Joint Stock companies - Executors and Trustees - Clubs and Associations and Joint Hindu Undivided Family.	
Module No. 4: Negotiable Instruments	**12**
Introduction – Meaning & Definition – Features – Kinds of Negotiable Instruments: Promissory Notes - Bills of Exchange - Cheques - Crossing of Cheques – Types of Crossing; Endorsements: Introduction - Meaning - Essentials & Kinds of Endorsement – Rules of endorsement.	
Module No. 5: Recent Developments in Banking	**10**
Introduction - New technology in Banking – E-services – Debit and Credit cards - Internet Banking-Electronic Fund Transfer- MICR – RTGS - NEFT –ECS- Small banks-Payment banks-Digital Wallet-Crypto currency- KYC norms – Basel Norms - Mobile banking-E- payments - E-money. Any other recent development in the banking sector.	

UG_B.COM_Laws and practice of Banking-2021-2022

Module No. 1: Introduction to Banking	**12**
Introduction- Meaning – Need – Importance – Primary, Secondary & Modern functions of banks - Origin of banking- Banker and Customer Relationship (General and special relationship) - Origin and growth of commercial banks in India – Types of Banks in India– Banks' Lending - changing role of commercial banks. RBI: History-Role & Functions.	
Module No. 2: Paying and Collecting Banker	**12**
Paying banker: Introduction - Meaning – Role – Functions - Duties - Precautions and Statutory Protection and rights - Dishonor of Cheques – Grounds of Dishonor – Consequences of wrongful dishonor of Cheques; **Collecting Banker**: Introduction - Meaning – Legal status of collecting banker - Holder for value -Holder in due course – Duties & Responsibilities - Precautions and Statutory Protection to Collecting Banker.	
Module No. 3: Customers and Account Holders	**10**
Introduction - Types of Customers and Account Holders - Procedure and Practice in opening and operating accounts of different customers: Minors - Joint Account Holders-Partnership Firms - Joint Stock companies - Executors and Trustees - Clubs and Associations and Joint Hindu Undivided Family.	
Module No. 4: Negotiable Instruments	**12**
Introduction – Meaning & Definition – Features – Kinds of Negotiable Instruments: Promissory Notes - Bills of Exchange - Cheques - Crossing of Cheques – Types of Crossing; Endorsements: Introduction - Meaning - Essentials & Kinds of Endorsement – Rules of endorsement.	
Module No. 5: Recent Developments in Banking	**10**
Introduction - New technology in Banking – E-services – Debit and Credit cards - Internet Banking-Electronic Fund Transfer- MICR – RTGS - NEFT –ECS- Small banks-Payment banks-Digital Wallet-Crypto currency- KYC norms – Basel Norms - Mobile banking-E- payments - E-money. Any other recent development in the banking sector.	

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF ELECTRONICS

Syllabus on Skill Development

2022-23

PRACTICAL VI
ELECTRONIC INSTRUMENTATION LAB

1. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
2. Measurement of Capacitance by De Sauty's bridge.
3. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge).
4. To determine the Characteristics of LVDT.
5. To determine the Characteristics of Thermistors and RTD.
6. Measurement of temperature by Thermocouples.
7. Design a regulated power supply of given rating (5 V or 9V).
8. To design and study the Sample and Hold Circuit.
9. To plot the frequency response of a microphone.

PRACTICAL VII
VERILOG AND VHDL LAB

Experiments using Verilog

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half Subtractor and Full Subtractor using basic and derived gates.
4. Design and simulation of a 4 bit Adder.
5. Multiplexer (4x1) and Demultiplexer using logic gates.
6. Decoder and Encoder using logic gates.
7. Clocked D, JK and T Flip flops (with Reset inputs).
8. 3-bit Ripple counter

Experiments using VHDL

1. Behavioral modeling and simulation of basic gates
2. Structural modeling and simulation of simple Boolean expression
3. Modeling and simulation of adders and subtractors
4. Modeling and simulation of magnitude comparators
5. Modeling and simulation of Flip-flops
6. Modeling and simulation of Shift registers
7. Modeling and simulation of Counters
8. Modeling and simulation of encoders and decoders
9. Modeling and simulation of multiplexers

PRACTICAL VIII

PHOTONIC DEVICES AND POWER ELECTRONICS

1. To determine wavelength of sodium light using Michelson's Interferometer.
2. Diffraction experiments using a laser.
3. Study of Electro-optic Effect.
4. To determine characteristics of (a) LEDs, (b) Photo voltaic cell and (c) Photo diode.
5. To study the Characteristics of LDR and Photodiode with (i) Variable Illumination intensity, and (ii) Linear Displacement of source.
6. To measure the numerical aperture of an optical fiber.
7. Output and transfer characteristics of a power MOSFET.
8. Study of I-V characteristics of SCR.
9. SCR as a half wave and full wave rectifiers with R and RL loads.
10. AC voltage controller using TRIAC with UJT triggering.
11. Study of I-V characteristics of DIAC
12. Study of I-V characteristics of TRIAC.

DME26404

ELECTRICAL CIRCUITS AND NETWORK SKILLS

Credits: 02 Theory: 30 Lectures

Course Outcome:

After completion of the course the student acquires skill to

CO1: Design and trouble shoot the electrical circuits and networks

CO2: Carry-out simple domestic wiring.

UNIT 1:

Basic Electricity Principles:

Discussion of Voltage (AC & DC), Current(AC & DC), Resistance, and Power. Ohm's law. Series, parallel, Series and Parallel combinations of R, L and C. Response of inductors and capacitors with DC or AC sources. Impedance in of Inductor and Capacitor

Electrical Circuits:

DC Circuits - Basic electric circuit elements and their combination in DC circuits. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements.

AC Circuits - . Simple numericals on network theorms. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Electrical Drawing and Symbols:

Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. (15 Lectures)

UNIT 2:

Generators and Transformers:

DC Power sources. AC/DC generators. Basic principle of operation, constructional features. Transformers – Principle of working, Construction and Operation of transformers.

Electric Motors:

Single-phase, three-phase & DC motors - Construction and Working. Speed & power of ac motor. Interfacing DC or AC sources/ Motors to control heaters

Solid-State Devices: Diodes, types of diodes –symbol and applications, Rectifiers - PN junction diode as rectifier (Half wave and Full wave rectifier) construction and working

Electrical Protection:

Relays - Relay as protection device, Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection.

Electrical Wiring:

Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, and solder. Preparation of extension board. (15 Lectures)

Reference Books:

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press.
2. A text book in Electrical Technology - B L Theraja - S Chand & Co.
3. A text book of Electrical Technology - A K Theraja.
4. Performance and design of AC machines - M G Say ELBS Edn.

https://drive.google.com/file/d/1qzea3KMY6yomll0MIzZpsGnMQe1zCWtp/view?usp=sharing

DME26604

COMPUTER NETWORKS

Credits: 02 Theory: 30 Lectures

COURSE OUTCOME:

After completion of the course the student acquires skill to
CO1: Understand the concepts of network devices
CO2: Understand the terminology and concepts of the OSI model

Unit 1:

Data communication, Components & Basic Concepts

Line configuration- point-to-point, multipoint, Topology – Mesh, Star, Tree, Bus, Ring, and Hybrid Topologies Transmission modes – Simplex, Half Duplex, Full Duplex. Categories of networks – LAN, MAN, WAN, Internet

Transmission Media

Guided media – Twisted pair cable, Co-axial cable, Optical fiber

Multiplexing:

Many to one/one to many, types of multiplexing, Frequency division multiplexing, time division multiplexing, multiplexing applications

Error detection

Types of error, multiple bit error, Burst error,Detection – redundancy, Checksum Error correction – Single bit error correction, Hamming code (15 Lectures)

Unit 2

The OSI Model

Model – layered Architecture, Functions of layers- physical layer, Data link layer, Network layer, Transport layer, Session layer, Presentation Layer, Application layer

Networking and internetworking devices

Repeaters, Bridges- types of Bridges, Routers- Routing concepts, Gate ways

World Wide Web:

Uniform Resource Locator (URL), Browser Architect (15 Lectures)

Text Book:

Introduction to Data Communications & Networking by- BEHROUZ FOROUZAN

Reference Book:

Computer Networks by – ANDREW S TANENBAUM

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

DEPARTMENT OF ELECTRONICS

Syllabus on Skill Development

2022-23

Electronic Devices and Circuits -Practicals

Program Name	**BSc in Electronics**	Semester	**First Semester**
Course Title	Electronic Devices & Circuits **(Practicals)**		
Course Code:	**FSA 443**	No. of Credits	**2**
Contact hours	**60**	Duration of SEA/Exam	**3 hours**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

PART - A

1. Verification of Thevenin's, Norton's, and Maximum Power Transfer Theorems
2. Study the I-V Characteristics of p-n junction and Zener diodes.
3. Study of Half and full wave rectifiers without and with shunt capacitor filter and to find the Ripple factor for different values of load resistance.
4. Study of Zener diode as a voltage regulator using bridge rectifier with shunt capacitor filter and to find the Load and Line regulation.
5. Study of clipping and clamping circuits.

PART – B:

6. Study of Transistor characteristics in CE configuration – determination of h-parameters.
7. Study of Voltage divider bias circuits.
8. Study of single stage CE amplifier and to draw its frequency response and to determine the input and output impedances in mid-band.
9. Study of Series and Parallel Resonance circuits.
10. Verification of truth tables of OR, AND, NOT, NAND, NOR, XOR and XNOR gates using Respective ICs and Realization of basic gates using universal gates.
11. Binary to Gray and Gray to Binary code conversion and parity checker using XOR IC 7486.

Analog and Digital Electronics –Practicals

Program Name	BSc in Electronics		Semester	Second Semester
Course Title	Analog and Digital Electronics **(Practicals)**			
Course Code:	**FSB 443**		No. of Credits	**2**
Contact hours	**60**		Duration of SEA/Exam	**3 hours**
Formative Assessment Marks		**25**	Summative Assessment Marks	**25**

PART- A

1. Study the JFET characteristics and obtain the frequency response and calculate band width of single stage JFET amplifier.
2. Study of inverting and non-inverting amplifier, adder, Subtractor, and averaging amplifier using Op-amp
3. Study of differentiator and integrator using op-amp for different input waveforms.
4. Design and study Colpitt's and RC phase shift oscillator using op-amp.
5. Obtain the frequency response of first order low-pass and high-pass filters using op-amp.
6. Study of Astable and Monostabe multivibrators using IC 555 timer.

PART- B

1. Study of Half and Full Adder, half and full Subtractor using NAND gates.
2. Study of 4 - bit parallel binary adder and Subtractor using IC.
3. Study of Clocked RS, D and JK Flip-Flops using NAND gates.
4. Study of BCD to decimal decoder using IC, Encoders and priority encoders.
5. Study of Multiplexer and Demultiplexer using ICs.
6. Study of 4-bit asynchronous counter using JK Flip-Flop.
7. Study of 4-bit Shift Register – SISO, modification to ring counter using IC.
8. Study of Digital to Analog Converter using binary weighted resistor method

V SEMESTER

Practical Paper – V

FUNDAMENTALS OF G.I.S

Unit	Topic	Total teaching hours: 60
Unit 1	a) Meaning, definitions, components and importance of GIS	20
	b) Spatial entities – Point, line and polygon	
	Sources of spatial data- Census, Topographical Maps, Aerial Photographs and Satellite Imageries	
Unit 2	a) Spatial Data Structure	20
	- Raster and vector data Structures	
	Linking spatial and non spatial data	
	b) Introduction to MapInfo software	
Unit 3		20
	a) Geo – referencing , Choice of map projection b) Digitization c) Attaching attribute data (Creating data base) d) Editing e) Map layout f) Thematic map	

References:

1. Burrough P.A. : Geographical Information Systems for Land Resources
2. Maguire D. J. : Computers in Geography
3. Star J. C and J.E. : Geographic Information Systems
4. Internet : GIS. Development
5. Heywood : Introduction to GIS, 2002.
6. Mahesh : Introduction to GSI Shivalingappa Chandrashekar

VI SEMESTER

Practical Paper – VI

COMPUTER MAPPING AND GPS SURVEYING

Unit	Topic	Total teaching hours: 60
1.	Introduction to Computer : Generation of Computers, Hardware and Software Components	20
2.	Computer graphics : Creating Data base in computer, creation of Line, Bar and Pie diagrams. Thematic Maps - Choro chromatic and schematic Maps	20
3.	GPS Surveying: Concepts, Segments and applications, plotting way points by using map source software .	20
4.	Tour report / Factory visit	

References:

1. Singh L.R. : Fundamentals of Practical Geography, Sharadha Pustaka Bhavan, Alahabad, 2006
2. Dr. M.A. Siddaqui : Introduction to Geographical Information System, Sharadha Pustaka Bhavan, Alahabad, 2006
3. Chang : Introduction to GIS, Tata McGraw Hill W, New Delhi.

V SEMESTER

Practical Paper – V

FUNDAMENTALS OF G.I.S

Unit	Topic	Total teaching hours: 60
Unit 1	a) Meaning, definitions, components and importance of GIS	20
	b) Spatial entities – Point, line and polygon	
	Sources of spatial data- Census, Topographical Maps, Aerial Photographs and Satellite Imageries	
Unit 2	a) Spatial Data Structure	20
	- Raster and vector data Structures	
	Linking spatial and non spatial data	
	b) Introduction to MapInfo software	
Unit 3		20

a) Geo – referencing , Choice of map projection
b) Digitization
c) Attaching attribute data (Creating data base)
d) Editing
e) Map layout
f) Thematic map

References:

1. Burrough P.A. : Geographical Information Systems for Land Resources
2. Maguire D. J. : Computers in Geography
3. Star J. C and J.E. : Geographic Information Systems
4. Internet : GIS. Development
5. Heywood : Introduction to GIS, 2002.
6. Mahesh : Introduction to GSI Shivalingappa Chandrashekar

VI SEMESTER

Practical Paper – VI

COMPUTER MAPPING AND GPS SURVEYING

Unit Topic Total teaching hours: 60

1. Introduction to Computer : Generation of Computers, Hardware and 20
   Software Components

2. Computer graphics : Creating Data base in computer, creation of 20
   Line, Bar and Pie diagrams.

   Thematic Maps - Choro chromatic and schematic Maps

3. GPS Surveying: Concepts, Segments and applications, plotting way 20
   points by using map source software .

4. Tour report / Factory visit

References:

1.	Singh L.R.	:	Fundamentals of Practical Geography, Sharadha Pustaka Bhavan, Alahabad, 2006
2.	Dr. M.A. Siddaqui	:	Introduction to Geographical Information System, Sharadha Pustaka Bhavan, Alahabad, 2006
3.	Chang	:	Introduction to GIS, Tata McGraw Hill W, New Delhi.

JSS COLLEGE OF ARTS, COMMERCE ANDSCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

NATIONAL EDUCATION POLICY 2020 INITIATIVES

B.Sc. (Hons) Mathematics,

B.Sc. with Mathematics as a Major/Minor Subject

Syllabus for B.Sc (Hons) programmes

- **Physics and Mathematics**
- **Computer Science and Mathematics**

W.E.F. THE ACADEMIC YEAR 2021-22

DEPARTMENT OF MATHEMATICS

Preamble

The subject wise expert committee to draft model curriculum contents in Mathematics constituted by the Department of Higher Education, Government of Karnataka, Bangalore vide GO No. ED 260 UNE 2019 (PART-1) DATED 13.08.2021 is pleased to submit its partial report on the syllabus for the First Year (First & Second Semesters) B.Sc.(Basic/Honors) Mathematics and detailed Course Structure for B.Sc.(Honors) Mathematics and M.Sc. (One Year) Mathematics.

The committee discussed various models suggested by the Karnataka State Higher Education Council in its joint meetings with the Chairpersons of Board of Studies of all state universities in Karnataka and resolved to adopt Model IIA *Bachelor of Science (Basic/Hons.*) for the subjects with practical's with Mathematics as Major/Minor.

To achieve the core objectives of the National Education Policy 2020 it is unanimously resolved to introduce computer based practical's for the Discipline Core (DSC) courses by using Free and Open Source Software's (FOSS) tools for implementation of theory based on DSC courses as it is also suggested by the LOCF committee that the papers may be taught using various Computer Algebra System (CAS) software's such as Mathematica, MATLAB, Maxima and R to strengthen the conceptual understanding and widen up the horizon of students' self-experience. In view of these observations the subject expert committee suggested the software's Phython /R / Maxima/ Scilab/ Maple/MatLab/Mathematica for hands on experience of implementation of mathematical concepts in computer based lab.

The expert committee suggests the implementation this curriculum structure in all the Departments of Mathematics in Universities/Colleges in Karnataka.

The subject expert committee designed the Course Learning Outcome (CO) to help the learners to understand the main objectives of studying the courses by keeping in mind of the Programme outcomes (PO) of the graduate degree with honors in Mathematics or a graduate degree with Mathematics as a major subject.

As the Mathematics subject is a vast with several branches of specializations, it is difficult for every student to learn each branch of Mathematics, even though each paper has its own importance. Hence the subject expert committee suggests number of elective papers (for both Discipline electives and Open Electives) along with Discipline Core Courses. The BoS in Mathematics of universities may include additional electives based on the expertise of their staff and needs of the students'. A student can select elective paper as per her/his needs and interest.

The subject expert committee in Mathematics suggests that the concerned Department/Autonomous Colleges/Universities to encourage their faculty members to include necessary topics in addition to courses suggested by the expert committee.

Syllabus for B.Sc. with Mathematics as Major Subject & B.Sc. (Hons) Mathematics

SEMESTER – I

Algebra - I and Calculus – I	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**
Course Code	**FSA43032/FSA43034**

Course Learning Outcomes: This course will enable the students to

- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous linear of *m* equations in *n*

  variables by using concept of rank of matrix.
- Students will be familiar with the techniques of integration and differentiation of function with real variables.
- Students learn to solve polynomial equations.
- Learn to apply Reduction formulae.

Unit-I: Matrix: Recapitulation of Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction to Echelon form. Rank of a matrix; Inverse of a matrix by elementary operations; Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Cayley- Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **14 Hours**

Unit-II: Theory of equations: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only), Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method. **14 Hours**

Unit-III: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, circle of curvature. **14 Hours**

Unit IV: Successive Differentiation and Integral Calculus-I: nth Derivatives of Standard functions e^{as+b}, a^s, $(ax + b)^n$, $\log(ax + b)$, $\sin(ax + b)$, $\cos(ax+ b)$, $e^{as} \sin(bx + c)$, $e^{as}\cos(bx +c)$, Leibnitz theorem and its applications.

Recapitulation of definite integrals and its properties. Reduction formulae for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$, $\int \sin^n x \cos^N x \, dx$, $\int \tan^n x \, dx$, $\int \cot^n x \, dx$, $\int \sec^n x \, dx$, $\int \mathrm{cosec}^n x \, dx$, $\int x^n \sin x \, dx$, $\int x^n \cos x \, dx$, $\int x^n e^{as} \, dx$, $\int x^n (\log x)^N dx$ with definite limits.

14 Hour

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited.
2. Algebra – Natarajan, Manicavasagam Pillay and Ganapathy.
3. Theory of Matrices - B S Vatsa, New Age International Publishers.
4. Matrices - A R Vasista, Krishna Prakashana Mandir.
5. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
6. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.
10. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.
11. Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013

Theory based Practical's on Algebra - I and Calculus-I	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50 (S.A.-25 + I.A.-25)**
Course Code	**FSA43332/FSA43334**

Course Learning Outcomes: This course will enable the students to

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and calculus theory studied in **FSA43032/FSA43034** by using FOSS software's.
- Acquire knowledge of applications of algebra and calculus

through FOSS **Practical/Lab Work to be performed in Computer**

Lab (FOSS) Suggested Software's: Maxima/Scilab /Python/R.

Introduction to the software and commands related to the topic.

1. Computation of addition and subtraction of matrices,
2. Computation of Multiplication of matrices.
3. Computation of Trace and Transpose of Matrix
4. Computation of Rank of matrix and Row reduced Echelon form.
5. Computation of Inverse of a Matrix using Cayley-Hamilton theorem.
6. Solving the system of homogeneous and non-homogeneous linear algebraic equations.
7. Finding the nth Derivative of e^{ax}, trigonometric and hyperbolic functions
8. Finding the nth Derivative of algebraic and logarithmic functions.
9. Finding the nth Derivative of $e^{ax}\sin(bx + c)$, $e^{ax}\cos(bx +c)$.
10. Finding the roots of the equation, factoring.
11. Finding the angle between the radius vector and tangent.
12. Finding the curvatures of the given curves.

Open Elective Course

(who have not chosen Mathematics as one of Core subjects)

Optional Mathematics – I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**
Course Code	

Course Learning Outcomes: This course will enable the students to

- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous m linear equations by using the concept of rank of matrix.
- Students will be familiar with the techniques of differentiation of function with real variables.
- Identify and apply the intermediate value theorems and L'Hospital rule.
- Learn to apply Reduction formulae.

Unit-I: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction, Echelon form. Rank of a matrix; Inverse of a matrix by elementary operations; Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Cayley- Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **14 Hours**

Unit-II: Theory of equations: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only), Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method. **14 Hours**

Unit-III: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, circle of curvature. **14 Hours**

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited.
2. Algebra – Natarajan, Manicavasagam Pillay and Ganapathy.
3. Theory of Matrices - B S Vatsa, New Age International Publishers.
4. Matrices – A. R. Vasista, Krishna Prakashana Mandir.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Calculus – S. Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd.,vol. I & II.
9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.
10. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.
11. Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.

Open Elective

UG-Mathematics- CBCS (For Students of all Streams)

Business Mathematics-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**
Course Code	**FSA850**

Course Learning Outcomes: This course will enable the students to

- Translate the real word problems through appropriate mathematical modellling.
- Explain the concepts and use equations, formulae and mathematical expression and relationship in a variety of context.
- Finding the extreme values of functions.
- Analyze and demonstrate the mathematical skill require in mathematically intensive areas in economics and business.

Unit-I: Algebra – Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics. **14 Hours**

Unit - II: Matrices: Definition of a matrix; types of matrices; algebra of matrices. Properties of determinants; calculations of values of determinants upto third order; Adjoint of a matrix, elementary row and column operations; solution of a system of linear equations having unique solution and involving not more than three variables. Examples on commercial mathematics. **14 Hours**

Unit - III: **Differential Calculus**: Constant and variables, functions, Limits & continuity. Differentiability and Differentiation, partial differentiation, rates as a measure, maxima, minima, Partial Derivatives up to second order; Homogeneity of functions and Euler's Theorem; Total Differentials; Differentiation of implicit function with the help of total differentials, Maxima and Minima; cases of one variable involving second or higher order derivatives; Cases of two variables involving not more than one constraint. **14 Hours**

Reference Books:

1. Basic Mathematics, Allel R.G.A, Macmillan, New Delhi.
2. Mathematics for Economics, Dowling, E.T. , Schaum's Series, McGraw Hill London.
3. Quantitative Techniques in Management, Vohra, N.D., Tata McGraw Hill, New Delhi.

4. Business Mathematics, Soni R.S., Pitamber Publishing House, Delhi.

Open Elective

UG-Mathematics- CBCS

(For Students of all Streams)

Mathematical Aptitude-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSA840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit-I: Number System, Types of Numbers, series (AP and GP), Algebraic operations BODMAS, Divisibility, LCM and HCF, Fraction, Simplification. **14 Hours**

Unit-II: Time and Distance, Problems based on Trains, Boats and Streams. **14 Hours**

Unit-III: Time, work and wages, Pipes and Cistern, Problems on Clock, Problems on Calendar.

14 Hours

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

SEMESTER – II

Algebra – II {Number Theory) and Calculus – II	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100** **(S.A.-60 + I.A. – 40)**
Course Code	**FSB43032/FSB43034**

Course Learning Outcomes: This course will enable the students to

- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.
- Identify and apply the intermediate value theorems and L'Hospital rule.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.
- Students learn to find areas and volumes using integration.

Unit-I: Number Theory: Division Algorithm, Divisibility, Prime and composite numbers, Euclidean algorithm, Fundamental theorem of Arithmetic, The greatest common divisor and least common multiple. Congruences, Linear congruences, Simultaneous congruences, Euler's Phi-function, Wilson's, Euler's and Fermat's Theorems and their applications. **14 Hours**

Unit-II: Differential Calculus-I: Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series, Indeterminate forms and evaluation of limits using L'Hospital rule. **14 Hours**

Unit-III: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem and extension of Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 Hours

Unit-IV: Integral Calculus-II: *Line integral*: Definition of line integral and basic properties, examples on evaluation of line integrals. *Double integral*: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas using double integrals. *Triple integral*: Definition of triple integrals and evaluation- change of variables, volume as triple integral. **14 Hours**

Reference Books:

1. Differential Calculus, Shantinarayan, S. Chand & Company, New Delhi.
2. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
3. Calculus – Lipman Bers, Holt, Rinehart & Winston.
4. Calculus - Shanthinarayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
5. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill, 2008.
6. Integral Calculus, Shanthinarayan, New Delhi: S. Chand and Co. Pvt. Ltd.
7. Integral Calculus, Shantinarayan and P K Mittal, S. Chand and Co. Pvt. Ltd.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.
9. David M Burton, Elementary Number Theory, 6th edition, McCraw Hill, 2007.
10. Emil Grosswald, Topics from the Theory of Numbers, Modern Birhauser, 1984.
11. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991

Theory based practical's On Algebra – II (Number Theory) and Calculus – II	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. –25)**
Course Code	**FSB43332/FSB43334**

Course Learning Outcomes: This course will enable the students to

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and calculus by using FOSS software's.
- Acquire knowledge of applications of algebra and calculus through FOSS

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Scilab /Phython/R.

1. Programs related to Number Theory.
2. ***Program to verify Mean value theorems.***
3. Program for finding the Taylor's and Maclaurin's expansions of the given functions.
4. Program to verify the Euler's theorem and its extension.
5. Programs to construct series using Maclaurin's expansion for functions of two variables.
6. Program to evaluate the line integrals with constant and variable limits.
7. Program to evaluate the Double integrals with constant and variable limits.
8. Program to evaluate the Triple integrals with constant and variable limits.

Open Elective

(For students of Science stream who have not chosen Mathematics as one of the Core subjects)

Optional Mathematics – II	
Teaching Hours : 3 Hours/Week	**Credits:3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.
- To understand the concepts of multiple integrals and their applications.

Unit-I: Number Theory: Division Algorithm, Divisibility, Prime and composite numbers, Euclidean algorithm, Fundamental theorem of Arithmetic, The greatest common divisor and least common multiple. Congruences, Linear congruences, Simultaneous congruences, Euler's Phi-function, Wilson's, Euler's and Fermat's Theorems and their applications. **14 Hours**

Unit-II: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem and extension of Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 Hours

Unit-III: Integral Calculus: *Line integral*: Definition of line integral and basic properties, examples on evaluation of line integrals. *Double integral*: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas, *Triple integral*: Definition of triple integrals and evaluation-change of variables, volume as triple integral.

14 Hours

Reference Books:

1. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi.
2. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
3. Calculus – Lipman Bers, Holt, Rinehart & Winston.
4. Calculus - Shanthinarayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
5. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill, 2008.
6. Integral Calculus, Shanthinarayan, S. Chand and Co. Pvt. Ltd.
7. Integral Calculus, Shantinarayan and P K Mittal, S. Chand and Co. Pvt. Ltd.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.
9. David M Burton, Elementary Number Theory, 6th edition, McCraw Hill, 2007.
10. Emil Grosswald, Topics from the Theory of Numbers, Modern Birhauser, 1984.
11. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991.

Open Elective

(For Students of all streams)

Business Mathematics-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**
Course Code	**FSB850**

Course Learning Outcomes: This course will enable the students to

- Integrate concept in international business concept with functioning of global trade.
- Evaluate the legal, social and economic environment of business.
- Apply decision-support tools to business decision making.
- Will be able to apply knowledge of business concepts and functions in an integrated manner.

Unit - I: Commercial Arithmetic: Interest**:** Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems Annuity: Ordinary Annuity, Sinking Fund, Annuity due, Present Value and Future Value of Annuity, Equated Monthly Installments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems. **14 Hours**

Unit - II: Measures of central Tendency and Dispersion: Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and give curves. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits, Choice of A.M., G.M.and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, combined SD, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems. **14 Hours**

Unit - III: Correlation and regression: Concept and types of correlation, Scatter diagram, Interpretation with respect to magnitude and direction of relationship. Karl Pearson's coefficient of correlation for ungrouped data. Spearman's rank correlation coefficient. (with tie and without tie) Concept of regression, Lines of regression for ungrouped data, predictions using lines of regression. Regression coefficients and their properties (without proof). Examples and problems. **14 Hours**

Reference Books:

1. Practical Business Mathematics, S. A. Bari New Literature Publishing Company New Delhi
2. Mathematics for Commerce, K. Selvakumar Notion Press Chennai
3. Business Mathematics with Applications, Dinesh Khattar & S. R. Arora S. Chand Publishing New Delhi
4. Business Mathematics and Statistics, N.G. Das &Dr. J.K. Das McGraw Hill New Delhi
5. Fundamentals of Business Mathematics, M. K. Bhowal, Asian Books Pvt. Ltd New Delhi
6. Mathematics for Economics and Finance: Methods and Modelling, Martin Anthony and Norman, Biggs Cambridge University Press Cambridge
7. Financial Mathematics and its Applications, Ahmad Nazri Wahidudin Ventus Publishing APS Denmark
8. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.
9. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.
10. Applied Statistics, Mukhopadhya Parimal New Central Book Agency Pvt. Ltd. Calcutta.
11. Fundamentals of Statistics, Goon A. M., Gupta, M. K. and Dasgupta, B. World Press Calcutta.
12. Fundamentals of Applied Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.

Open Elective

(For Students of all Streams)

Mathematical Aptitude-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**
Course Code	**FSB840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit-I: Percentage, Average, Problems based on Ages, Ratio and Proportion, Partnership and share, Mixtures. **14 Hours**

Unit-II: Profit, Loss and Discount, Simple Interest, Compound Interest, Shares and Debentures. **14 Hours**

Unit-III: Permutations and Combinations, Probability, True discount and Banker's discount.

14 Hours

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

JSS COLLEGE OF ARTS, COMMERCE ANDSCIENCE

(Autonomous)

OOTY ROAD, MYSURU- 570 025

NATIONAL EDUCATION POLICY 2020 INITIATIVES

B.Sc. (Hons) Mathematics,

B.Sc. with Mathematics as a Major/Minor Subject

Syllabus for B.Sc (Hons) programmes

- **Physics and Mathematics**
- **Computer Science and Mathematics**

W.E.F. THE ACADEMIC YEAR 2021-22

DEPARTMENT OF MATHEMATICS

Preamble

The subject wise expert committee to draft model curriculum contents in Mathematics constituted by the Department of Higher Education, Government of Karnataka, Bangalore vide GO No. ED 260 UNE 2019 (PART-1) DATED 13.08.2021 is pleased to submit its partial report on the syllabus for the First Year (First & Second Semesters) B.Sc.(Basic/Honors) Mathematics and detailed Course Structure for B.Sc.(Honors) Mathematics and M.Sc. (One Year) Mathematics.

The committee discussed various models suggested by the Karnataka State Higher Education Council in its joint meetings with the Chairpersons of Board of Studies of all state universities in Karnataka and resolved to adopt Model IIA *Bachelor of Science (Basic/Hons.*) for the subjects with practical's with Mathematics as Major/Minor.

To achieve the core objectives of the National Education Policy 2020 it is unanimously resolved to introduce computer based practical's for the Discipline Core (DSC) courses by using Free and Open Source Software's (FOSS) tools for implementation of theory based on DSC courses as it is also suggested by the LOCF committee that the papers may be taught using various Computer Algebra System (CAS) software's such as Mathematica, MATLAB, Maxima and R to strengthen the conceptual understanding and widen up the horizon of students' self-experience. In view of these observations the subject expert committee suggested the software's Phython /R / Maxima/ Scilab/ Maple/MatLab/Mathematica for hands on experience of implementation of mathematical concepts in computer based lab.

The expert committee suggests the implementation this curriculum structure in all the Departments of Mathematics in Universities/Colleges in Karnataka.

The subject expert committee designed the Course Learning Outcome (CO) to help the learners to understand the main objectives of studying the courses by keeping in mind of the Programme outcomes (PO) of the graduate degree with honors in Mathematics or a graduate degree with Mathematics as a major subject.

As the Mathematics subject is a vast with several branches of specializations, it is difficult for every student to learn each branch of Mathematics, even though each paper has its own importance. Hence the subject expert committee suggests number of elective papers (for both Discipline electives and Open Electives) along with Discipline Core Courses. The BoS in Mathematics of universities may include additional electives based on the expertise of their staff and needs of the students'. A student can select elective paper as per her/his needs and interest.

The subject expert committee in Mathematics suggests that the concerned Department/Autonomous Colleges/Universities to encourage their faculty members to include necessary topics in addition to courses suggested by the expert committee.

SEMESTER – I

Algebra - I and Calculus – I	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**
Course Code	**FSA43032/FSA43034**

Course Learning Outcomes: This course will enable the students to

- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous linear of *m* equations in *n*

  variables by using concept of rank of matrix.
- Students will be familiar with the techniques of integration and differentiation of function with real variables.
- Students learn to solve polynomial equations.
- Learn to apply Reduction formulae.

Unit-I: Matrix: Recapitulation of Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction to Echelon form. Rank of a matrix; Inverse of a matrix by elementary operations; Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Cayley- Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **14 Hours**

Unit-II: Theory of equations: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only), Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method. **14 Hours**

Unit-III: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, circle of curvature. **14 Hours**

Unit IV: Successive Differentiation and Integral Calculus-I: nth Derivatives

of Standard functions e^{as+b}, a^s, $(ax + b)^n$, $\log(ax + b)$, $\sin(ax + b)$, $\cos(ax+ b)$, $e^{as}\sin(bx + c)$, $e^{as}\cos(bx +c)$, Leibnitz theorem and its applications.

Recapitulation of definite integrals and its properties. Reduction formulae for $\int \sin^n x\, dx$,$\int \cos^n x\, dx$, $\int \sin^n x \cos^N x\, dx$, $\int \tan^n x\, dx$, $\int \cot^n x\, dx$, $\int \sec^n x\, dx$, $\int \operatorname{cosec}^n x\, dx$,$\int x^n \sin x\, dx$,$\int x^n \cos x\, dx$, $\int x^n e^{as}\, dx$, $\int x^n(\log x)^N dx$ with definite limits.

14 Hour

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited.
2. Algebra – Natarajan, Manicavasagam Pillay and Ganapathy.
3. Theory of Matrices - B S Vatsa, New Age International Publishers.
4. Matrices - A R Vasista, Krishna Prakashana Mandir.
5. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
6. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.
10. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.
11. Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013

Theory based Practical's on Algebra - I and Calculus-I	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50 (S.A.-25 + I.A.-25)**
Course Code	**FSA43332/FSA43334**

Course Learning Outcomes: This course will enable the students to

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and calculus theory studied in **FSA43032/FSA43034** by using FOSS software's.
- Acquire knowledge of applications of algebra and calculus

through FOSS **Practical/Lab Work to be performed in Computer**

Lab (FOSS) Suggested Software's: Maxima/Scilab /Python/R.

Introduction to the software and commands related to the topic.

1. Computation of addition and subtraction of matrices,
2. Computation of Multiplication of matrices.
3. Computation of Trace and Transpose of Matrix
4. Computation of Rank of matrix and Row reduced Echelon form.
5. Computation of Inverse of a Matrix using Cayley-Hamilton theorem.
6. Solving the system of homogeneous and non-homogeneous linear algebraic equations.
7. Finding the nth Derivative of e^{ax}, trigonometric and hyperbolic functions
8. Finding the nth Derivative of algebraic and logarithmic functions.
9. Finding the nth Derivative of $e^{ax}\sin(bx + c)$, $e^{ax}\cos(bx +c)$.
10. Finding the roots of the equation, factoring.
11. Finding the angle between the radius vector and tangent.
12. Finding the curvatures of the given curves.

Open Elective Course

(who have not chosen Mathematics as one of Core subjects)

Optional Mathematics – I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**
Course Code	

Course Learning Outcomes: This course will enable the students to

- Learn to solve system of linear equations.
- Solve the system of homogeneous and non homogeneous m linear equations by using the concept of rank of matrix.
- Students will be familiar with the techniques of differentiation of function with real variables.
- Identify and apply the intermediate value theorems and L'Hospital rule.
- Learn to apply Reduction formulae.

Unit-I: Matrices: Recapitulation of Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction, Echelon form. Rank of a matrix; Inverse of a matrix by elementary operations; Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Cayley- Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem (Without Proof). **14 Hours**

Unit-II: Theory of equations: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only), Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method. **14 Hours**

Unit-III: Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, circle of curvature. **14 Hours**

Reference Books:

1. University Algebra - N.S. Gopala Krishnan, New Age International (P) Limited.
2. Algebra – Natarajan, Manicavasagam Pillay and Ganapathy.
3. Theory of Matrices - B S Vatsa, New Age International Publishers.
4. Matrices – A. R. Vasista, Krishna Prakashana Mandir.
5. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Calculus – S. Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd.,vol. I & II.
9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw.
10. Shanthinarayan – Integral Calculus, New Delhi: S. Chand and Co. Pvt. Ltd.
11. Shanthinarayan and P K Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.

Open Elective

UG-Mathematics- CBCS (For Students of all Streams)

Business Mathematics-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSA850**

Course Learning Outcomes: This course will enable the students to

- Translate the real word problems through appropriate mathematical modellling.
- Explain the concepts and use equations, formulae and mathematical expression and relationship in a variety of context.
- Finding the extreme values of functions.
- Analyze and demonstrate the mathematical skill require in mathematically intensive areas in economics and business.

Unit-I: Algebra – Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics. **14 Hours**

Unit - II: Matrices: Definition of a matrix; types of matrices; algebra of matrices. Properties of determinants; calculations of values of determinants upto third order; Adjoint of a matrix, elementary row and column operations; solution of a system of linear equations having unique solution and involving not more than three variables. Examples on commercial mathematics. **14 Hours**

Unit - III: **Differential Calculus**: Constant and variables, functions, Limits & continuity. Differentiability and Differentiation, partial differentiation, rates as a measure, maxima, minima, Partial Derivatives up to second order; Homogeneity of functions and Euler's Theorem; Total Differentials; Differentiation of implicit function with the help of total differentials, Maxima and Minima; cases of one variable involving second or higher order derivatives; Cases of two variables involving not more than one constraint. **14 Hours**

Reference Books:

1. Basic Mathematics, Allel R.G.A, Macmillan, New Delhi.
2. Mathematics for Economics, Dowling, E.T. , Schaum's Series, McGraw Hill London.
3. Quantitative Techniques in Management, Vohra, N.D., Tata McGraw Hill, New Delhi.

4. Business Mathematics, Soni R.S., Pitamber Publishing House, Delhi.

Open Elective

UG-Mathematics- CBCS

(For Students of all Streams)

Mathematical Aptitude-I	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100 (S.A.- 60 + I.A. – 40)**
Course Code	**FSA840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit-I: Number System, Types of Numbers, series (AP and GP), Algebraic operations BODMAS, Divisibility, LCM and HCF, Fraction, Simplification. **14 Hours**

Unit-II: Time and Distance, Problems based on Trains, Boats and Streams. **14 Hours**

Unit-III: Time, work and wages, Pipes and Cistern, Problems on Clock, Problems on Calendar.

14 Hours

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

SEMESTER – II

Algebra – II {Number Theory) and Calculus – II	
Teaching Hours : 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 56 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**
Course Code	**FSB43032/FSB43034**

Course Learning Outcomes: This course will enable the students to

- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.
- Identify and apply the intermediate value theorems and L'Hospital rule.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.
- Students learn to find areas and volumes using integration.

Unit-I: Number Theory: Division Algorithm, Divisibility, Prime and composite numbers, Euclidean algorithm, Fundamental theorem of Arithmetic, The greatest common divisor and least common multiple. Congruences, Linear congruences, Simultaneous congruences, Euler's Phi-function, Wilson's, Euler's and Fermat's Theorems and their applications. **14 Hours**

Unit-II: Differential Calculus-I: Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series, Indeterminate forms and evaluation of limits using L'Hospital rule. **14 Hours**

Unit-III: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem and extension of Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 Hours

Unit-IV: Integral Calculus-II: *Line integral*: Definition of line integral and basic properties, examples on evaluation of line integrals. *Double integral*: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas using double integrals. *Triple integral*: Definition of triple integrals and evaluation- change of variables, volume as triple integral. **14 Hours**

Reference Books:

1. Differential Calculus, Shantinarayan, S. Chand & Company, New Delhi.
2. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
3. Calculus – Lipman Bers, Holt, Rinehart & Winston.
4. Calculus - Shanthinarayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
5. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill, 2008.
6. Integral Calculus, Shanthinarayan, New Delhi: S. Chand and Co. Pvt. Ltd.
7. Integral Calculus, Shantinarayan and P K Mittal, S. Chand and Co. Pvt. Ltd.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.
9. David M Burton, Elementary Number Theory, 6th edition, McCraw Hill, 2007.
10. Emil Grosswald, Topics from the Theory of Numbers, Modern Birhauser, 1984.
11. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991

Theory based practical's On Algebra – II (Number Theory) and Calculus – II	
Practical Hours : 4 Hours/Week	**Credits: 2**
Total Practical Hours: 56 Hours	**Max. Marks: 50 (S.A.-25 + I.A. –25)**
Course Code	**FSB43332/FSB43334**

Course Learning Outcomes: This course will enable the students to

- Learn *Free and Open Source Software (FOSS)* tools for computer programming
- Solve problem on algebra and calculus by using FOSS software's.
- Acquire knowledge of applications of algebra and calculus through FOSS

Practical/Lab Work to be performed in Computer Lab

Suggested Software's: Maxima/Scilab /Phython/R.

1. Programs related to Number Theory.
2. ***Program to verify Mean value theorems.***
3. Program for finding the Taylor's and Maclaurin's expansions of the given functions.
4. Program to verify the Euler's theorem and its extension.
5. Programs to construct series using Maclaurin's expansion for functions of two variables.
6. Program to evaluate the line integrals with constant and variable limits.
7. Program to evaluate the Double integrals with constant and variable limits.
8. Program to evaluate the Triple integrals with constant and variable limits.

Open Elective

(For students of Science stream who have not chosen Mathematics as one of the Core subjects)

Optional Mathematics – II	
Teaching Hours : 3 Hours/Week	**Credits:3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Learn the concept of Divisibility.
- Learn about prime and composite numbers.
- Learn the concept of congruences and its applications.
- Understand the concept of differentiation and fundamental theorems in differentiation and various rules.
- Find the extreme values of functions of two variables.
- To understand the concepts of multiple integrals and their applications.

Unit-I: Number Theory: Division Algorithm, Divisibility, Prime and composite numbers, Euclidean algorithm, Fundamental theorem of Arithmetic, The greatest common divisor and least common multiple. Congruences, Linear congruences, Simultaneous congruences, Euler's Phi-function, Wilson's, Euler's and Fermat's Theorems and their applications. **14 Hours**

Unit-II: Partial Derivatives: Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem and extension of Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.

14 Hours

Unit-III: Integral Calculus: *Line integral*: Definition of line integral and basic properties, examples on evaluation of line integrals. *Double integral*: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas, *Triple integral*: Definition of triple integrals and evaluation-change of variables, volume as triple integral.

14 Hours

Reference Books:

1. Differential Calculus, Shanti Narayan, S. Chand & Company, New Delhi.
2. Applications of Calculus, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
3. Calculus – Lipman Bers, Holt, Rinehart & Winston.
4. Calculus - Shanthinarayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
5. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill, 2008.
6. Integral Calculus, Shanthinarayan, S. Chand and Co. Pvt. Ltd.
7. Integral Calculus, Shantinarayan and P K Mittal, S. Chand and Co. Pvt. Ltd.
8. Text Book of B.Sc. Mathematics, G K Ranganath, S Chand & Company.
9. David M Burton, Elementary Number Theory, 6th edition, McCraw Hill, 2007.
10. Emil Grosswald, Topics from the Theory of Numbers, Modern Birhauser, 1984.
11. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991.

Open Elective

(For Students of all streams)

Business Mathematics-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSB850**

Course Learning Outcomes: This course will enable the students to

- Integrate concept in international business concept with functioning of global trade.
- Evaluate the legal, social and economic environment of business.
- Apply decision-support tools to business decision making.
- Will be able to apply knowledge of business concepts and functions in an integrated manner.

Unit - I: Commercial Arithmetic: Interest**:** Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems Annuity: Ordinary Annuity, Sinking Fund, Annuity due, Present Value and Future Value of Annuity, Equated Monthly Installments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems. **14 Hours**

Unit - II: Measures of central Tendency and Dispersion: Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and give curves. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits, Choice of A.M., G.M.and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation (SD) for grouped and ungrouped data, combined SD, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems. **14 Hours**

Unit - III: Correlation and regression: Concept and types of correlation, Scatter diagram, Interpretation with respect to magnitude and direction of relationship. Karl Pearson's coefficient of correlation for ungrouped data. Spearman's rank correlation coefficient. (with tie and without tie) Concept of regression, Lines of regression for ungrouped data, predictions using lines of regression. Regression coefficients and their properties (without proof). Examples and problems. **14 Hours**

Reference Books:

1. Practical Business Mathematics, S. A. Bari New Literature Publishing Company New Delhi
2. Mathematics for Commerce, K. Selvakumar Notion Press Chennai
3. Business Mathematics with Applications, Dinesh Khattar & S. R. Arora S. Chand Publishing New Delhi
4. Business Mathematics and Statistics, N.G. Das &Dr. J.K. Das McGraw Hill New Delhi
5. Fundamentals of Business Mathematics, M. K. Bhowal, Asian Books Pvt. Ltd New Delhi
6. Mathematics for Economics and Finance: Methods and Modelling, Martin Anthony and Norman, Biggs Cambridge University Press Cambridge
7. Financial Mathematics and its Applications, Ahmad Nazri Wahidudin Ventus Publishing APS Denmark
8. Fundamentals of Mathematical Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.
9. Statistical Methods, Gupta S. P.: Sultan Chand and Sons, New Delhi.
10. Applied Statistics, Mukhopadhya Parimal New Central Book Agency Pvt. Ltd. Calcutta.
11. Fundamentals of Statistics, Goon A. M., Gupta, M. K. and Dasgupta, B. World Press Calcutta.
12. Fundamentals of Applied Statistics, Gupta S. C. and Kapoor V. K.:, Sultan Chand and Sons, New Delhi.

Open Elective

(For Students of all Streams)

Mathematical Aptitude-II	
Teaching Hours : 3 Hours/Week	**Credits: 3**
Total Teaching Hours: 42 Hours	**Max. Marks: 100** **(S.A.- 60 + I.A. – 40)**
Course Code	**FSB840**

Course Learning Outcomes: This course will enable the students to

- have a strong base in the fundamental mathematical concepts.
- grasp the approaches and strategies to solve problems with speed and accuracy
- gain appropriate skills to succeed in preliminary selection process for recruitment

Unit-I: Percentage, Average, Problems based on Ages, Ratio and Proportion, Partnership and share, Mixtures. **14 Hours**

Unit-II: Profit, Loss and Discount, Simple Interest, Compound Interest, Shares and Debentures. **14 Hours**

Unit-III: Permutations and Combinations, Probability, True discount and Banker's discount.

14 Hours

Reference Books:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Revised Edition, S. Chand and Co. Ltd, New Delhi, 2018.
2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3. Quantitative Aptitude : Numerical Ability (Fully Solved) Objective Questions, Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers.
4. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw hill publications.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

B N ROAD, MYSURU- 570 025

DEPARTMENT OF MATHEMATICS

Syllabus

CHOICE BASED CREDIT SYSTEM

For B.Sc programmes

- **Physics, Mathematics and Chemistry**
- **Physics, Mathematics and Computer Science**
- **Physics, Mathematics and Computer Maintenance**
- **Physics, Mathematics and Electronics**

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE (AUTONOMOUS)

B.N ROAD, MYSORE

DEPARTMENT OF MATHEMATICS

B.Sc Syllabus (CBCS)

LIST OF COURSES WITH CREDIT PATTREN

Year	Semester	DSC/DSE/SEC	Title of the paper	Lecture +Practical hours per week	No. of Credits			Total Credits	Total hours		Maximum Marks in Exam/Assesment				Exam duration
					L	T	P		Th	Pr	Exam	IA		Total	
												C1	C2		
I B.Sc	I	DSC-I Theory	Differential Calculus	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-I Practical		04	0	0	2				35	7.5	7.5	50	
	II	DSC-II Theory	Differential Equations	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-II Practical		04	0	0	2				35	7.5	7.5	50	
II B.Sc	III	DSC-III Theory	Real Analysis	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-III Practical		04	0	0	2				35	7.5	7.5	50	
	IV	DSC-IV Theory	Algebra	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-IV Practical		04	0	0	2				35	7.5	7.5	50	
III B.Sc	V	DSE-I Theory	Linear Algebra / Matrices	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSE-I Practical	Based on theory	04	0	0	2				35	7.5	7.5	50	
	VI	DSE-II Theory	Complex Analysis / Numerical Methods	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSE-II Practical	Based on theory	04	0	0	2				35	7.5	7.5	50	
		SEC	Vector calculus	02	2	0	0	**2**	30	-	35	7.5	7.5	50	2h

Scheme of Assessment:

Credits L:T:P	Percentage			Maximum marks in the Exam /Assessment			Exam Duration	
	Th	Pr	IA	Th	Pr	IA	Th	Pr
4:0:2	50	20	30	70	70	30	3h	3h
5:1:0	70	-	30	70	-	30	3h	-
4:0:0	70	-	30	70	-	30	3h	-
2:0:2	35	35	30	50	70	30	2h	3h
3:0:0	70	-	30	70	-	30	3h	-
2:1:0	70	-	30	70	-	30	3h	-
2:0:0	70	-	30	50	-	30	2h	-
0:0:1	-	70	30	-	70	30	-	2h

Note: L-Lecture, T-Tutorial, P-Practical; Th- Theory, Pr-Practical,

I A- Internal Assessment

SEMESTER III

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSC III : Real Analysis

Unit I: Finite and infinite sets, examples of countable and uncountable sets.Real line, bounded sets, supremum and infimum, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weistrass theorem.

Unit II: Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence .

Unit III: Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test , Definition and examples of absolute and conditional convergence.

Unit IV: Sequences and series of functions, Point wise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence, Power series and radius of convergence.

Reference Books:

1. S.C Malik –Real Analysis
2. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992
3. Richard R Goldberg, Methods of Real Analysis, Indian ed.
4. Asha Rani Singhal and M .K Singhal, A first course in Real Analysis
5. E.Kreyszig- Advanced Engineering Mathematics, Wiely India Pvt. Ltd.
6. Raisinghania M. D., Laplace and Fourier Transforms S. Chand publications.
7. Principles of Mathematical Analysis- Walter Rudin.
8. Mathematical Analysis- Tom M Apostol

PRACTICAL COMPONENTS –III

Credits: L: T: P = 0:0:2

1. Illustration of convergent, divergent and oscillatory sequences.
2. Plotting of recursive sequences.
3. Study of convergence of sequences through plotting
4. Illustration of convergent, divergent and oscillatory series.
5. To study the convergence and divergence of infinite series by plotting their sequences of partial sums.
6. Using Cauchy's criterion on the sequence of partial sums of the series to determine convergence of series.
7. Cauchy's root test by plotting n^{th} roots.
8. Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ terms.
9. Testing the convergence of binomial, exponential and logarithmic series and finding the sum.
10. To find the sum of the series and it's radius of convergence.

SEMESTER IV

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSC IV: Algebra

Unit I: Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, cyclic group, groups of symmetries ,the permutation group , Group of quarter nion's.

Unit II: Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups. Homomorphism, Kernal and Image, Isomorphism, Fundamental Theorem of Homomorphism.

Unit III: Definition and examples of rings, examples of commutative and non- commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternion's, rings of matrices, polynomial rings, and rings of continuous functions. Sub rings and ideals.

Unit IV: Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions. Homomorphisms', Isomorphism'.

Reference Books :

1. I. N. Herstien – Topics in Algebra.
2. Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi, Fourth Edition.
3. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
4. J B Fraleigh – A first course in Abstract Algebra.
5. Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
6. Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.
7. R Balakrishan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
8. University algebra by N.S.Gopalakrishnan

PRACTICAL COMPONENTS-IV

Credits: L: T: P = 0:0:2

1. Verifying whether a given operator is binary or not.
2. To find identity element of a group.
3. To find inverse element of a group.
4. Finding all possible subgroups of a finite group.
5. Examples to verify Lagrange's theorem.
6. Illustrating homomorphism and isomorphism of groups.
7. Verification of normality of a given subgroup.
8. Verifying Cayley's theorem and isomorphism theorems.
9. Examples for finding left and right coset and finding the index of a group.
10. Examples on different types of rings.
11. Examples on integral domains and fields.
12. Examples on subrings, ideals and subrings which are not ideals.
13. Homomorphism and isomorphism of rings – illustrative examples.
14. Solving polynomial equations.
15. Finding the G.C.D of polynomials.
16. Finding units and associates.
17. Test for rational roots.

SEMESTER V

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE I: Linear Algebra

Unit I: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, Direct sum of two subspaces, Quotient space.

Unit II: Inner Product, Inner Product of any two vectors in V (R), Euclidean Vectorspace, Orthogonal Vectors, Ortho normal Basis, Orthogonal Projection, Orthogonal Compliment.

Unit III: Linear transformations, algebra of linear transformations , matrix representation of a linear transformation, null space, range, rank and nullity of a linear transformation,

Unit IV: Eigen values and Eigen vectors, Characteristic Polynomial. Isomorphism, Auto morphism, theorems, invertibility of non singular linear transformation, change of Basis and similar matrices.

Reference Books:

1. I. N. Herstien – Topics in Algebra.
2. Stewart – Introduction to Linear Algebra
3. S. Kumaresan – Linear Algebra
4. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
5. N.S.Gopalakrishna – University Algebra
6. Saymour Lipschitz – Theory and Problems of Linear Algebra.
7. B.S Grewal – Higher engineering mathematics.
8. E.Kreyszig – Advanced Engineering Mathematics, Wiely India Pvt. Ltd.
9. J B Fraleigh – A first course in Abstract Algebra.

PRACTICAL COMPONENTS–V

Credits: L: T: P = 0:0:2

1. Vector space, subspace – illustrative examples.
2. Expressing a vector as a linear combination of given set of vectors.
3. Examples on linear dependence and independence of vectors.
4. Basis and Dimension – illustrative examples.
5. Verifying whether a given transformation is linear.
6. Finding matrix of a linear transformation.
7. Problems on rank and nullity.
8. Find characteristics polynomials.
9. To find Eigen values and their multiplicity.
10. Calculation of Eigen vector.
11. Change of basis.
12. Linear transformations to matrices and vice versa.
13. Matrix with respect to change of basis.
14. Orthogonal and orthonormal sets.
15. Gram- Schmidt orthogonalisation of the columns.

SEMESTER V

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE I A: Matrices

Unit I: Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.

Unit II: Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Unit III: R1, R2, R3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases.Subspaces of R2, R3.

Unit IV: Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Reference Books:

1. A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.
4. E.Kreyszig – Advanced Engineering Mathematics, Wiely India Pvt. Ltd
5. B.S Grewal – Higher engineering mathematics

PRACTICAL COMPONENTS-V

Credits: L:T:P = 0:0:2

1. Introduction to matrices and commands connected to the matrices.
2. Addition and subtraction of matrices.
3. Multiplication and transpose of matrices.
4. Power of a matrix.
5. Row reduced echelon form.
6. Rank of a matrix.
7. Adjoint of a matrix.
8. Inverse of a non-singular matrix.
9. Systems of linear equations.
10. Trace of a matrix.

SEMESTER VI

Credits: L:T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE II: Complex Analysis

Unit I: Complex numbers, Polar and exponential form of complex numbers, Triangular inequality, Geometry of complex numbers, Equations of lines and circles in complex form ,Functions of complex variables, Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit II: Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, Harmonic functions, Construction of Analytic functions.

Unit III: Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula, Cauchy's inequality, Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series.

Unit IV: Linear and Bilinear Transformations, Cross ratio of four points , Conformal mapping, Transformations of the form z^2, $\frac{1}{z}$, $sinz$, $cosz$, e^z , $\sinh z$, $\cosh z$ etc , Laurent series and its examples, Poles and residues.

Reference Books:

1. L. V. Ahlfors – Complex Analysis
2. Bruce P. Palica – Introduction to the Theory of Function of a Complex Variable
3. Serge Lang – Complex Analysis
4. Shanthinarayan – Theory of Functions of a Complex Variable
5. S. Ponnuswamy – Foundations of Complex Analysis
6. R. P. Boas – Invitation to Complex Analysis.
7. R V Churchil & J W Brown, Complex Variables and Applications,5th ed.:McGraw Hill Companies., 1989.
8. A R Vashista, Complex Analysis, Krishna Prakashana Mandir, 2012.

PRACTICAL COMPONENTS-VI

Credits: L:T:P = 0:0:2

1. Declaring a complex number and graphical representation.
2. Complex numbers and their representations, operations like addition, multiplication, division, modulus, graphical representations of polar form.
3. To plot the complex functions and analyze the graph

   (i)f(z)= z, (ii) f(z) = z^3, (iii) f(z) =$(z^4- 1)^{1/4}$
4. Some problems on Cauchy – Riemann equations (polar forms).
5. Implementation of Milne – Thomson method of constructing analytic functions (simple examples).
6. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
7. Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates)
8. Examples connected with Cauchy's integral theorem.
9. To compute the poles and corresponding residues of complex functions.
10. Illustrating the angle preserving property in a transformation.
11. Illustrating the circles are transformed to circles by a bilinear transformation.
12. To perform conformal mapping and bilinear transformations.

SEMESTER VI

Credits: L:T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE II B: Numerical Methods

Unit I: Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Unit II: Lagrange and Newton interpolation: linear and higher order, finite difference operators. Numerical differentiation: forward difference, backward difference and central Difference. Integration: trapezoidal rule, Simpson's rule, Euler's method.

Reference Books:

1. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5th Ed., New age International Publisher, India, 2007.
3. Introduction to Numerical analysis by S.S.Shasthri
4. B.S Grewal – Higher engineering mathematics
5. E.Kreyszig – Advanced Engineering Mathematics, Wiely India Pvt. Ltd

PRACTICAL COMPONENTS-VI A

Credits: L:T:P = 0:0:2

1. Newton Gregory forward interpolation.
2. Lagrange interpolation.
3. Simpson's one-third method.
4. Simpson's three-eighth method.
5. Bisection method.
6. Regula-Falsi method.
7. Newton-Raphson method.
8. Modified Euler's metod.
9. Runge Kutta second order method.
10. Runge Kutta fourth order method.

Vector Calculus

Credits: L:T: P = 2:0:0 **Teaching hours: 2 hours per week**

Skill Enhancement Course (SEC - II)

Unit I: Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors.

Unit II: Gradient, divergence and curl, Standard derivations and Exercise ,

Reference Books:

1. Murray R Spiegel – Theory and problems of vector calculus.
2. Shanthinarayan and J N Kapur – A text book of Vector calculus.
3. B.S Grewal – Higher engineering mathematics.
4. Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous)

B N ROAD, MYSURU- 570 025

DEPARTMENT OF MATHEMATICS

Syllabus

CHOICE BASED CREDIT SYSTEM

For B.Sc programmes

- **Physics, Mathematics and Chemistry**
- **Physics, Mathematics and Computer Science**
- **Physics, Mathematics and Computer Maintenance**
- **Physics, Mathematics and Electronics**

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE (AUTONOMOUS)

B.N ROAD, MYSORE

DEPARTMENT OF MATHEMATICS

B.Sc Syllabus (CBCS)

LIST OF COURSES WITH CREDIT PATTREN

Year	Semester	DSC/DSE/SEC	Title of the paper	Lecture +Practical hours per week	No. of Credits			Total Credits	Total hours		Maximum Marks in Exam/Assesment				Exam duration
					L	T	P		Th	Pr	Exam	IA C1	IA C2	Total	
I B.Sc	I	DSC-I Theory	Differential Calculus	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-I Practical		04	0	0	2				35	7.5	7.5	50	
	II	DSC-II Theory	Differential Equations	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-II Practical		04	0	0	2				35	7.5	7.5	50	
II B.Sc	III	DSC-III Theory	Real Analysis	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-III Practical		04	0	0	2				35	7.5	7.5	50	
	IV	DSC-IV Theory	Algebra	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSC-IV Practical		04	0	0	2				35	7.5	7.5	50	
III B.Sc	V	DSE-I Theory	Linear Algebra / Matrices	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSE-I Practical	Based on theory	04	0	0	2				35	7.5	7.5	50	
	VI	DSE-II Theory	Complex Analysis / Numerical Methods	04	4	0	0	**6**	60	60	70	15	15	100	3h
		DSE-II Practical	Based on theory	04	0	0	2				35	7.5	7.5	50	
		SEC	Vector calculus	02	2	0	0	**2**	30	-	35	7.5	7.5	50	2h

Scheme of Assessment:

Credits L:T:P	Percentage			Maximum marks in the Exam /Assessment			Exam Duration	
	Th	Pr	IA	Th	Pr	IA	Th	Pr
4:0:2	50	20	30	70	70	30	3h	3h
5:1:0	70	-	30	70	-	30	3h	-
4:0:0	70	-	30	70	-	30	3h	-
2:0:2	35	35	30	50	70	30	2h	3h
3:0:0	70	-	30	70	-	30	3h	-
2:1:0	70	-	30	70	-	30	3h	-
2:0:0	70	-	30	50	-	30	2h	-
0:0:1	-	70	30	-	70	30	-	2h

Note: L-Lecture, T-Tutorial, P-Practical; Th- Theory, Pr-Practical,

I A- Internal Assessment

SEMESTER III

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSC III : Real Analysis

Unit I: Finite and infinite sets, examples of countable and uncountable sets.Real line, bounded sets, supremum and infimum, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weistrass theorem.

Unit II: Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence .

Unit III: Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test , Definition and examples of absolute and conditional convergence.

Unit IV: Sequences and series of functions, Point wise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence, Power series and radius of convergence.

Reference Books:

1. S.C Malik –Real Analysis
2. S.C.Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992
3. Richard R Goldberg, Methods of Real Analysis, Indian ed.
4. Asha Rani Singhal and M .K Singhal, A first course in Real Analysis
5. E.Kreyszig- Advanced Engineering Mathematics, Wiely India Pvt. Ltd.
6. Raisinghania M. D., Laplace and Fourier Transforms S. Chand publications.
7. Principles of Mathematical Analysis- Walter Rudin.
8. Mathematical Analysis- Tom M Apostol

PRACTICAL COMPONENTS –III

Credits: L: T: P = 0:0:2

1. Illustration of convergent, divergent and oscillatory sequences.
2. Plotting of recursive sequences.
3. Study of convergence of sequences through plotting
4. Illustration of convergent, divergent and oscillatory series.
5. To study the convergence and divergence of infinite series by plotting their sequences of partial sums.
6. Using Cauchy's criterion on the sequence of partial sums of the series to determine convergence of series.
7. Cauchy's root test by plotting n^{th} roots.
8. Ratio test by plotting the ratio of n^{th} and $(n+1)^{th}$ terms.
9. Testing the convergence of binomial, exponential and logarithmic series and finding the sum.
10. To find the sum of the series and it's radius of convergence.

SEMESTER IV

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSC IV: Algebra

Unit I: Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, cyclic group, groups of symmetries ,the permutation group , Group of quarter nion's.

Unit II: Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups. Homomorphism, Kernal and Image, Isomorphism, Fundamental Theorem of Homomorphism.

Unit III: Definition and examples of rings, examples of commutative and non- commutative rings: rings from number systems, Zn the ring of integers modulo n, ring of real quaternion's, rings of matrices, polynomial rings, and rings of continuous functions. Sub rings and ideals.

Unit IV: Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions. Homomorphisms', Isomorphism'.

Reference Books :

1. I. N. Herstien – Topics in Algebra.
2. Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi, Fourth Edition.
3. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
4. J B Fraleigh – A first course in Abstract Algebra.
5. Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.
6. Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.
7. R Balakrishan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.
8. University algebra by N.S.Gopalakrishnan

PRACTICAL COMPONENTS-IV

Credits: L: T: P = 0:0:2

1. Verifying whether a given operator is binary or not.
2. To find identity element of a group.
3. To find inverse element of a group.
4. Finding all possible subgroups of a finite group.
5. Examples to verify Lagrange’s theorem.
6. Illustrating homomorphism and isomorphism of groups.
7. Verification of normality of a given subgroup.
8. Verifying Cayley’s theorem and isomorphism theorems.
9. Examples for finding left and right coset and finding the index of a group.
10. Examples on different types of rings.
11. Examples on integral domains and fields.
12. Examples on subrings, ideals and subrings which are not ideals.
13. Homomorphism and isomorphism of rings – illustrative examples.
14. Solving polynomial equations.
15. Finding the G.C.D of polynomials.
16. Finding units and associates.
17. Test for rational roots.

SEMESTER V

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE I: Linear Algebra

Unit I: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces, Direct sum of two subspaces, Quotient space.

Unit II: Inner Product, Inner Product of any two vectors in V (R), Euclidean Vectorspace, Orthogonal Vectors, Ortho normal Basis, Orthogonal Projection, Orthogonal Compliment.

Unit III: Linear transformations, algebra of linear transformations , matrix representation of a linear transformation, null space, range, rank and nullity of a linear transformation,

Unit IV: Eigen values and Eigen vectors, Characteristic Polynomial. Isomorphism, Auto morphism, theorems, invertibility of non singular linear transformation, change of Basis and similar matrices.

Reference Books:

1. I. N. Herstien – Topics in Algebra.
2. Stewart – Introduction to Linear Algebra
3. S. Kumaresan – Linear Algebra
4. G. D. Birkhoff and S Maclane – A brief Survey of Modern Algebra.
5. N.S.Gopalakrishna – University Algebra
6. Saymour Lipschitz – Theory and Problems of Linear Algebra.
7. B.S Grewal – Higher engineering mathematics.
8. E.Kreyszig – Advanced Engineering Mathematics, Wiely India Pvt. Ltd.
9. J B Fraleigh – A first course in Abstract Algebra.

PRACTICAL COMPONENTS–V

Credits: L: T: P = 0:0:2

1. Vector space, subspace – illustrative examples.
2. Expressing a vector as a linear combination of given set of vectors.
3. Examples on linear dependence and independence of vectors.
4. Basis and Dimension – illustrative examples.
5. Verifying whether a given transformation is linear.
6. Finding matrix of a linear transformation.
7. Problems on rank and nullity.
8. Find characteristics polynomials.
9. To find Eigen values and their multiplicity.
10. Calculation of Eigen vector.
11. Change of basis.
12. Linear transformations to matrices and vice versa.
13. Matrix with respect to change of basis.
14. Orthogonal and orthonormal sets.
15. Gram- Schmidt orthogonalisation of the columns.

SEMESTER V

Credits: L: T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE I A: Matrices

Unit I: Types of matrices. Rank of a matrix. Invariance of rank under elementary transformations. Reduction to normal form, Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four.

Unit II: Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Unit III: R1, R2, R3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases.Subspaces of R2, R3.

Unit IV: Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigen values and eigen vectors for such transformations and eigen spaces as invariant subspaces.

Reference Books:

1. A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984.
2. S. H. Friedberg, A. L. Insel and L. E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.
4. E.Kreyszig – Advanced Engineering Mathematics, Wiely India Pvt. Ltd
5. B.S Grewal – Higher engineering mathematics

PRACTICAL COMPONENTS-V

Credits: L:T:P = 0:0:2

1. Introduction to matrices and commands connected to the matrices.
2. Addition and subtraction of matrices.
3. Multiplication and transpose of matrices.
4. Power of a matrix.
5. Row reduced echelon form.
6. Rank of a matrix.
7. Adjoint of a matrix.
8. Inverse of a non-singular matrix.
9. Systems of linear equations.
10. Trace of a matrix.

SEMESTER VI

Credits: L:T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE II: Complex Analysis

Unit I: Complex numbers, Polar and exponential form of complex numbers, Triangular inequality, Geometry of complex numbers, Equations of lines and circles in complex form ,Functions of complex variables, Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit II: Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, Harmonic functions, Construction of Analytic functions.

Unit III: Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula, Cauchy's inequality, Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series.

Unit IV: Linear and Bilinear Transformations, Cross ratio of four points , Conformal mapping, Transformations of the form z^2, $\frac{1}{z}$, $sinz$, $cosz$, e^z , $\sinh z$, $\cosh z$ etc , Laurent series and its examples, Poles and residues.

Reference Books:

1. L. V. Ahlfors – Complex Analysis
2. Bruce P. Palica – Introduction to the Theory of Function of a Complex Variable
3. Serge Lang – Complex Analysis
4. Shanthinarayan – Theory of Functions of a Complex Variable
5. S. Ponnuswamy – Foundations of Complex Analysis
6. R. P. Boas – Invitation to Complex Analysis.
7. R V Churchil & J W Brown, Complex Variables and Applications,5th ed.:McGraw Hill Companies., 1989.
8. A R Vashista, Complex Analysis, Krishna Prakashana Mandir, 2012.

PRACTICAL COMPONENTS-VI

Credits: L:T:P = 0:0:2

1. Declaring a complex number and graphical representation.
2. Complex numbers and their representations, operations like addition, multiplication, division, modulus, graphical representations of polar form.
3. To plot the complex functions and analyze the graph

   (i)$f(z)= z$, (ii) $f(z) = z^3$, (iii) $f(z) =(z^4- 1)^{1/4}$
4. Some problems on Cauchy – Riemann equations (polar forms).
5. Implementation of Milne – Thomson method of constructing analytic functions (simple examples).
6. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
7. Verifying real and imaginary parts of an analytic function being harmonic (in polar coordinates)
8. Examples connected with Cauchy's integral theorem.
9. To compute the poles and corresponding residues of complex functions.
10. Illustrating the angle preserving property in a transformation.
11. Illustrating the circles are transformed to circles by a bilinear transformation.
12. To perform conformal mapping and bilinear transformations.

SEMESTER VI

Credits: L:T: P = 4:0:0 **Teaching hours: 4 hours per week**

DSE II B: Numerical Methods

Unit I: Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton’s method, Secant method, LU decomposition, Gauss-Jacobi, Gauss-Siedel and SOR iterative methods.

Unit II: Lagrange and Newton interpolation: linear and higher order, finite difference operators. Numerical differentiation: forward difference, backward difference and central Difference. Integration: trapezoidal rule, Simpson’s rule, Euler’s method.

Reference Books:

1. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5th Ed., New age International Publisher, India, 2007.
3. Introduction to Numerical analysis by S.S.Shasthri
4. B.S Grewal – Higher engineering mathematics
5. E.Kreyszig – Advanced Engineering Mathematics, Wiely India Pvt. Ltd

PRACTICAL COMPONENTS-VI A

Credits: L:T:P = 0:0:2

1. Newton Gregory forward interpolation.
2. Lagrange interpolation.
3. Simpson’s one-third method.
4. Simpson’s three-eighth method.
5. Bisection method.
6. Regula-Falsi method.
7. Newton-Raphson method.
8. Modified Euler’s metod.
9. Runge Kutta second order method.
10. Runge Kutta fourth order method.

Vector Calculus

Credits: L:T: P = 2:0:0 **Teaching hours: 2 hours per week**

Skill Enhancement Course (SEC - II)

Unit I: Differentiation and partial differentiation of a vector function. Derivative of sum, dot product and cross product of two vectors.

Unit II: Gradient, divergence and curl, Standard derivations and Exercise ,

Reference Books:

1. Murray R Spiegel – Theory and problems of vector calculus.
2. Shanthinarayan and J N Kapur – A text book of Vector calculus.
3. B.S Grewal – Higher engineering mathematics.
4. Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(An autonomous College of University of Mysuru)
Re-accredited by NAAC with ‘A’ grade
Ooty road, Mysuru-570 025, Karnataka

ESTD-1964

DEPARTMENT OF MICROBIOLOGY

SYLLABUS

NATIONAL EDUCATION POLICY
FOR
B.Sc. PROGRAMME

Microbiology & Biotechnology

Microbiology & Biochemistry

(W. E. F. 2022 – 2023)

BSc Microbiology (Basic / Hons.)

Semester 1

Title of the Courses:

Course 1 : DSC-1T: General Microbiology
Course 2 : OE 1T: Microbial Technology for Human Welfare
Course 3 : SEC 1T: Microbiological Methods and Analytical Techniques

Course 1 : DSC-1T General Microbiology		Course 2 : OE 1T Microbial Technology for Human Welfare		Course 3 : SEC 1T Microbiological Methods and Analytical Techniques	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**	**1**	**14**

Content of Course 1: Theory: DSC-1T, MBL 101, General Microbiology	56 Hrs
Unit – 1: Historical development, major contributions, origin of microorganisms and microscopy	**14Hrs**
Historical development of microbiology -Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Edward Jenner, Alexander Fleming, Martinus Beijirinic, Segei Winogrodsky, Elei Metechnikoff. Contributions of Indian scientists in the field of Microbiology. Fossil evidences of microorganisms. Origin of life, primitive cells and evolution of microorganisms. Microcopy- working principle, construction and operation of simple and compound microscopes.	
Unit – 2: Staining, sterilization and preservation of microorganisms	**14Hrs**
Staining: Nature of strains, principles, mechanism, methods and types of staining- Simple, Differential-Gram staining, Acid fast staining, staining of capsule, cell wall, endospore, inclusion bodies. Sterilization: Principles, types and techniques, Physical and chemical methods. Culture media – Types, Cultivation of aerobic and anaerobic bacteria. Pure culture techniques and Cultural characteristics. Preservation of microorganisms: Methods of preservation of microorganisms; slant culture, stab culture, soil culture, mineral oil overlaying, glycerol preservation.	
Unit – 3: Types, structure, organisation and reproduction of prokaryotic microorganism	**14Hrs**
Overview of Prokaryotic Cell Structure: Size, shape, arrangement. Diagram of Prokaryotic cell organisation, cell wall structure of Gram positive and negative bacteria, cell membrane; Bacterial and Archaeal, Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Materials – Bacterial chromosomes structure (its differences with the Eukaryotic chromosome); Extra Chromosomal materials. Components external to cell wall- capsule, slime, s- layer, pilli, fimbriae, flagella; structure, motility, chemotaxis. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination.Reproduction in bacteria and bacterial cell cycle.	

Unit – 4: Types, structure, organisation and reproduction of eukaryotic microorganisms	14Hrs
Over view of eukaryotic cell structure: General structure and types of cells; External cell coverings and cell membrane. Structure and function of Cytoplasmic matrix- cytoskeleton: Structure and function; single Membrane organelles- Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles and Ribosomes; Double Membrane organelles- Nucleus, Mitochondrion and Chloroplast: Structure and Functions; Peroxisomes; Organelles of motility- Structure and movement of flagella and cilia.	

FSA501P Course 1: Practical: DSC-1P : General Microbiology

1. Microbiological laboratory standards and safetyprotocols
2. Standard aseptic conditions of Microbiological laboratory.
3. Operation and working principles of Light/ Compound microscope.
4. A. Working principles and operations of basic equipments of microbiological laboratory (Autoclave, Oven, Incubator, pH meter, Spectrophotometer, Colorimeter, Vortex, Magnetic stirrer).
5. Applications of basic microbiological tools (Pipettes, Micropipette, Bunsen burner, Inoculation loop, Spreader).
6. Demonstration and observations of microorganisms from natural sources under light microscope (Algae, Yeast and Protozoa).
7. Demonstration of bacterial motility by hanging drop method.
8. Simple staining & Negative staining
9. Differential staining - Gram staining
10. Acid fast staining
11. Structural staining - Flagella and Capsule
12. Bacterial endospore staining
13. Staining of fungi by Lactophenol cotton blue.
14. Staining of reserved food materials.
15. A.Preparation of Physiological saline and Serial dilution

    B. Method of obtaining pure cultures of Microorganisms

BSc Microbiology (Basic / Hons.)
Semester II

Title of the Courses:

Course 1: DSC-2T: Microbial Biochemistry and Physiology Course 2 : OE- 2T: Environmental and Sanitary Microbiology

Course code:FSB500

Course 1: DSC-2T, MBL 102, Microbial Biochemistry and Physiology		**Course 2: OE- 2T, MBL 302, Environmental and Sanitary Microbiology**	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**

Content of Course: DSC-2T: Microbial Biochemistry and Physiology	**56 Hrs**
Unit – 1 Biochemical Concepts	**14Hrs**
Basic Biochemical Concepts: Major elements of life and their primary characteristics, atomic bonds and molecules – bonding properties of carbon, chemical bonds- covalent and non covalent, Hydrogen bonds and Vander Waal Forces. Biological Solvents: Structure and properties of water molecule, Water as an universal solvent, polarity, hydrophilic and hydrophobic interactions, properties of water, Acids, bases, electrolytes, hydrogen ion concentration, pH, buffers and physiological buffer system, Handerson – Hasselbatch equation.	
Unit – 2 Macromolecules – Types, Structure and Properties	**14Hrs**
Carbohydrates: Definition, classification, structure and properties. Amino acids and proteins: Definition, structure, classification and properties of amino acids, Structure and classification of proteins. Lipids and Fats: Definition, classification, structure, properties and importance of lipids. Porphyrins and Vitamins: Definition, structure, properties and importance of chlorophyll, cytochrome and hemoglobin.	
Unit – 3 Microbial Physiology	**14Hrs**
Microbial Growth: Definition of growth, Mathematical expression, Growth curve, phases of growth, calculation of generation time and specific growth rate. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth. Measurement of Growth: Direct Microscopic count – Haemocytometer; Viable count, Membrane filtration; Electronic Counting; Measurement of cell mass; Turbidity measurements-Nephelometer and spectrophotometer techniques;Measurements of cell constituents. Growth Yield (definition of terms). Influence of environmental factors on growth. Microbial growth in natural environments. Viable non-culturable organisms. Quorum sensing. **Microbial Nutrition**: Microbial nutrients, Classification of organisms based on carbon source, energy source and electron source, Macro and micronutrients. **Membrane Transport**: Structure and organization of biological membranes, Types of Cellular transport, Passive, Facilitated, Active, Group Translocation, Membrane bound and binding protein transport system, Carrier models, Liposomes, Ion transduction Na K^+, ATPase.	
Unit – 4: Microbial Physiology- Bioenergetics, Microbial Respiration, Microbial Photosynthesis	**14Hrs**

Bioenergetics: Free energy, Enthalpy, Entropy, Classification of high energy compounds, Oxidation reduction reactions, equilibrium constant, Redox potential, Law of thermodynamics. Microbial Respiration:Respiratory electron transport chain in bacteria, oxidation – reduction reactions, protein translocation, oxidative and substrate level phosphorylation – inhibitors and mechanism, chemiosmotic coupling. Fermentation reactions (homo and hetero) Microbial Photosynthesis: Light reaction:Light harvesting pigments Photophosphorylation, CO_2 fixation pathways: Calvin cycle, CODH pathway, Reductive TCA pathway.	

FSB501P Course 1: Practicals: DSC-2P: Microbial Biochemistry and Physiology

1. Preparation of Solution: Normal and Molar solutions
2. Calibration of pH meter and determination of pH of natural samples
3. Preparation of Buffer Solutions
4. Qualitative determination and identification of Carbohydrates
5. Qualitative determination and identification of Proteins & Amino Acids
6. Qualitative determination and identification of Fatty Acids
7. Quantitative estimation of Reducing Sugar by DNS method
8. Quantitative estimation of Proteins by Biuret and Lowry's method
9. Determination of lipid saponification values of fats and iodine number of fatty acids
10. Determination of bacterial growth by spectrophotometric method & calculation of generation time
11. Measurement of cell number by Haemocytometer
12. Effect of pH on bacterial growth
13. Effect of Salt concentration on bacterial growth
14. Effect of Temperature on bacterial growth
15. Demonstration of aerobic and anaerobic respiration in microbes

Course Title	**Microbial Diversity**		Practical Credits	**2**
Course code.	**FSC501P**	**DSC-3P**	Contact hours	

Content

1. Study of morphology of bacteria
2. Isolation of bacteria from soil
3. Isolation of bacteria from air and water
4. Isolation of fungi from soil
5. Isolation of fungi from air
6. Cultivation of cyanobacteria
7. Cultivation of Actinomycetes
8. Measurement of microbial cell size by Micrometry
9. Study of cyanobacteria -*Nostoc,Microcyctis, Spirulina*
10. Study of Algae –*Chlorella, Diatoms, Gracilaria*
11. Study of Fungi – *Rhizopus, Aspergillus, Saccharomyces, Agaricus*
12. Study of Protozoa – *Amoeba, Paramoecium, Euglena*
13. Study of HIV, TMV, Corona virus, T4Phage
14. Study of Paramyxovirus, Oncogenic viruses

Course Title	**Microbial Enzymology and Metabolism**		Practical Credits	**2**
Course code.	**FSD501P**	**DSC-4P**	Contact hours	
		Content		

1. Identification of fatty acids and other lipids by TLC
2. Chemotaxis of *Pseudomonas*
3. Effect of variables on enzyme activity (amylase): a. Temperature b. pH c. substrate concentration d.Enzyme concentration
4. Sugar fermentation tests for bacteria
5. Separation of amino acids by paper chromatography
6. Screening of fungi for cellulose and pectin degradation
7. Screening of fungi for invertase
8. Enzyme immobilization by Alginate method
9. Gelatin hydrolysis
10. Microscopic examination of root nodules
11. Demonstration of Ammonifiaction
12. Demonstration of Nitrification – Nitrite and Nitrate
13. Demonstration of Denitrification
14. Demonstration of lipolytic activity
15. Demonstration of citric acid production
16. Effect of variables on enzyme activity (amylase): A. temperature B. pH C. substrate concentration D.enzyme concentration
17. Study of photographs/models: Chemolithotrophy- Hydrogen oxidation, Sulphur oxidation, Ironoxidation, Nitrogen oxidation, biological Nitrogen fixation, ammonia assimilation, ribozymes,abzymes, lock and key hopothesis, enzyme inhibition – competitive, non competitive and un competitive. Enzyme regulation- allosteric enzymes. Feedback inhibition.

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(An autonomous College of University of Mysuru)
Re-accredited by NAAC with ‘A’ grade
Ooty road, Mysuru-570 025, Karnataka

ESTD-1964

DEPARTMENT OF MICROBIOLOGY

SYLLABUS

NATIONAL EDUCATION POLICY
FOR
B.Sc. PROGRAMME

Microbiology & Biotechnology

Microbiology & Biochemistry

(W. E. F. 2022 – 2023)

BSc Microbiology (Basic / Hons.)

Semester 1

Title of the Courses:

Course 1 : DSC-1T: General Microbiology
Course 2 : OE 1T: Microbial Technology for Human Welfare
Course 3 : SEC 1T: Microbiological Methods and Analytical Techniques

Course 1 : DSC-1T General Microbiology		**Course 2 : OE 1T Microbial Technology for Human Welfare**		**Course 3 : SEC 1T Microbiological Methods and Analytical Techniques**	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**	**1**	**14**

Content of Course 1: Theory: DSC-1T, MBL 101, General Microbiology	**56 Hrs**
Unit – 1: Historical development, major contributions, origin of microorganisms and microscopy	**14Hrs**
Historical development of microbiology -Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Edward Jenner, Alexander Fleming, Martinus Beijirinic, Segei Winogrodsky, Elei Metechnikoff. Contributions of Indian scientists in the field of Microbiology. Fossil evidences of microorganisms. Origin of life, primitive cells and evolution of microorganisms. Microcopy- working principle, construction and operation of simple and compound microscopes.	
Unit – 2: Staining, sterilization and preservation of microorganisms	**14Hrs**
Staining: Nature of strains, principles, mechanism, methods and types of staining- Simple, Differential-Gram staining, Acid fast staining, staining of capsule, cell wall, endospore, inclusion bodies. Sterilization: Principles, types and techniques, Physical and chemical methods. Culture media – Types, Cultivation of aerobic and anaerobic bacteria. Pure culture techniques and Cultural characteristics. Preservation of microorganisms: Methods of preservation of microorganisms; slant culture, stab culture, soil culture, mineral oil overlaying, glycerol preservation.	
Unit – 3: Types, structure, organisation and reproduction of prokaryotic microorganism	**14Hrs**
Overview of Prokaryotic Cell Structure: Size, shape, arrangement. Diagram of Prokaryotic cell organisation, cell wall structure of Gram positive and negative bacteria, cell membrane; Bacterial and Archaeal, Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Materials – Bacterial chromosomes structure (its differences with the Eukaryotic chromosome); Extra Chromosomal materials. Components external to cell wall- capsule, slime, s- layer, pilli, fimbriae, flagella; structure, motility, chemotaxis. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination.Reproduction in bacteria and bacterial cell cycle.	

Unit – 4: Types, structure, organisation and reproduction of eukaryotic microorganisms	14Hrs
Over view of eukaryotic cell structure: General structure and types of cells; External cell coverings and cell membrane. Structure and function of Cytoplasmic matrix- cytoskeleton: Structure and function; single Membrane organelles- Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles and Ribosomes; Double Membrane organelles- Nucleus, Mitochondrion and Chloroplast: Structure and Functions; Peroxisomes; Organelles of motility- Structure and movement of flagella and cilia.	

FSA501P Course 1: Practical: DSC-1P : General Microbiology

1. Microbiological laboratory standards and safetyprotocols
2. Standard aseptic conditions of Microbiological laboratory.
3. Operation and working principles of Light/ Compound microscope.
4. A. Working principles and operations of basic equipments of microbiological laboratory (Autoclave, Oven, Incubator, pH meter, Spectrophotometer, Colorimeter, Vortex, Magnetic stirrer).
5. Applications of basic microbiological tools (Pipettes, Micropipette, Bunsen burner, Inoculation loop, Spreader).
6. Demonstration and observations of microorganisms from natural sources under light microscope (Algae, Yeast and Protozoa).
7. Demonstration of bacterial motility by hanging drop method.
8. Simple staining & Negative staining
9. Differential staining - Gram staining
10. Acid fast staining
11. Structural staining - Flagella and Capsule
12. Bacterial endospore staining
13. Staining of fungi by Lactophenol cotton blue.
14. Staining of reserved food materials.
15. A.Preparation of Physiological saline and Serial dilution

    B. Method of obtaining pure cultures of Microorganisms

BSc Microbiology (Basic / Hons.)
Semester II

Title of the Courses:

Course 1: DSC-2T: Microbial Biochemistry and Physiology Course 2 : OE- 2T: Environmental and Sanitary Microbiology

Course code:FSB500

Course 1: DSC-2T, MBL 102, Microbial Biochemistry and Physiology		Course 2: OE- 2T, MBL 302, Environmental and Sanitary Microbiology	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**

Content of Course: DSC-2T: Microbial Biochemistry and Physiology	56 Hrs
Unit – 1 Biochemical Concepts	**14Hrs**
Basic Biochemical Concepts: Major elements of life and their primary characteristics, atomic bonds and molecules – bonding properties of carbon, chemical bonds- covalent and non covalent, Hydrogen bonds and Vander Waal Forces. Biological Solvents: Structure and properties of water molecule, Water as an universal solvent, polarity, hydrophilic and hydrophobic interactions, properties of water, Acids, bases, electrolytes, hydrogen ion concentration, pH, buffers and physiological buffer system, Handerson – Hasselbatch equation.	
Unit – 2 Macromolecules – Types, Structure and Properties	**14Hrs**
Carbohydrates: Definition, classification, structure and properties. Amino acids and proteins: Definition, structure, classification and properties of amino acids, Structure and classification of proteins. Lipids and Fats: Definition, classification, structure, properties and importance of lipids. Porphyrins and Vitamins: Definition, structure, properties and importance of chlorophyll, cytochrome and hemoglobin.	
Unit – 3 Microbial Physiology	**14Hrs**
Microbial Growth: Definition of growth, Mathematical expression, Growth curve, phases of growth, calculation of generation time and specific growth rate. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth. Measurement of Growth: Direct Microscopic count – Haemocytometer; Viable count, Membrane filtration; Electronic Counting; Measurement of cell mass; Turbidity measurements-Nephelometer and spectrophotometer techniques;Measurements of cell constituents. Growth Yield (definition of terms). Influence of environmental factors on growth. Microbial growth in natural environments. Viable non-culturable organisms. Quorum sensing. **Microbial Nutrition**: Microbial nutrients, Classification of organisms based on carbon source, energy source and electron source, Macro and micronutrients. **Membrane Transport**: Structure and organization of biological membranes, Types of Cellular transport, Passive, Facilitated, Active, Group Translocation, Membrane bound and binding protein transport system, Carrier models, Liposomes, Ion transduction Na K^+, ATPase.	
Unit – 4: Microbial Physiology- Bioenergetics, Microbial Respiration, Microbial Photosynthesis	**14Hrs**

Bioenergetics: Free energy, Enthalpy, Entropy, Classification of high energy compounds, Oxidation reduction reactions, equilibrium constant, Redox potential, Law of thermodynamics. Microbial Respiration:Respiratory electron transport chain in bacteria, oxidation – reduction reactions, protein translocation, oxidative and substrate level phosphorylation – inhibitors and mechanism, chemiosmotic coupling. Fermentation reactions (homo and hetero) Microbial Photosynthesis: Light reaction:Light harvesting pigments Photophosphorylation, CO2 fixation pathways: Calvin cycle, CODH pathway, Reductive TCA pathway.	

FSB501P Course 1: Practicals: DSC-2P: Microbial Biochemistry and Physiology

1. Preparation of Solution: Normal and Molar solutions
2. Calibration of pH meter and determination of pH of natural samples
3. Preparation of Buffer Solutions
4. Qualitative determination and identification of Carbohydrates
5. Qualitative determination and identification of Proteins & Amino Acids
6. Qualitative determination and identification of Fatty Acids
7. Quantitative estimation of Reducing Sugar by DNS method
8. Quantitative estimation of Proteins by Biuret and Lowry's method
9. Determination of lipid saponification values of fats and iodine number of fatty acids
10. Determination of bacterial growth by spectrophotometric method & calculation of generation time
11. Measurement of cell number by Haemocytometer
12. Effect of pH on bacterial growth
13. Effect of Salt concentration on bacterial growth
14. Effect of Temperature on bacterial growth
15. Demonstration of aerobic and anaerobic respiration in microbes

Course Title	**Microbial Diversity**		Practical Credits	**2**
Course code.	**FSC501P**	**DSC-3P**	Contact hours	

Content

1. Study of morphology of bacteria
2. Isolation of bacteria from soil
3. Isolation of bacteria from air and water
4. Isolation of fungi from soil
5. Isolation of fungi from air
6. Cultivation of cyanobacteria
7. Cultivation of Actinomycetes
8. Measurement of microbial cell size by Micrometry
9. Study of cyanobacteria -*Nostoc,Microcyctis, Spirulina*
10. Study of Algae –*Chlorella, Diatoms, Gracilaria*
11. Study of Fungi – *Rhizopus, Aspergillus, Saccharomyces, Agaricus*
12. Study of Protozoa – *Amoeba, Paramoecium, Euglena*
13. Study of HIV, TMV, Corona virus, T4Phage
14. Study of Paramyxovirus, Oncogenic viruses

Course Title	**Microbial Enzymology and Metabolism**		Practical Credits	**2**
Course code.	**FSD501P**	**DSC-4P**	Contact hours	
		Content		

1. Identification of fatty acids and other lipids by TLC
2. Chemotaxis of *Pseudomonas*
3. Effect of variables on enzyme activity (amylase): a. Temperature b. pH c. substrate concentration d.Enzyme concentration
4. Sugar fermentation tests for bacteria
5. Separation of amino acids by paper chromatography
6. Screening of fungi for cellulose and pectin degradation
7. Screening of fungi for invertase
8. Enzyme immobilization by Alginate method
9. Gelatin hydrolysis
10. Microscopic examination of root nodules
11. Demonstration of Ammonifiaction
12. Demonstration of Nitrification – Nitrite and Nitrate
13. Demonstration of Denitrification
14. Demonstration of lipolytic activity
15. Demonstration of citric acid production
16. Effect of variables on enzyme activity (amylase): A. temperature B. pH C. substrate concentration D.enzyme concentration
17. Study of photographs/models: Chemolithotrophy- Hydrogen oxidation, Sulphur oxidation, Ironoxidation, Nitrogen oxidation, biological Nitrogen fixation, ammonia assimilation, ribozymes,abzymes, lock and key hopothesis, enzyme inhibition – competitive, non competitive and un competitive. Enzyme regulation- allosteric enzymes. Feedback inhibition.

CBCS

SEMESTER I

Course code: DMA29001/ DMA29002/ DMA29003/ DMA29004

Credits: Theory – 04, Practical – 02 **Theories: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, the student is able to

CO1.Learn the details of Elasticity

CO2.Understand the classification and characteristics of motion of a point particle

CO3.Understand in details with examples Frames of reference and relative motion

CO4.Deliberate the classification and characteristics of Dynamics of particle in conservative field

CO5.Specify the classification and characteristics of Special theory of relativity and gravitation

CO6.Write down the characteristics of Surface tension and viscosity

MECHANICS: DSC1

Unit-1

Vectors: Vector algebra(with special reference to the rules of addition and multiplication), Scalar and vector products with specific examples.

Motion of a point particle: The positionvector $r(t)$ of a moving point particle and its Cartesian components. Velocity and acceleration as the vector derivatives.Derivatives of a vector with respect to a parameter; Derivation of planar vector of a constant magnitude.Radial and transverse components of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion-centripetal force.**(05 Lectures)**

Frames of references and relative motion:

Newton's laws of motion and inertial mass. Galilean transformation; Galilean principle of relativity, Plumb line accelerometer and a freely falling elevator, Non-inertial frames and fictitious force, uniformly rotating frame of reference and coriolis force. Effect of rotation of earth on acceleration due to gravity. **(07Lectures)**

Dynamics of a particle in conservative fields:

Work done by force acting on a particle, work-energy theorem.Conservativeand non conservative force field.Conservation of energy.Conservative force as a negative gradient of potential, central force as an example of conservative force field. **(05 Lectures)**

Conservation of momentum: Conservation of linear momentum, centre of mass, rocket equation. Angular momentum and torque, law of conservation of angular momentum, angular momentum of a system taking centreof mass of the system. **(06 Lectures)**

Dynamics of rigid bodies: Moment of inertia, radius of gyration, calculation of momentum of inertia of rectangular plate, circular plate and solid sphere, kinetic energy of rotation.**(04 Lectures)**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions.Kinetic and Potential Energy, Total Energy and their time averages.Damped oscillations.**(03 Lectures)**

Unit-2

Gravitation: Newton's Law of gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws, derivations of Kepler's law, satellite in circular orbit and applications, geosynchronous orbits, weightlessness, basic idea of global positioning system (GPS). **(08Lectures)**

Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz transformation equations, Length contraction, time dilation, relativistic addition of velocities.Mass-Energy relation, energy-momentum relation**.(06 Lectures)**

Elasticity:

Review of concepts of modulii of elasticity, Hooke's Law and Poisson's ratio(σ). Relation between the elastic constants ***q, k, n*** and$\boldsymbol{\sigma}$, limiting values for$\boldsymbol{\sigma}$**.**Work done in stretching.Elastic potential energy.Bendingmoment.Theory of light single cantilever.I-section girders.Torsion; calculation of couple per unit twist.The Torsional pendulum, Static torsion, Searle's double bar experiment.

Surface Tension: Review of basic concepts. Pressure inside curved liquid surface.Surface tension and interfacial tension by drop-weight method.Surface tension and angle of contact of mercury by Quincke'smethod.

Viscosity: Review of basic concepts; Variation of Viscosity of liquids with temperature and pressure. **(16 Lectures)**

Reference Books:

- Halliday, Resnick, Jearl Walker, "Principles of Physics" 9th edition, Wiley, 2013.

- Berkeley Physics Course, Vol-1 "Mechanics", 2nd edition, Charles Kittle, Walter D Knight, Malvin A
- D S Mathur, "Elements of properties of matter", S Chand and company, New Delhi, Reprint-2007.
- D S Mathur, "Mechanics", S Chand and company, New Delhi, Reprint-2001.
- BrijLal and N Subrahmanyam, "Properties of matter", 6th edition, Eurasia publishing house Ltd. New Delhi, Reprint-1993.
- Mechanics by ShankaraNarayana&Chopra.
- Mechanics by Bhargava and Sharma.

PHYSICS LAB: DSC 1A LAB: MECHANICS
Course code: DMA29101/ DMA29102/ DMA29103/ DMA29104

(Minimum of eight is to be conducted)

1. Bar pendulum: Determination of the acceleration due to gravity and radius of gyration (Both graphical and calculation methods).
2. To determine the Moment of Inertia of a Flywheel.
3. Determination of the Young's modulus by Dynamic method (graphical and calculation method).
4. Torsional pendulum; Determination of the rigidity modulus.
5. Oscillations of a spiral Spring and calculate a) Spring Constant b) Value of g
6. Young's modulus by the single cantilever method.
7. Determination of rigidity modulus by the static torsion method.
8. To determine g by Kater's Pendulum.
9. Determination of young's modulus by the method of uniform bending.
10. Drop weight method; Determination of surface tension of liquid and the interfacial tension between two liquids.
11. To determine the Elastic Constants of a Wire by Searle's method.
12. To determine the Modulus of Rigidity of a Wire by Maxwell's needle
13. To determine **g** and velocity for a freely falling body using Digital Timing Technique
14. To determine the Height of a Building using a Sextant.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4^{th} Edition,

reprinted 1985, Heinemann Educational Publishers.

- Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

SEMESTER II

Course code: DMB29001/ DMB29002/ DMB29003/ DMB29004

Credits: Theory – 04, Practical – 02 **Theories: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, the student is able to

CO1.Deliberate in detail with examples vector analysis

CO2.Write down in detail with application, electrostatics and magneto static

CO3.Write down the classification and characteristics of AC Circuits

CO4.Specify in details with application, if applicable, properties of magnet material

CO5.Understand the characteristics of electromagnetic theory

CO6.Write down the characteristic of galvanometer

ELECTRICITY AND MAGNETISM: DSC 2

Unit-1

Vector Analysis: Review of vector algebra (Scalar and Vector product), Scalar and vector fields,gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). **(07 Lectures)**

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics and applications; 1) infinite line of charge and 2)plane charged sheet. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.
Capacitance of an isolated spherical conductor.Parallel plate, spherical and cylindrical condenser.Energy per unit volume in electrostatic field.
Dielectric medium, Polarization, Displacement vector.Gauss’s theorem in dielectrics. Parallel plate

capacitor completely filled with dielectric.

Galvanometers: Construction, theory and working of Helmholtz galvanometer.**(15Lectures)**

Alternating current: R M S values, Response of LR, CR and LCR circuits to sinusoidal voltages(discussion using the j symbol), Series and parallel resonance, Half-power frequencies, bandwidth and Q-factor, Power in electrical circuits, power factor and Maximum power transfer theorem.

(08 Lectures)

Unit-2

Applications of ac circuits - ac bridges**;** Anderson's bridge and De-Sauty's bridge

(02 Lectures)

Magneto statics: Biot-Savart's law & its applications; long straight conductor, circular coil and solenoid carrying current. Divergence and curl of magnetic field.Magnetic vector potential.Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction ofDia-magnetic, Para-magnetic and Ferro-magnetic materials.

(10Lectures)

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, selfInductance (L) and mutual inductance (M), L of single coil, M of two coils. Energy stored in magnetic field. **(06 Lectures)**

Electromagnetic Theory: Equation of continuity, Displacement current, setting up of Maxwell's equations, wave equation in free space, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through free space and isotropic dielectric medium, Transverse nature of electromagnetic waves, polarization.**(12 Lectures)**

Reference Books:

- D. C. Tayal, Electricity and Magnetism, 1988, Himalaya Publishing House.
- K. K. Tewari: Electricity and magnetism, S. Chand Co. Ltd., New Delhi, Reprint 2007.
- B. B. Laud: Electrodynamics, Wiley Eastern Limited, New Delhi.
- David. J. Griffiths: Introduction to Electrodynamics, 3rd edition, Prentice-Hall of India Private limited, New Delhi.
- BrijLal and N. Subramanian:Electricity and Magnetism, 19th edition- RatanPrakashanMandir, Educational and University Publishers, Agra.
- D.N. Vasudeva: Fundamentals of Magnetism and Electricity, 12th edition-S.Chand and Co. Ltd., New Delhi

PHYSICS LAB- DSC 2A LAB: ELECTRICITY AND MAGNETISM

Course code: DMB29101 / DMB29102 / DMB29103 / DMB29104

(Minimum of eight is to be conducted)

1. LCR series circuits – Determination of L & Q factor
2. LCR parallel circuits – Determination of L & Q factor
3. Anderson's Bridge – Determination of the self-inductance of the coil.
4. De-Sauty's bridge – Verification of laws of combination of capacitances, unknown capacitance.
5. To verify the Thevinin'stheorem.
6. Maximum Power Transfer Theorem.
7. Maxwell's bridge-determination of mutual inductance.
8. Low resistance-determination of the resistivity of the material.
9. Determination of capacitance by measuring impedance of RC circuit.
10. Determination of inductance by measuring impedance of RL circuit.
11. Low pass and High pass filters.
12. Black box – Identification of L,C& R .
13. Measurement of Magnetic field strength B and its gradient in a Solenoid (Determine dB/dx).
14. To determine a Low Resistance by Carey Foster's Bridge.
15. B_H using Helmholtz double coil galvanometer.

Reference Books

- Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
- Edition, reprinted 1985, Heinemann Educational Publishers

CBCS

SEMESTER I

Course code: DMA29001/ DMA29002/ DMA29003/ DMA29004

Credits: Theory – 04, Practical – 02 **Theories: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, the student is able to

CO1.Learn the details of Elasticity

CO2.Understand the classification and characteristics of motion of a point particle

CO3.Understand in details with examples Frames of reference and relative motion

CO4.Deliberate the classification and characteristics of Dynamics of particle in conservative field

CO5.Specify the classification and characteristics of Special theory of relativity and gravitation

CO6.Write down the characteristics of Surface tension and viscosity

MECHANICS: DSC1

Unit-1

Vectors: Vector algebra(with special reference to the rules of addition and multiplication), Scalar and vector products with specific examples.

Motion of a point particle: The positionvector *r(t)* of a moving point particle and its Cartesian components. Velocity and acceleration as the vector derivatives.Derivatives of a vector with respect to a parameter; Derivation of planar vector of a constant magnitude.Radial and transverse components of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion-centripetal force.**(05 Lectures)**

Frames of references and relative motion:
Newton's laws of motion and inertial mass. Galilean transformation; Galilean principle of relativity, Plumb line accelerometer and a freely falling elevator, Non-inertial frames and fictitious force, uniformly rotating frame of reference and coriolis force. Effect of rotation of earth on acceleration due to gravity. **(07Lectures)**

Dynamics of a particle in conservative fields:

Work done by force acting on a particle, work-energy theorem.Conservativeand non conservative force field.Conservation of energy.Conservative force as a negative gradient of potential, central force as an example of conservative force field. **(05 Lectures)**

Conservation of momentum: Conservation of linear momentum, centre of mass, rocket equation. Angular momentum and torque, law of conservation of angular momentum, angular momentum of a system taking centreof mass of the system. **(06 Lectures)**

Dynamics of rigid bodies: Moment of inertia, radius of gyration, calculation of momentum of inertia of rectangular plate, circular plate and solid sphere, kinetic energy of rotation.**(04 Lectures)**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions.Kinetic and Potential Energy, Total Energy and their time averages.Damped oscillations.**(03 Lectures)**

Unit-2

Gravitation: Newton's Law of gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws, derivations of Kepler's law, satellite in circular orbit and applications, geosynchronous orbits, weightlessness, basic idea of global positioning system (GPS). **(08Lectures)**

Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz transformation equations, Length contraction, time dilation, relativistic addition of velocities.Mass-Energy relation, energy-momentum relation**.(06 Lectures)**

Elasticity:

Review of concepts of modulii of elasticity, Hooke's Law and Poisson's ratio(σ). Relation between the elastic constants ***q, k, n*** andσ, limiting values for**σ.**Work done in stretching.Elastic potential energy.Bendingmoment.Theory of light single cantilever.I-section girders.Torsion; calculation of couple per unit twist.The Torsional pendulum, Static torsion, Searle's double bar experiment.

Surface Tension: Review of basic concepts. Pressure inside curved liquid surface.Surface tension and interfacial tension by drop-weight method.Surface tension and angle of contact of mercury by Quincke'smethod.

Viscosity: Review of basic concepts; Variation of Viscosity of liquids with temperature and pressure. **(16 Lectures)**

Reference Books:

- Halliday, Resnick, Jearl Walker, "Principles of Physics" 9th edition, Wiley, 2013.

- Berkeley Physics Course, Vol-1 "Mechanics", 2nd edition, Charles Kittle, Walter D Knight, Malvin A
- D S Mathur, "Elements of properties of matter", S Chand and company, New Delhi, Reprint-2007.
- D S Mathur, "Mechanics", S Chand and company, New Delhi, Reprint-2001.
- BrijLal and N Subrahmanyam, "Properties of matter", 6th edition, Eurasia publishing house Ltd. New Delhi, Reprint-1993.
- Mechanics by ShankaraNarayana&Chopra.
- Mechanics by Bhargava and Sharma.

PHYSICS LAB: DSC 1A LAB: MECHANICS
Course code: DMA29101/ DMA29102/ DMA29103/ DMA29104

(Minimum of eight is to be conducted)

1. Bar pendulum: Determination of the acceleration due to gravity and radius of gyration (Both graphical and calculation methods).
2. To determine the Moment of Inertia of a Flywheel.
3. Determination of the Young's modulus by Dynamic method (graphical and calculation method).
4. Torsional pendulum; Determination of the rigidity modulus.
5. Oscillations of a spiral Spring and calculate a) Spring Constant b) Value of g
6. Young's modulus by the single cantilever method.
7. Determination of rigidity modulus by the static torsion method.
8. To determine g by Kater's Pendulum.
9. Determination of young's modulus by the method of uniform bending.
10. Drop weight method; Determination of surface tension of liquid and the interfacial tension between two liquids.
11. To determine the Elastic Constants of a Wire by Searle's method.
12. To determine the Modulus of Rigidity of a Wire by Maxwell's needle
13. To determine **g** and velocity for a freely falling body using Digital Timing Technique
14. To determine the Height of a Building using a Sextant.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition,

reprinted 1985, Heinemann Educational Publishers.

- Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

SEMESTER II

Course code: DMB29001/ DMB29002/ DMB29003/ DMB29004

Credits: Theory – 04, Practical – 02 **Theories: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, the student is able to

CO1.Deliberate in detail with examples vector analysis

CO2.Write down in detail with application, electrostatics and magneto static

CO3.Write down the classification and characteristics of AC Circuits

CO4.Specify in details with application, if applicable, properties of magnet material

CO5.Understand the characteristics of electromagnetic theory

CO6.Write down the characteristic of galvanometer

ELECTRICITY AND MAGNETISM: DSC 2

Unit-1

Vector Analysis: Review of vector algebra (Scalar and Vector product), Scalar and vector fields,gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only). **(07 Lectures)**

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics and applications; 1) infinite line of charge and 2)plane charged sheet. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.
Capacitance of an isolated spherical conductor.Parallel plate, spherical and cylindrical condenser.Energy per unit volume in electrostatic field.
Dielectric medium, Polarization, Displacement vector.Gauss's theorem in dielectrics. Parallel plate

capacitor completely filled with dielectric.

Galvanometers: Construction, theory and working of Helmholtz galvanometer.**(15Lectures)**

Alternating current: R M S values, Response of LR, CR and LCR circuits to sinusoidal voltages(discussion using the j symbol), Series and parallel resonance, Half-power frequencies, bandwidth and Q-factor, Power in electrical circuits, power factor and Maximum power transfer theorem.

(08 Lectures)

Unit-2

Applications of ac circuits - ac bridges**;** Anderson's bridge and De-Sauty's bridge

(02 Lectures)

Magneto statics: Biot-Savart's law & its applications; long straight conductor, circular coil and solenoid carrying current. Divergence and curl of magnetic field.Magnetic vector potential.Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction ofDia-magnetic, Para-magnetic and Ferro-magnetic materials.

(10Lectures)

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, selfInductance (L) and mutual inductance (M), L of single coil, M of two coils. Energy stored in magnetic field. **(06 Lectures)**

Electromagnetic Theory: Equation of continuity, Displacement current, setting up of Maxwell's equations, wave equation in free space, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through free space and isotropic dielectric medium, Transverse nature of electromagnetic waves, polarization.**(12 Lectures)**

Reference Books:

- D. C. Tayal, Electricity and Magnetism, 1988, Himalaya Publishing House.
- K. K. Tewari: Electricity and magnetism, S. Chand Co. Ltd., New Delhi, Reprint 2007.
- B. B. Laud: Electrodynamics, Wiley Eastern Limited, New Delhi.
- David. J. Griffiths: Introduction to Electrodynamics, 3rd edition, Prentice-Hall of India Private limited, New Delhi.
- BrijLal and N. Subramanian:Electricity and Magnetism, 19th edition-RatanPrakashanMandir, Educational and University Publishers, Agra.
- D.N. Vasudeva: Fundamentals of Magnetism and Electricity, 12th edition-S.Chand and Co. Ltd., New Delhi

PHYSICS LAB- DSC 2A LAB: ELECTRICITY AND MAGNETISM

Course code: **DMB29101 / DMB29102 / DMB29103 / DMB29104**

(Minimum of eight is to be conducted)

1. LCR series circuits – Determination of L & Q factor
2. LCR parallel circuits – Determination of L & Q factor
3. Anderson's Bridge – Determination of the self-inductance of the coil.
4. De-Sauty's bridge – Verification of laws of combination of capacitances, unknown capacitance.
5. To verify the Thevinin'stheorem.
6. Maximum Power Transfer Theorem.
7. Maxwell's bridge-determination of mutual inductance.
8. Low resistance-determination of the resistivity of the material.
9. Determination of capacitance by measuring impedance of RC circuit.
10. Determination of inductance by measuring impedance of RL circuit.
11. Low pass and High pass filters.
12. Black box – Identification of L,C& R .
13. Measurement of Magnetic field strength B and its gradient in a Solenoid (Determine dB/dx).
14. To determine a Low Resistance by Carey Foster's Bridge.
15. B_H using Helmholtz double coil galvanometer.

Reference Books

- Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
- Edition, reprinted 1985, Heinemann Educational Publishers

JSSCOLLEGEOFARTS,COMMERCEANDSCIENCE
(Autonomous)
BNROAD,MYSURU-570025

DEPARTMENTOFZOOLOGY

Syllabusfor
B.Sc.HonsZOOLOGY(UG) I

& II SEMESTERS

FramedAccordingtotheNationalEducationalPolicy

(2021-22BatchOnwards)

ModelCurriculumStructureforDegreeProgram

B.Sc.,HonsinZoology

NameoftheDegreeProgram: B.Sc.,Hons

DisciplineCore: ZoologyTotalCreditsforthe

Program:50/100/142/184/268Startingyearofimplementation:2021-22

PROGRAMOBJECTIVES(POs)

POs1-TheProgrammeoffers bothclassicalaswellas modernconceptsofZoologyin higher education.

POs2-It enablesthestudentstostudyanimaldiversityinbothlocalandglobal environments.

POs3-Tomakethestudy of animals more interesting and relevant to human studies more emphasisisgiventobrancheslikebehaviouralbiology,evolutionarybiologyandeconomic zoology.

POs4-Moreofupcomingareasincellbiology,genetics,molecularbiology, biochemistry, genetic engineering and bioinformatics have been also included.

POs5-Equalimportanceisgiventopracticallearningandpresentationskillsofstudents.

POs6-The lab courses provide the students necessary skills required for their employability.**POs7-**Skillenhancement coursesinclassicalandappliedbranchesof Zoology enhance enterprising skills of students.

POs8-Theglobalpracticesintermsofacademicstandardsandevaluationstrategies.

POs9- Providesopportunityforthe mobilityofthe studentbothwithinand acrossthe world.

POs10-Theuniformgradingsystemwillbenefit thestudentstomoveacrossinstitutions within India to begin with and across countries.

POs11-Itwillalso enablepotentialemployers inassessingtheperformanceofthe candidates across the world.

Semester I- Zoology Core Course I Content:

Zoology:Paper-I:Cytology,Genetics&InfectiousDiseases.

CourseTitle/Code: Cytology,GeneticsandInfectious Diseases	**CourseCredits:**4
CourseCode:FSA470	**L-T-Pperweek:**4-0-0
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:40	**SummativeAssessmentMarks:**60

CourseOutcomes (COs):

Attheendofthecoursethestudent shouldbeabletounderstand: CO1. The

structure and function ofthe cell organelles.

CO2.Thechromatinstructureanditslocation.

CO3. Thebasicprincipleoflife, howacelldivides leadingtothegrowthofan Organism and also reproduces to form a new organism.

CO4.Howacellcommunicateswithitsneighboringcells.

CO5.Theprinciplesofinheritance,Mendel'slawsandthedeviations.

CO6.Howenvironmentplaysanimportantrolebyinteractingwithgeneticfactors. CO7. Detect chromosomal aberrations in humans and studyofpedigree analysis.

Content	Hours
Unit -1	14hrs
Chapter1:StructureandFunctionofCellOrganelles-IinAnimalcell • Ultrastructureofanimalcell • **Plasmamembrane**:Fluidmosaicmodel,Chemicalstructure–lipids,Proteinsandtheir role in maintaining structural integrity. Functions of Plasma membrane - Cell permeability, diffusion, passive transport, active transport. • **Endomembranesystem:**Proteintargetingandsorting,transport,endocytosisand exocytosis. **Chapter2:StructureandFunctionofCellOrganelles-IIinAnimalcell.** • **Endoplasmicreticulum-**Types,Structureandfunctions. • **Peroxisome &Ribosome**: Types – (Prokaryotic & Eukaryotic), Structureand functions. • **Golgiapparatus**-Structureandfunctions. • **Lysosomes**-Structureandfunctions. • **Mitochondria:** Structure and functions. Oxidative phosphorylation; electron transport system • **Cytoskeleton**:Structureandfunctionsof -Microtubules,microfilamentintermediate filaments.	
Unit -2	14hrs
Chapter3:NucleusandChromatinStructure. • **Ultra structure of Nucleus and Functions** - Nuclear envelop, Nuclear pore complex, Nucleoplasm. • Ultrastructureofnucleolusandfunctions. • **Chemicalstructure**andbasecompositionofDNAandRNA. • **Nucleosome model,** DNAsuper coiling, Chromatinorganization, Structureof chromosomes (Fine structure). Types of DNA and RNA. **Chapter4:Cellcycle,CellDivision andCellSignalling.** • Introduction to Cell cycle and its regulation**Cell division:** Mitosis stages and its Significance and Meiosis Stages and its Significance. • **Signal transduction**: Intracellularsignalling and Cell surface receptors, via G-protein linked receptors. • **Cell-cellinteraction**:Celladhesionmolecules,Cellularjunctions.	
Unit -3	14hrs
Chapter5:MendelismandSexDetermination. • **Basic principles of heredity:** Mendel's laws - Monohybrid cross and Dihybrid cross. Complete and Incomplete Dominance (Ex. *Mirabilis jalapa).* Penetrance and Expressivity. • **GeneticSexDeterminingSystems**(XX-XY,XX–XO,ZZ–ZW),EnvironmentalSex Determination (*Bonelia viridis*), Sex Determination and Mechanism in *Drosophila melanogaster (Genic balance theory).* • **DosageCompensation** -Barrbody,Lyon's hypothesis.	

Chapter6:ExtensionsofMendelism,GenesandEnvironment. • **Extensions of Mendelism**: Multiple Alleles (Inheritance of ABO blood group in Humans and Rh factor), Gene Interaction (Supplementary, Complementary and Epistasis). • **The Interaction between Sex and Heredity**: Sex-Influenced characteristics (Male pattern baldness in humans, horns in sheep) and Sex-Limited Characteristics (Plumage pattern, milk production andMoustache and Beard in Males) • **Cytoplasmic Inheritance** (Kappa particles in *Paramecium*), Genetic Maternal Effects (Shell coiling in *Limnaea*). • **InteractionbetweenGenesandEnvironment-**Himalayanalbinorabbit Environmental Effects on Gene Expression (Norm of reaction), Inheritance of Continuous Characteristics (Polygenic Inheritance - Skin colour in Man).	
Unit -4	14hrs
Chapter7: HumanChromosomesandPatternsofInheritance. • **Patterns of Inheritance**: Autosomal dominance (Huntington's chorea, PTC), Autosomal recessive (Sickle cell anemia, Albinism), X-linked recessive (Colour blindness, Hemophilia),X-linked dominant (Vitamin D resistance Ricketts,Coffin Lowry syndrome). • **Chromosomal Anomalies**: Structural (Deletion, Duplication, Inversion, Translocation with examples) and Numerical aberrations (Turner's syndrome,Klinefelter'ssyndrome). Autosomal anomalies - Down syndrome and Cri-du-chat syndrome. • **Human Karyotyping** and Pedigree analysis (Autosomal dominant, Autosomal recessive, X – linked dominant, X – linked recessive). **Chapter8:InfectiousDiseases.** • **Introduction to Pathogenic Organisms**: Viruses, Bacteria, Fungi, Protozoa and Worms. Structure, Life cycle, Pathogenicity, including diseases, causes, symptoms and control of common parasites: *Trypanosoma, Giardia* and *Wuchereria.*	

SuggestedReadings:

1. Lodishetal:MolecularCellBiology:Freeman&Co,USA(2004).
2. Albertsetal:MolecularBiologyoftheCell:Garland(2002).
3. Cooper:Cell:AMolecularApproach:ASMPress(2000).
4. Karp:CellandMolecularBiology:Wiley(2002).PierceB.Genetics.Freeman(2004).
5. LewinB.GenesVIII.Pearson(2004).
6. Watsonetal.MolecularBiologyoftheGene. Pearson(2004).
7. ThomasJ.Kindt,RichardA.Goldsby,BarbaraA.Osborne,JanisKuby-Kuby Immunology. W H Freeman(2007).
8. DelvesPeterJ.,MartinSeamusJ.,BurtonDennisR.,RoittIvanM.Roitt'sEssential Immunology, 13thEdition. Wiley Blackwell(2017).
9. PrinciplesofGeneticsbyB.D.Singh
10. Cell-BiologybyC.B.Pawar,KalyaniPublications
11. EconomicZoologybyShuklaandUpadhyaya

Semester I- Zoology Core Course I Content:

Zoology:Paper-I:Cytology,Genetics&InfectiousDiseases.

SemesterI

CourseTitle: Cytology,GeneticsandInfectiousDiseases	**CourseCredits:**2
CourseCode:FSA470	**L-T-Pperweek:**0-0-4
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:25	**SummativeAssessmentMarks:**25

CourseOutcomes(COs):

Attheendofthecoursethestudentshould beableto:

1. Tousesimpleandcompoundmicroscopes.
2. Topreparestainedslidestoobservethe cellorganelles.
3. To be familiar withthe basic principle of life, howa cell divides leading tothe growth ofan organismand also reproduces to form new organisms.
4. Thechromosomalaberrationsbypreparingkaryotypes.
5. Howchromosomalaberrationsareinheritedinhumansbypedigreeanalysisin families. The antigen-antibody reaction.

LabCourseContent

Listoflabstobeconducted	**56hrs**
1.Understandingofsimpleandcompoundmicroscopes.	
2.Tostudydifferentcelltypessuchasbuccalepithelialcells,neurons,striated musclecellsusingMethyleneblue/anysuitablestain(virtual/ slaughtered tissue).	
3.TostudythedifferentstagesofMitosisinroottipof*Alliumcepa*.	
4.TostudythedifferentstagesofMeiosisingrasshoppertestis(virtual).	
5.Tocheckthepermeabilityofcellsusingsaltsolutionofdifferent concentrations.	
6.Studyofparasitesinhumans(e.g.Protozoans,Helminthesincompliance withexamplesbeingstudiedintheory)permanentmicroslides.	
7.Tolearntheproceduresofpreparationoftemporary(spicules)orpermanent stainedslides(Fishscales),withavailablemountingmaterial.	
8.StudyofwildDrosophilamelanogaster(male&female)andMutant Phenotypesof*Drosophila* sp, –Whiteeye, bar eye, sepiaeye, vestigialwing& yellowbody.(FromCulturesor Photographs).	
9.StudyofPolytenechromosomes(ChironomuslarvaorDrosophila larva).	
10.PreparationofDrosophillaand humanKaryotypeandstudy(identification) ofthechromosomalstructural(chriduchatsyndrome(Deletion), FragileX syndrome(duplication),walker-warburgsyndrome(Inversion)and leukemia (translocation)andnumericalaberrations(Turner's,Klinefelter'sandDown's syndrome)fromthepicturesprovided.(Virtual/ Optional).	
11. Topreparefamilypedigrees. 12. https://www.vlab.co.in 13.https://zoologysan.blogspot.com 14.[illegible] 15.www.onlinelabs.in 16.www.powershow.com 17.https://vlab.amrita.eduhttps://sites.dartmouth.edu/	

SuggestedReadings:

1. Lodishetal:MolecularCellBiology:Freeman&Co,USA(2004).
2. Albertset al:MolecularBiologyoftheCell:Garland(2002).
3. Cooper:Cell:AMolecularApproach:ASMPress(2000).
4. Karp:CellandMolecular Biology:Wiley(2002).PierceB. Genetics.Freeman(2004).
5. ThomasJ. Kindt, Richard A. Goldsby, BarbaraA. Osborne, JanisKuby- Kuby Immunology. W HFreeman(2007).
6. Kesar, Sarojand Vasishta N.2007ExperimentalPhysiology: Comprehensive Manual. Heritage Publishers,NewDelhi.

SchemeofPracticalExaminationI
Semester BSc. Zoology
Cytology,GeneticsandInfectiousdiseases
Course Code: FSA470

Duration:3hours **Max.Marks:25**

1.	IdentifythespotsA, BandC,givingsuitablereasonswith diagram (Experiment no1,2,3,4,6,8, 9&10)	12M
2.	Prepareawholemountofthegivenmaterial	03M
3.	Preparation ofKaryotype	05M
4.	PreparationofPedigree analysis	05M

(Thecandidatehas tosubmit thedulycertifiedrecordat thetimeofpractical examination. Therecordis for thereference of the examiners, but not for assessment (since it is already assessed for IA)

Assessment:

Weightageforassessments(inpercentage)

TypeofCourse	FormativeAssessment/IA Marks	SummativeAssessmentMarks
Theory	40	60
Practical	25	25

Pedagogy:WrittenAssignment/Presentation/Seminar

FormativeAssessment-Theory	
AssessmentOccasion	**WeightageinMarks**
HouseExamination/Test	C1+C2=10+10=20
WrittenAssignment/Presentation/Seminar	10+10=20
Total	40

Pedagogy:WrittenAssignment/Presentation/Record/Seminar

FormativeAssessment-Practical	
AssessmentOccasion	**WeightageinMarks**
InternalassessmentC1	10
InternalassessmentC2	10
Classrecord	05
Total	25

OpenElectiveCourseContent

Semester:I

CourseTitle: Economic Zoology **CourseCode:**FSA920	**CourseCredits**:3
TotalContactHours: 42	**DurationofESA:**3Hours
FormativeAssessmentMarks:40	**SummativeAssessmentMarks**:60

CourseOutcomes(COs):

Attheendofthecoursethestudentwillbeableto:

1. Gainknowledgeaboutsilkwormsrearingandtheirproducts.
2. GainknowledgeinBeekeepingequipmentandapiarymanagement.
3. Acquaintknowledgeon dairyanimalmanagement,thebreedsand diseasesofcattleandlearn thetestingofegg and milk quality.
4. Acquaintknowledgeabouttheculturetechniquesoffishandpoultry.
5. Acquainttheknowledgeaboutbasicprocedureandmethodologyofvermiculture.
6. Learnvariousconceptsoflaccultivation.
7. Studentscanstarttheirownbusinessi.e.self-employments.
8. Getemploymentindifferentappliedsectors

CourseContent

Content	Hrs
UnitI	**14**
Chapter1.Sericulture: • HistoryandpresentstatusofsericultureinIndia • Mulberryandnon-mulberryspeciesinKarnatakaandIndia • Mulberrycultivation • Morphologyandlifecycle of*Bombyxmori* • Silkwormrearingtechniques:Processingofcocoon,reeling • Silkwormdiseasesandpest control **Chapter2.Apiculture:** • Introductionandpresentstatusofapiculture • SpeciesofhoneybeesinIndia,lifecycleof*Apisindica* • Colonyorganization,divisionoflabourandcommunication • Bee keeping as an agro based industry; methods and equipments: indigenousmethods,extractionappliances,extractionofhoneyfromthe comb and processing • Beepasturage,honeyandbeeswaxandtheiruses • Pestsanddiseasesofbeesandtheirmanagement	
UnitII	**14**
Chapter3. LiveStockManagement: • **Dairy:**Introductiontocommondairyanimalsandtechniquesofdairy management • Types, loose housing system and conventional barn system; advantages and limitationsof dairy farming • Establishmentofdairyfarmandchoosing suitabledairyanimals-cattle • Cattlefeeds,milkandmilkproducts • Cattlediseases • **Poultry:**Typesofbreedsandtheirrearingmethods • Feedformulationsforchicks • Nutritive valueofeggandmeat • Diseaseofpoultryandcontrol measures **Chapter4.Aquaculture:** • AquacultureinIndia:Anoverviewandpresentstatusandscopeof aquaculture • Types of aquaculture: Pond culture: Construction, maintenance and management; carpculture,shrimpculture,shellfishculture,composite fish culture and pearl culture	
Unit-III	**14**

Chapter5.Fishculture: • Commonfishesusedforculture. • Fishingcraftsandgears. • Ornamentalfishculture:Freshwaterornamentalfishes-biology,breeding techniques • Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality. control of snail and algal growth. • Moderntechniquesoffishseedproduction **Chapter6.Prawnculture:** • Cultureoffreshandmarinewaterprawns. • Preparation offarm. • Preservationandprocessingofprawn,exportofprawn. **Chapter7.Vermiculture:** • Scopeofvermiculture. • Typesofearthworms. • Habitcategories-epigeic,endogeicandanecic;indigenousandexotic species. • Methodology of vermicomposting:containers forculturing, raw materials	
required,preparationofbed,environmentalpre-requisites, feeding, harvesting andstorage of vermicompost. • Advantagesofvermicomposting. • Diseasesandpestsofearthworms. **Chapter8.Lac Culture:** • Historyoflacanditsorganization,lacproductioninIndia. • Lifecycle,hostplantsandstrainsoflacinsect. • Laccultivation:Localpractice, improvedpractice,propagationoflac insect, inoculationperiod, harvesting of lac. • Laccomposition,processing,products,usesandtheir pests.	

Text Books

SuggestedReadings:

1. Eikichi,H.(1999).SilkwormBreeding(TranslatedfromJapanese).Oxford& IBH Publishing Co.Pvt. Ltd., New Delhi.
2. Ganga,G.(2003).ComprehensiveSericultureVol-II:SilkwormRearingandSilkReeling.
3. Oxford&IBHPublishingCo.Pvt.Ltd.,NewDelhi.
4. Mahadevappa,D.,Halliyal,V.G.,Shankar,D.G.andBhandiwad,R.,(2000).MulberrySilk
5. ReelingTechnologyOxford&IBHPublishingCo.Pvt.Ltd.,NewDelhi.
6. Roger,M(1990).TheABCand XyzofBeeCulture:AnEncyclopedia of Beekeeping, KindleEdition.
7. ShuklaandUpadhyaya(2002).EconomicZoology,RastogiPublishers
8. YadavManju(2003).EconomicZoology,DiscoveryPublishingHouse.
9. JabdePradipV(2005).TextbookofappliedZoology,DiscoveryPublishingHouse,NewDelhi.
10. Cherian&RamachandranBeekeepingin-SouthIndianGovt.Press,Madras.
11. Sathe,T.V.VermicultureandOrganicfarming.
12. Bard.J(1986). HandbookofTropicalAquaculture.
13. Santhanam,R.A.ManualofAquaculture.
14. Zuka.R.1andHamiyn(1971).Aquariumfishesandplants
15. Jabde,P.V.(2005)TextBookofAppliedZoology: Vermiculture,Apiculture, Sericulture, Lacculture.
16. AnimalDisease-BairagiK.N.AnmolPublicationsPvt.Ltd2014

17. EconomicsOfAquaculture-Singh(R.K.P)-DanikaPublishingCompany2003
18. AppliedandEconomicZoology(SWAYAM)web
https://swayam.gov.in/nd2_cec20_ge23/preview

Assessment

Pedagogy: ChalkandTalk,PPT,Groupdiscussion,Seminar,Fieldvisit

FormativeAssessment-Theory	
AssessmentOccasion	**WeightageinMarks**
HouseExamination/Test	C1+C2=10+10=20
WrittenAssignment/Presentation/Seminar	10+10=20
Total	40

SkillEnhancementCourseinZoology

CourseContent

Semester:I

CourseTitle: Vermiculture **CourseCode**: VEC5ZOOP1	**CourseCredits:**2
TotalContactHours:56Hours	**DurationofESA:**3Hrs
FormativeAssessmentMarks:20	**SummativeAssessmentMarks:**30

CourseOutcomes (COs):

At theendofthecoursethe student:

1. Understandstheimportanceofearthwormsinmaintaining soilquality.
2. Learnsthatthevermicomposting isaneffectiveorganicsolidwastemanagement method.
3. Getsacquaintedwiththeimportanceofearthwormsinagro-basedeconomicactivity.
4. Vermicompostingleadstoorganic farmingandhealthyfoodproduction.
5. Vermicomposting maybetakenupas asmallscale industrybythe farmersand unemployed youth.
6. Getjobs inteachinginstitutionsorvermicultureunitsas technicians.
7. Learntheconceptofvermicompostingasbiofertilizersthusstudent canbecomean entrepreneur after completion of the course.
8. Bestopportunityforself-employmentandlifelonglearningwithfarmers.

CourseContent

Listoflabstobeconducted		56Hrs
1	Collectionofnativeearthwormsspeciestostudyhabitandhabitat.	
2	Keystoidentifydifferentspeciesofearthworm.	
3	ExternalsandLifecycleof***Eiseniafetida***and***Eudriluseugeniae.***	
4	Dissectionofdigestiveandreproductivesystem.	
5	Studyofvermicompostingequipmentsand devices.	
6	Preparationofvermibedsandtheirmaintenance.	
7	Studyofdifferentvermicompostingmethods.	
8	Harvesting,separationofworms, packaging,transportandstorageof varmicompost.	
9	Vermi-washcollectionandprocessing.	
10	Smallscaleearthwormfarmingfor homegardensandstudyingtheeffectof vermicompostongardenplants.	
11	Budgetandcostscenarioofvermiculture(Project).	
12	Diseasesandnaturalenemiesofearthwormsand theircontrolmeasures.	
13	Roleofvermitechnologyinenvironmentalprotection.	
14	EconomicsandMarketingofvermicompost andvermiwash.	
15	Visittovermiculturefarmtoacquaintwithlatesttechniques.	

TextBooksand references

1. BhattJ.V. &S.R. Khambata(1959) —RoleofEarthworms in Agriculture‖Indian Council ofAgriculturalResearch,NewDelhi
2. Edwards,C.A.andJ.R.Lofty(1977)—BiologyofEarthworms‖ChapmanandHall Ltd., London.
3. Lee,K.E.(1985)—Earthworms:TheirecologyandRelationshipwithSoilsandLand Use‖ AcademicPress,Sydney.
4. Dash,M.C.,B.K.Senapati,P.C.Mishra(1980)—VermsandVermicomposting‖ Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec.5-8,1984,(Part B),SchoolofLifeSciences,SambalpurUniversity,JyotiVihar, Orissa.
5. Kevin,Aand K.E.Lee(1989)—Earthwormfor GardenersandFisherman‖ (CSIRO,Australia, Division of Soils)
6. Satchel,J.E.(1983)—EarthwormEcology‖ChapmanHall,London.
7. Wallwork,J.A.(1983)—EarthwormBiology‖EdwardArnold(Publishers) Ltd. London.

Pedagogy

1. Demonstration
2. Assignment
3. Groupdiscussion
4. Fieldvisit
5. UseofAudio-Visualaids.

FormativeAssessment	
AssessmentOccasion	**WeightageinMarks**
ClassTest	10
AttendanceandAssignments	05
Visittovermicompostunitandreport	05
Total	20

SchemeofPracticalExaminationI
Semester BSc. Zoology
SkillEnhancementcourse:Vermiculture

Duration:3hours **Max.marks:30**

1. Identifyanddescribethegivensystemofthegivenspecimen/chart'A'given, withneat labelled diagram. (05 marks)

2. IdentifyandcommentonthespottersBtoE(Life cycle/Externals/Devicesused in vermicomposting/ Vermicompost types) (5x5=25 marks)

TOTAL= 30 Marks

SemesterII-ZoologyCoreCourseIContent:

Paper-II: Biochemistry and Physiology

CourseTitle:BiochemistryandPhysiology	**CourseCredits:**4
CourseCode: FSB470	**L-T-Pperweek:**4-0-0
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:40	**SummativeAssessmentMarks**:60

Courseoutcomes:

Thestudentatthecompletionofthecoursewilllearn:

1. Todevelopadeepunderstandingofstructureofbiomoleculeslikeproteins,lipidsandcarbohydrates.
2. Howsimplemoleculestogetherformcomplexmacromolecules.
3. Tounderstandthethermodynamicsofenzymecatalyzedreactions.
4. Mechanismsofenergyproductionatcellularandmolecularlevels.
5. Tounderstandvariousfunctionalcomponentsofanorganism.
6. Toexplorethecomplex networkofthesefunctionalcomponents.
7. Tocomprehendtheregulatorymechanisms for maintenanceoffunctioninthebody.

Content	Hours
UnitI	**14**
Chapter1.StructureandFunctionofBiomolecules: • StructureandBiologicalimportanceofcarbohydrates(Classification withexamplesMonosaccharides,Disaccharides,Polysaccharidesand Glycoconjugates). • LipidsClassificationandBiologicalimportance-(saturatedandunsaturated Fatty acids, Tri-acylglycerols, Phospho lipids,Glycolipids and Steroids) Clinical importance of Lipids, HDL & LDL ,TG and Cholesterol • ProteinsStructure,ClassificationandGeneralPropertiesofa-amino acids; Essential and non-essential amino acids, Levels of organization in proteins(Primary, secondary,tertiary and quaternary structure with Haemoglobin as an example) Simple and conjugate proteins.	
Chapter2.Enzyme Actionand Regulation • Nomenclatureandclassificationofenzymes;Cofactors;Specificityof enzyme action. • Isozymes;Mechanismofenzymeaction • Enzymekinetics;Factorsaffectingrateofenzyme-catalyzedreactions ; EquationofMichaela's -Mendon, Concept ofKm and V max, Enzyme inhibition • Allostericenzymesandtheirkinetics;Regulationofenzymeaction.	
Unit2	**14**
Chapter3.MetabolismofCarbohydratesandLipids • MetabolismofCarbohydrates:glycolysis,citricacidcycle,gluconeogenesis, phosphate pentose pathway, Glycogenolysis and Glycogenesis • Lipids-Biosynthesisofpalmiticacid; Ketogenesis,β-oxidationand omega – oxidation of saturated fatty acids with even and oddnumber of carbonatoms	
Chapter4. MetabolismofProteinsandNucleotides • **Catabolismofaminoacids**:Transamination,Deamination, Ureacycle,Nucleotides and vitamins • **Anabolism**-Peptidelinkages	
Unit3	**14**

Chapter5.DigestionandRespirationinhumans • **Digestion**-Structuralorganizationandfunctionsofgastrointestinaltract and associatedglands. • Mechanicalandchemicaldigestionoffood;Absorptionsofcarbohydrates, lipids, proteins, water, minerals and vitamins; Physiology oftrachea and Lung. • **Respiration** -Mechanism of respiration, Pulmonary ventilation; Respiratory volumes andcapacities; Transport of oxygen and carbon dioxideinblood,Respiratorypigments,Dissociationcurvesandthefactors influencing it; Control of respiration.	
Chapter6.CirculationandExcretioninhumans • Componentsofbloodandtheirfunctions; hemopoiesis • **Bloodclotting**:Bloodclottingsystem,Bloodgroups:Rh-factor,ABOandMN • Structureofmammalian heart • Cardiaccycle;Cardiacoutputanditsregulation,Electrocardiogram,Blood pressure and its regulation • Structureofkidneyanditsfunctionalunit;Mechanismofurineformation	
UnitIV	**14**
Chapter7.NervousSystemandEndocrinologyinhumans • Structureofneuron,restingmembrane potential(RMP) • Originofactionpotentialand itspropagationacrossthemyelinatedand unmyelinated nerve fibers. Types of synapse • **Endocrineglands**-pineal,pituitary,thyroid,parathyroid,pancreasand adrenal;hormones secreted by them. • Classificationofhormones;MechanismofHormoneaction.	
Chapter8. MuscularSysteminhumans • Histology of different types of muscle; Ultra structure of skeletal muscle; Molecularandchemicalbasisofmusclecontraction;Characteristicsofmuscle twitch; Motor unit, summation and tetanus	

SuggestedReadings:

I.Nelson&Cox:Leininger‘sPrinciplesofBiochemistry:McMillan(2000)
2. Zubayetal:PrinciplesofBiochemistry:WCB(1995)
3. Voet&Voet:BiochemistryVolsl&2:Wiley(2004)
4. Murrayet al:Harper‘sIllustratedBiochemistry:McGrawHill(2003)ElliottandElliott: Biochemistryand Molecular Biology: Oxford University Press
5. Guyton,A.C.&Hall, J.E. TextbookofMedicalPhysiology, XlEdition, Hercourt AsiaPTE Ltd. /W.B.Saunders Company. (2006).
6. Tortora,G.J.&Grabowski, S.PrinciplesofAnatomy&Physiology. XIEditionJohnWiley & sons (2006).
7. ChristopherD.Moyes,PatriciaM.Schulte.PrinciplesofAnimalPhysiology.3rdEdition, Pearson Education (2016).
8. Hill,RichardW.,etal.Animalphysiology.Vol.2.Sunderland,MA:SinauerAssociates, (2004).
9. ChatterjeeCCHumanPhysiologyVolumel&2, 11thedition,CBS Publishers(20I6).

ZoologySemesterIICoreCourseLabContent

CourseTitle/Code: Biochemistryand Physiology	**CourseCredits:**2
CourseCode:FSB470	**L-T-Pperweek:**0-0-4
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:25	**SummativeAssessmentMarks:**25

CourseOutcomes(COs):

1. Attheendofthecoursethestudentshouldbeabletounderstand:Basicstructureof biomolecules through model making.
2. Developtheskillstoidentifydifferenttypesofbloodcells.
3. Enhancebasiclaboratoryskilllikekeenobservation,analysisanddiscussion.
4. Learnthefunctionalattributesofbiomoleculesinanimalbody.
5. Knowuniquenessofenzymesinanimalbodyandtheirimportancethroughenzyme kinetics

CourseContent

Listoflabstobeconducted	56Hours
1.Preparationofmodelsofnitrogenousbases-nucleosidesandnucleotides.	
2.Preparationofmodelsofaminoacidsanddipeptides.	
3.PreparationofmodelsofDNAandRNA.	
4.QualitativeanalysisofCarbohydrates,ProteinsandLipids.	
5.QualitativeanalysisofNitrogenouswastes–Ammonia,UreaandUricacid.	
6.Separationofamino acidsorproteinsbypaperchromatography.	
7.Determinationoftheactivityofenzyme(Urease)-Effectof[S]and determinationofKmandVmax.	
8. Determinationoftheactivityofenzyme(Urease)-Effectoftemperatureandtime.	
9.Actionofsalivaryamylaseunderoptimumconditions.	
10. QuantitativeestimationofOxygenconsumptionbyfreshwaterCrab.	
11.Quantitativeestimationofsaltgainandsaltloss byfreshwater.	
12.EstimationofHemoglobin inhumanbloodusingSahli‘shaemoglobinometer	
12. CountingofRBC inbloodusingHemocytometer	
13.CountingofWBCinbloodusingHemocytometer	
14.DifferentialstainingofhumanbloodcorpusclesusingLeishmanstain	
15.Recordingofbloodglucoselevelbyusing glucometer	
VirtualLabs(Suggestivesites)	
https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlabwww.onlinelabs.inwww.powershow.com https://vlab.amrita.eduhttps://sites.dartmouth.edu	

TextBooks

1. Nelson&Cox:Leininger‘sPrinciplesofBiochemistry:McMillan(2000)
2. Zubayet al:PrinciplesofBiochemistry:WCB(1995)
3. Voet&Voet:BiochemistryVolsl&2:Wiley(2004)
4. Murrayetal:Harper‘sIllustratedBiochemistry:McGrawHill(2003)Elliottand Elliott: Biochemistryand Molecular Biology: Oxford University Press
5. Guyton,A.C.&Hall,J.E.TextbookofMedicalPhysiology,XlEdition, Hercourt Asia PTE Ltd. /W.B.Saunders Company. (2006).
6. Tortora,G.J.&Grabowski,S.PrinciplesofAnatomy&Physiology.XIEditionJohn Wiley & sons (2006).
7. ChristopherD.Moyes,PatriciaM.Schulte.PrinciplesofAnimalPhysiology.3rd Edition, Pearson Education (2016).
8. Hill,RichardW.,etal.Animalphysiology.Vol.2.Sunderland,MA:Sinauer Associates, (2004).
9. ChatterjeeCCHumanPhysiologyVolume l&2, 11thedition, CBSPublishers(20I 6).

Web References:

- MammalianPhysiology–www.biopac.com

TOPICSRECOMMENDEDFORSEMINAR/PROJECTREPORT

1. Biochemicalpathways,theirevolutionarybackgroundandregulation.
2. Bloodgroupsandtheirimportance.
3. Vitalenzymesforhumanbody.
4. Essentialandnonessentialaminoacids.
5. Importantbodylipids.
6. Significanceofanimalproteins.
7. Roleofcarbohydratesinanimalbody.
8. Natureofproteins andnurtureofanimalbody.
9. Roleoflipidsinstructuralandfunctionalorganizationofbody.

SchemeofPracticalExaminationII
Semester BSc. Zoology
Biochemistry and Physiology
Course Code: FSB470

Time:3 hours **Maximummarks:25M**

1. Biochemistryexperimentsbylots
   (Carbohydrates,Proteins&Lipids) **6 Marks**
2. Physiologyexperimentsbylots
   (Nitrogenouswastes/salivaryamylase/activityofureaseenzyme). **6 Marks**
3. DifferentialstainingofhumanbloodcorpusclesOREstimationofbloodglucoselevel **5 Marks**
4. IdentifythespotsA(Haemoglobinometer/Haemocytometer/Paperchromatography) **3Marks**
5. Modelsubmission. **5Marks**

Thecandidate has to submit the duly certified recordat thetime of practical examination. Therecord is for the reference of the examiners, but not for assessment (since it is already assessed for IA)

Assessment:

Weightageforassessments(inpercentage)

TypeofCourse	FormativeAssessment/IA Marks	SummativeAssessmentMarks
Theory	40	60
Practical	25	25

Pedagogy:WrittenAssignment/Presentation/Seminar

FormativeAssessment-Theory	
AssessmentOccasion	**WeightageinMarks**
HouseExamination/Test	C1+C2=10+10=20
WrittenAssignment/Presentation/Seminar	10+10=20
Total	40

Pedagogy:WrittenAssignment/Presentation/Record/Seminar

FormativeAssessment-Practical	
AssessmentOccasion	**WeightageinMarks**
InternalassessmentC1	10
InternalassessmentC2	10
Classrecord	05
Total	25

OpenElectiveCourseContent

Semester**:IIZoology**

CourseTitle:**Parasitology** CourseCode:**FSB920**	CourseCredits:**3**
TotalContactHours**: 42**	DurationofESA:3Hours
FormativeAssessmentMarks:**40**	SummativeAssessmentMarks:**60**

CourseOutcomes(COs):

Attheendofthecoursethestudentswillbeableto:

1. Knowthestagesofthelifecyclesoftheparasitesandinfectivestages.
2. Develop ecological model to know population dynamics of parasite, establishment of parasite population in host body,adaptive radiations and methods adopted by parasite to combat with thehost immune system.
3. Developskillsandrealizesignificanceofdiagnosisofparasiticinfectionandtreatment.
4. UnderstandaboutdiseasescausedbyProtozoa,Helminthes,NematodesandArthropodsatmolecularlevel.
5. Developtheirfuturecareerinmedicalsciencesandrelatedadministrativeservices.

CourseContent

Content	42Hrs
Unit–1	
Chapter1.GeneralConcepts • Introduction,Parasites,parasitoids,host,zoonosis • Originandevolutionofparasites • BasicconceptofParasitism,symbiosis,phoresis,commensalismsand mutualism • Host-parasiteinteractionsandadaptations • Lifecycleofhumanparasites • Occurance, modeofinfectionandprophylaxis **Chapter2.ParasiticPlatyhelminthes** • Studyofmorphology,lifecycle,pathogenicity, prophylaxisandcontrol measures of • *Fasciolopsisbuski* • *Schistosomahaematobium* • *Taeniasolium* • *Hymenolepis nana* **Chapter3.ParasiticProtists** • Studyofmorphology,lifecycle,pathogenicity,prophylaxisandcontrol *measures*of • *Entamoebahistolytica* • *Giardiaintestinalis*	**14**
• *Trypanosomagambiense* • *Plasmodiumvivax*	
Unit–2	**14**

Chapter4.ParasiticNematodes
• Studyofmorphology,lifecycle,pathogenicity,prophylaxisandcontrol measures of
  ◦ *Ascarislumbricoides*
  ◦ *Ancylostomaduodenale*
  ◦ *Wuchereriabancrofti*
  ◦ *Trichinellaspiralis*
• Nematodeplantinteraction;Gallformation
Chapter5.ParasiticArthropods
• Biology,importanceandcontrolof
  ◦ Ticks(Softtick*Ornithodoros*,Hardtick*Ixodes*)
  ◦ Mites(*Sarcoptes*)
  ◦ Lice(*Pediculus*)
  ◦ Flea(*Xenopsylla*)
• Bug (*Cimex*)
• Parasitoid(Beetles)
Chapter6.ParasiticVertebrates
• CookicutterShark
• HoodMockingbirdand
Vampirebatandtheirparasiticbehaviorandeffectonhost	

Unit–3	**14**

Chapter7.Moleculardiagnosis&clinicalparasitology
• Generalconceptofmoleculardiagnosisforparasiticinfection
• Advantagesanddisadvantagesofmolecular diagnosis
• Fundamentaltechniquesusedinmoleculardiagnosisofendoparasites
• Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules like G.intestinalis, B. coli, E.histolytica, L.donovani,Malarialparasiteusing
  • ELISA,RIA
  • CounterCurrentImmunoelectrophoresis(CCI)
  • ComplementFixationTest(CFT)PCR,DNA,RNAprobe	

SuggestedReadings:

19. Arora,D.RandArora,B.(2001)MedicalParasitology.IIEdition.CBS Publications andDistributors.
20. E.R.NobleandG.A.Noble(1982)Parasitology:Thebiologyofanimal parasites. V Edition, Lea&Febiger.
21. Ahmed,N.,Dawson,M.,Smith,C.andWood,Ed.(2007)BiologyofDisease. Taylor and FrancisGroup.
22. Parija, S. C. Textbookof medicalparasitology, protozoology& helminthology (Text andcolourAtlas),IIEdition,AllIndiaPublishers&Distributers,Medical Books Publishers, Chennai, Delhi.
23. Meyer,Olsen&Schmidt'sEssentialsofParasitology,Murray, D.Dailey, W.C.Brown Publishers.
24. K.D.Chatterjee(2009).Parasitology:ProtozoologyandHelminthology. XIII Edition, CBSPublishers & Distributors (P) Ltd.
25. Gunn,A.andPitt,S.J.(2012).Parasitology:anIntegratedApproach.WileyBlackwell.
26. Noble,E.R.andG.A.Noble(1982)Parasitology: Thebiologyofanimalparasites. V th Edition, Lea&Febiger.
27. Paniker,C.K.J.,Ghosh,S.[Ed}(2013).Paniker'sTextBookofMedical Parasitology. Jaypee, NewDelhi.
28. Parija,S.C.Textbookofmedicalparasitology,protozoology&helminthology(Textan d color Atlas),IIEdition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi.
29. Roberts,L.SandJanovy, J.(2009).Smith&Robert'sFoundationofParasitology. 8th. Edn. McGrawHill.

30. Bogitsh,B.J.andCheng,T.C.(2000).HumanParasitology. 2ndEd.AcademicPress,New York.
31. Chandler,A.C.andRead.C.P.(1961).IntroductiontoParasitology,10thed. John Wiley andSonsInc.
32. Cheng,T.C.(1986).GeneralParasitology.2nded. AcademicPress, Inc.Orlando.U.S.A.
33. Schmidt,G.D.andRoberts,L.S.(2001).FoundationofParasitology. 3rd ed. McGraw HillPublishers.
34. Schmidt,G.D.(1989).EssentialsofParasitology.Wm.C.BrownPublishers (Indian print1990,Universal Book Stall).
35. JohnHyde(1996)MolecularParasitologyOpenUniversityPress.
36. JJosephMarrandMiklosMuller (1995)BiochemistryandMolecular Biologyof Parasites 2 ndEdnAcademic Press.

Pedagogy: ChalkandTalk,PPT,Groupdiscussion,Seminar,Interaction,virtuallab,Labvisit

Formative Assessment	
AssessmentOccasion	**Weightage in Marks**
HouseExamination/Test	**20**
WrittenAssignment/Presentation/Project /TermPapers/Seminar	**20**
Total	**40**

Semester:IIZoology

CourseContent

ListofLabtobeconducted		42Hrs
1	Morphologyandtaxonomyofmulberry.	
2	Raisingofsaplings–cuttingpreparation, plantingandmaintenanceof nursery.	
3	Agronomicalpractices inmulberrycultivation-weeding,manuring,irrigation andharvesting.	
4	Diseasesand pestsof mulberry.	
5	Silkproducinginsects–nonmulberryandmulberrysilk worms.	
6	Lifecycleandmorphologyof***Bombyxmori.***	
7	Dissectionofdigestive systemandsilk glandsof***Bombyxmori.***	
8	Silkwormrearing equipments.	
9	Rearingprocess– incubation,chawkirearing,lateagewormrearing, mountingandharvestingofcocoons.	
10	Silkwormdiseasesandpests–Grasserie,Flacherie, Muscardine,Pebrine,Uzi flyandBeetles.	
11	Grainages–productionofsilkwormeggs**.**	
12	Physicaland commercialcharacteristics ofcocoons.	
13	Reelingandweavingprocess–stiffling, cooking,brushing, reelingandre-reeling,differenttypesof looms.	
14	Visit tomulberryfarmandsericulturecentre.	
15	Economicsofsilkproduction(Project)	

TextBooksand References

1. Govindan,R.,Narayanswami,T.KandDevaiah,M.C.1998,Principlesofsilkworm pathology.Ser Publishers ,Banglore.
2. Tazima,Y.1964―Thegeneticsofthesilkworm‖LogosPressLtd.London.
3. TazimaY 1978ThesilkwormanimportantlaboratorytoolKodnashaLtd.Tokyo.
4. GangaG,SulochanaChettyJAnintroductiontosericultureOxfordandIBH Publishing Co.Pvt. Ltd. New Delhi.
5. UllalandNarasimhannaHandbookofpracticlesericulture.
6. FAO Mannualsonsericulturevol.1-4.
7. TazimaY 1958SilkwormeggCSBPublication,Bombay.
8. YashimoroTanaka1964SericologyCSBPublication,Bombay.

Pedagogy

1. Demonstration
2. Assignment
3. Groupdiscussion
4. FieldVisit.
5. UseofAudio-Visualaids.

FormativeAssessment	
AssessmentOccasion	**WeightageinMarks**
ClassTest	10
AttendanceandAssignments	05
VisittoMulberryFarmandSericulture centre.	05
Total	20

JSSCOLLEGEOFARTS,COMMERCEANDSCIENCE
(Autonomous)
BNROAD,MYSURU-570025

DEPARTMENTOFZOOLOGY

Syllabusfor
B.Sc.HonsZOOLOGY(UG) I

& II SEMESTERS

FramedAccordingtotheNationalEducationalPolicy

(2021-22BatchOnwards)

ModelCurriculumStructureforDegreeProgram

B.Sc.,HonsinZoology

NameoftheDegreeProgram: B.Sc.,Hons

DisciplineCore: ZoologyTotalCreditsforthe

Program:50/100/142/184/268Startingyearofimplementation:2021-22

PROGRAMOBJECTIVES(POs)

POs1-TheProgrammeoffers bothclassicalaswellas modernconceptsofZoologyin higher education.

POs2-It enablesthestudentstostudyanimaldiversityinbothlocalandglobal environments.

POs3-Tomakethestudy of animals more interesting and relevant to human studies more emphasisisgiventobrancheslikebehaviouralbiology,evolutionarybiologyandeconomic zoology.

POs4-Moreofupcomingareasincellbiology,genetics,molecularbiology, biochemistry, genetic engineering and bioinformatics have been also included.

POs5-Equalimportanceisgiventopracticallearningandpresentationskillsofstudents.

POs6-The lab courses provide the students necessary skills required for their employability.**POs7-**Skillenhancement coursesinclassicalandappliedbranchesof Zoology enhance enterprising skills of students.

POs8-Theglobalpracticesintermsofacademicstandardsandevaluationstrategies.

POs9- Providesopportunityforthe mobilityofthe studentbothwithinand acrossthe world.

POs10-Theuniformgradingsystemwillbenefit thestudentstomoveacrossinstitutions within India to begin with and across countries.

POs11-Itwillalso enablepotentialemployers inassessingtheperformanceofthe candidates across the world.

Semester I- Zoology Core Course I Content:

Zoology:Paper-I:Cytology,Genetics&InfectiousDiseases.

CourseTitle/Code: Cytology,GeneticsandInfectious Diseases	**CourseCredits:**4
CourseCode:FSA470	**L-T-Pperweek:**4-0-0
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:40	**SummativeAssessmentMarks:**60

CourseOutcomes (COs):

Attheendofthecoursethestudent shouldbeabletounderstand: CO1. The

structure and function ofthe cell organelles.

CO2.Thechromatinstructureanditslocation.

CO3. Thebasicprincipleoflife, howacelldivides leadingtothegrowthofan Organism and also reproduces to form a new organism.

CO4.Howacellcommunicateswithitsneighboringcells.

CO5.Theprinciplesofinheritance,Mendel‘slawsandthedeviations.

CO6.Howenvironmentplaysanimportantrolebyinteractingwithgeneticfactors. CO7.
Detect chromosomal aberrations in humans and studyofpedigree analysis.

Content	Hours
Unit -1	14hrs
Chapter1:StructureandFunctionofCellOrganelles-IinAnimalcell • Ultrastructureofanimalcell • **Plasmamembrane**:Fluidmosaicmodel,Chemicalstructure–lipids,Proteinsandtheir role in maintaining structural integrity. Functions of Plasma membrane - Cell permeability, diffusion, passive transport, active transport. • **Endomembranesystem:**Proteintargetingandsorting,transport,endocytosisand exocytosis. **Chapter2:StructureandFunctionofCellOrganelles-IIinAnimalcell.** • **Endoplasmicreticulum-**Types,Structureandfunctions. • **Peroxisome &Ribosome**: Types – (Prokaryotic & Eukaryotic), Structureand functions. • **Golgiapparatus**-Structureandfunctions. • **Lysosomes**-Structureandfunctions. • **Mitochondria:** Structure and functions. Oxidative phosphorylation; electron transport system • **Cytoskeleton**:Structureandfunctionsof -Microtubules,microfilamentintermediate filaments.	
Unit -2	14hrs
Chapter3:NucleusandChromatinStructure. • **Ultra structure of Nucleus and Functions** - Nuclear envelop, Nuclear pore complex, Nucleoplasm. • Ultrastructureofnucleolusandfunctions. • **Chemicalstructure**andbasecompositionofDNAandRNA. • **Nucleosome model,** DNAsuper coiling, Chromatinorganization, Structureof chromosomes (Fine structure). Types of DNA and RNA. **Chapter4:Cellcycle,CellDivision andCellSignalling.** • Introduction to Cell cycle and its regulation**Cell division:** Mitosis stages and its Significance and Meiosis Stages and its Significance. • **Signal transduction**: Intracellularsignalling and Cell surface receptors, via G-protein linked receptors. • **Cell-cellinteraction**:Celladhesionmolecules,Cellularjunctions.	
Unit -3	14hrs
Chapter5:MendelismandSexDetermination. • **Basic principles of heredity:** Mendel’s laws - Monohybrid cross and Dihybrid cross. Complete and Incomplete Dominance (Ex. *Mirabilis jalapa).* Penetrance and Expressivity. • **GeneticSexDeterminingSystems**(XX-XY,XX–XO,ZZ–ZW),EnvironmentalSex Determination (*Bonelia viridis*), Sex Determination and Mechanism in *Drosophila melanogaster (Genic balance theory).* • **DosageCompensation** -Barrbody,Lyon’s hypothesis.	

Chapter6:ExtensionsofMendelism,GenesandEnvironment. • **Extensions of Mendelism**: Multiple Alleles (Inheritance of ABO blood group in Humans and Rh factor), Gene Interaction (Supplementary, Complementary and Epistasis). • **The Interaction between Sex and Heredity**: Sex-Influenced characteristics (Male pattern baldness in humans, horns in sheep) and Sex-Limited Characteristics (Plumage pattern, milk production andMoustache and Beard in Males) • **Cytoplasmic Inheritance** (Kappa particles in *Paramecium*), Genetic Maternal Effects (Shell coiling in *Limnaea*). • **InteractionbetweenGenesandEnvironment-**Himalayanalbinorabbit Environmental Effects on Gene Expression (Norm of reaction), Inheritance of Continuous Characteristics (Polygenic Inheritance - Skin colour in Man).	
Unit -4	14hrs
Chapter7: HumanChromosomesandPatternsofInheritance. • **Patterns of Inheritance**: Autosomal dominance (Huntington's chorea, PTC), Autosomal recessive (Sickle cell anemia, Albinism), X-linked recessive (Colour blindness, Hemophilia),X-linked dominant (Vitamin D resistance Ricketts,Coffin Lowry syndrome). • **Chromosomal Anomalies**: Structural (Deletion, Duplication, Inversion, Translocation with examples) and Numerical aberrations (Turner's syndrome,Klinefelter'ssyndrome). Autosomal anomalies - Down syndrome and Cri-du-chat syndrome. • **Human Karyotyping** and Pedigree analysis (Autosomal dominant, Autosomal recessive, X – linked dominant, X – linked recessive). **Chapter8:InfectiousDiseases.** • **Introduction to Pathogenic Organisms**: Viruses, Bacteria, Fungi, Protozoa and Worms. Structure, Life cycle, Pathogenicity, including diseases, causes, symptoms and control of common parasites: *Trypanosoma, Giardia* and *Wuchereria.*	

SuggestedReadings:

1. Lodishetal:MolecularCellBiology:Freeman&Co,USA(2004).
2. Albertsetal:MolecularBiologyoftheCell:Garland(2002).
3. Cooper:Cell:AMolecularApproach:ASMPress(2000).
4. Karp:CellandMolecularBiology:Wiley(2002).PierceB.Genetics.Freeman(2004).
5. LewinB.GenesVIII.Pearson(2004).
6. Watsonetal.MolecularBiologyoftheGene. Pearson(2004).
7. ThomasJ.Kindt,RichardA.Goldsby,BarbaraA.Osborne,JanisKuby-Kuby Immunology. W H Freeman(2007).
8. DelvesPeterJ.,MartinSeamusJ.,BurtonDennisR.,RoittIvanM.Roitt'sEssential Immunology, 13thEdition. Wiley Blackwell(2017).
9. PrinciplesofGeneticsbyB.D.Singh
10. Cell-BiologybyC.B.Pawar,KalyaniPublications
11. EconomicZoologybyShuklaandUpadhyaya

Semester I- Zoology Core Course I Content:

Zoology:Paper-I:Cytology,Genetics&InfectiousDiseases.

SemesterI

CourseTitle: Cytology,GeneticsandInfectiousDiseases	**CourseCredits:**2
CourseCode:FSA470	**L-T-Pperweek:**0-0-4
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:25	**SummativeAssessmentMarks:**25

CourseOutcomes(COs):

Attheendofthecoursethestudentshould beableto:

1. Tousesimpleandcompoundmicroscopes.
2. Topreparestainedslidestoobservethe cellorganelles.
3. To be familiar withthe basic principle of life, howa cell divides leading tothe growth ofan organismand also reproduces to form new organisms.
4. Thechromosomalaberrationsbypreparingkaryotypes.
5. Howchromosomalaberrationsareinheritedinhumansbypedigreeanalysisin families. The antigen-antibody reaction.

LabCourseContent

Listoflabstobeconducted	**56hrs**
1.Understandingofsimpleandcompoundmicroscopes.	
2.Tostudydifferentcelltypessuchasbuccalepithelialcells,neurons,striated musclecellsusingMethyleneblue/anysuitablestain(virtual/ slaughtered tissue).	
3.TostudythedifferentstagesofMitosisinroottipof*Alliumcepa*.	
4.TostudythedifferentstagesofMeiosisingrasshoppertestis(virtual).	
5.Tocheckthepermeabilityofcellsusingsaltsolutionofdifferent concentrations.	
6.Studyofparasitesinhumans(e.g.Protozoans,Helminthesincompliance withexamplesbeingstudiedintheory)permanentmicroslides.	
7.Tolearntheproceduresofpreparationoftemporary(spicules)orpermanent stainedslides(Fishscales),withavailablemountingmaterial.	
8.StudyofwildDrosophilamelanogaster(male&female)andMutant Phenotypesof*Drosophila* sp, –Whiteeye, bar eye, sepiaeye, vestigialwing& yellowbody.(FromCulturesor Photographs).	
9.StudyofPolytenechromosomes(ChironomuslarvaorDrosophila larva).	
10.PreparationofDrosophillaand humanKaryotypeandstudy(identification) ofthechromosomalstructural(chriduchatsyndrome(Deletion), FragileX syndrome(duplication),walker-warburgsyndrome(Inversion)and leukemia (translocation)andnumericalaberrations(Turner's,Klinefelter'sandDown's syndrome)fromthepicturesprovided.(Virtual/ Optional).	
11. Topreparefamilypedigrees. 12. https://www.vlab.co.in 13.https://zoologysan.blogspot.com 14.[illegible] 15.www.onlinelabs.in 16.www.powershow.com 17.https://vlab.amrita.eduhttps://sites.dartmouth.edu/	

SuggestedReadings:

1. Lodishetal:MolecularCellBiology:Freeman&Co,USA(2004).
2. Albertset al:MolecularBiologyoftheCell:Garland(2002).
3. Cooper:Cell:AMolecularApproach:ASMPress(2000).
4. Karp:CellandMolecular Biology:Wiley(2002).PierceB. Genetics.Freeman(2004).
5. ThomasJ. Kindt, Richard A. Goldsby, BarbaraA. Osborne, JanisKuby- Kuby Immunology. W HFreeman(2007).
6. Kesar, Sarojand Vasishta N.2007ExperimentalPhysiology: Comprehensive Manual. Heritage Publishers,NewDelhi.

SchemeofPracticalExaminationI
Semester BSc. Zoology
Cytology,GeneticsandInfectiousdiseases
Course Code: FSA470

Duration:3hours **Max.Marks:25**

1. IdentifythespotsA, BandC,givingsuitablereasonswith diagram (Experiment no1,2,3,4,6,8, 9&10)	12M
2. Prepareawholemountofthegivenmaterial	03M
3. Preparation ofKaryotype	05M
4. PreparationofPedigree analysis	05M

(Thecandidatehas tosubmit thedulycertifiedrecordat thetimeofpractical examination. Therecordis for thereference of the examiners, but not for assessment (since it is already assessed for IA)

Assessment:

Weightageforassessments(inpercentage)

TypeofCourse	FormativeAssessment/IA Marks	SummativeAssessmentMarks
Theory	40	60
Practical	25	25

Pedagogy:WrittenAssignment/Presentation/Seminar

FormativeAssessment-Theory	
AssessmentOccasion	**WeightageinMarks**
HouseExamination/Test	C1+C2=10+10=20
WrittenAssignment/Presentation/Seminar	10+10=20
Total	40

Pedagogy:WrittenAssignment/Presentation/Record/Seminar

FormativeAssessment-Practical	
AssessmentOccasion	**WeightageinMarks**
InternalassessmentC1	10
InternalassessmentC2	10
Classrecord	05
Total	25

OpenElectiveCourseContent

Semester:I

CourseTitle: Economic Zoology **CourseCode:**FSA920	**CourseCredits**:3
TotalContactHours: 42	**DurationofESA:**3Hours
FormativeAssessmentMarks:40	**SummativeAssessmentMarks**:60

CourseOutcomes(COs):

Attheendofthecoursethestudentwillbeableto:

1. Gainknowledgeaboutsilkwormsrearingandtheirproducts.
2. GainknowledgeinBeekeepingequipmentandapiarymanagement.
3. Acquaintknowledgeon dairyanimalmanagement,thebreedsand diseasesofcattleandlearn thetestingofegg and milk quality.
4. Acquaintknowledgeabouttheculturetechniquesoffishandpoultry.
5. Acquainttheknowledgeaboutbasicprocedureandmethodologyofvermiculture.
6. Learnvariousconceptsoflaccultivation.
7. Studentscanstarttheirownbusinessi.e.self-employments.
8. Getemploymentindifferentappliedsectors

CourseContent

Content	Hrs
UnitI	**14**
Chapter1.Sericulture: • HistoryandpresentstatusofsericultureinIndia • Mulberryandnon-mulberryspeciesinKarnatakaandIndia • Mulberrycultivation • Morphologyandlifecycle of*Bombyxmori* • Silkwormrearingtechniques:Processingofcocoon,reeling • Silkwormdiseasesandpest control **Chapter2.Apiculture:** • Introductionandpresentstatusofapiculture • SpeciesofhoneybeesinIndia,lifecycleof*Apisindica* • Colonyorganization,divisionoflabourandcommunication • Bee keeping as an agro based industry; methods and equipments: indigenousmethods,extractionappliances,extractionofhoneyfromthe comb and processing • Beepasturage,honeyandbeeswaxandtheiruses • Pestsanddiseasesofbeesandtheirmanagement	
UnitII	**14**
Chapter3. LiveStockManagement: • **Dairy:**Introductiontocommondairyanimalsandtechniquesofdairy management • Types, loose housing system and conventional barn system; advantages and limitationsof dairy farming • Establishmentofdairyfarmandchoosing suitabledairyanimals-cattle • Cattlefeeds,milkandmilkproducts • Cattlediseases • **Poultry:**Typesofbreedsandtheirrearingmethods • Feedformulationsforchicks • Nutritive valueofeggandmeat • Diseaseofpoultryandcontrol measures **Chapter4.Aquaculture:** • AquacultureinIndia:Anoverviewandpresentstatusandscopeof aquaculture • Types of aquaculture: Pond culture: Construction, maintenance and management; carpculture,shrimpculture,shellfishculture,composite fish culture and pearl culture	
Unit-III	**14**

Chapter5.Fishculture: • Commonfishesusedforculture. • Fishingcraftsandgears. • Ornamentalfishculture:Freshwaterornamentalfishes-biology,breeding techniques • Construction and maintenance of aquarium: Construction of home aquarium, materials used, setting up of freshwater aquaria, aquarium plants, ornamental objects, cleaning the aquarium, maintenance of water quality. control of snail and algal growth. • Moderntechniquesoffishseedproduction **Chapter6.Prawnculture:** • Cultureoffreshandmarinewaterprawns. • Preparation offarm. • Preservationandprocessingofprawn,exportofprawn. **Chapter7.Vermiculture:** • Scopeofvermiculture. • Typesofearthworms. • Habitcategories-epigeic,endogeicandanecic;indigenousandexotic species. • Methodology of vermicomposting:containers forculturing, raw materials	
required,preparationofbed,environmentalpre-requisites, feeding, harvesting andstorage of vermicompost. • Advantagesofvermicomposting. • Diseasesandpestsofearthworms. **Chapter8.Lac Culture:** • Historyoflacanditsorganization,lacproductioninIndia. • Lifecycle,hostplantsandstrainsoflacinsect. • Laccultivation:Localpractice, improvedpractice,propagationoflac insect, inoculationperiod, harvesting of lac. • Laccomposition,processing,products,usesandtheir pests.	

Text Books

SuggestedReadings:

1. Eikichi,H.(1999).SilkwormBreeding(TranslatedfromJapanese).Oxford& IBH Publishing Co.Pvt. Ltd., New Delhi.
2. Ganga,G.(2003).ComprehensiveSericultureVol-II:SilkwormRearingandSilkReeling.
3. Oxford&IBHPublishingCo.Pvt.Ltd.,NewDelhi.
4. Mahadevappa,D.,Halliyal,V.G.,Shankar,D.G.andBhandiwad,R.,(2000).MulberrySilk
5. ReelingTechnologyOxford&IBHPublishingCo.Pvt.Ltd.,NewDelhi.
6. Roger,M(1990).TheABCand XyzofBeeCulture:AnEncyclopedia of Beekeeping, KindleEdition.
7. ShuklaandUpadhyaya(2002).EconomicZoology,RastogiPublishers
8. YadavManju(2003).EconomicZoology,DiscoveryPublishingHouse.
9. JabdePradipV(2005).TextbookofappliedZoology,DiscoveryPublishingHouse,NewDelhi.
10. Cherian&RamachandranBeekeepingin-SouthIndianGovt.Press,Madras.
11. Sathe,T.V.VermicultureandOrganicfarming.
12. Bard.J(1986). HandbookofTropicalAquaculture.
13. Santhanam,R.A.ManualofAquaculture.
14. Zuka.R.1andHamiyn(1971).Aquariumfishesandplants
15. Jabde,P.V.(2005)TextBookofAppliedZoology: Vermiculture,Apiculture, Sericulture, Lacculture.
16. AnimalDisease-BairagiK.N.AnmolPublicationsPvt.Ltd2014

17. EconomicsOfAquaculture-Singh(R.K.P)-DanikaPublishingCompany2003
18. AppliedandEconomicZoology(SWAYAM)web
https://swayam.gov.in/nd2_cec20_ge23/preview

Assessment

Pedagogy: ChalkandTalk,PPT,Groupdiscussion,Seminar,Fieldvisit

FormativeAssessment-Theory	
AssessmentOccasion	**WeightageinMarks**
HouseExamination/Test	C1+C2=10+10=20
WrittenAssignment/Presentation/Seminar	10+10=20
Total	40

SkillEnhancementCourseinZoology

CourseContent

Semester:I

CourseTitle: Vermiculture **CourseCode**: VEC5ZOOP1	**CourseCredits:**2
TotalContactHours:56Hours	**DurationofESA:**3Hrs
FormativeAssessmentMarks:20	**SummativeAssessmentMarks:**30

CourseOutcomes (COs):

At theendofthecoursethe student:

1. Understandstheimportanceofearthwormsinmaintaining soilquality.
2. Learnsthatthevermicomposting isaneffectiveorganicsolidwastemanagement method.
3. Getsacquaintedwiththeimportanceofearthwormsinagro-basedeconomicactivity.
4. Vermicompostingleadstoorganic farmingandhealthyfoodproduction.
5. Vermicomposting maybetakenupas asmallscale industrybythe farmersand unemployed youth.
6. Getjobs inteachinginstitutionsorvermicultureunitsas technicians.
7. Learntheconceptofvermicompostingasbiofertilizersthusstudent canbecomean entrepreneur after completion of the course.
8. Bestopportunityforself-employmentandlifelonglearningwithfarmers.

CourseContent

Listoflabstobeconducted		56Hrs
1	Collectionofnativeearthwormspeciestostudyhabitandhabitat.	
2	Keystoidentifydifferentspeciesofearthworm.	
3	ExternalsandLifecycleof***Eiseniafetida***and***Eudriluseugeniae.***	
4	Dissectionofdigestiveandreproductivesystem.	
5	Studyofvermicompostingequipmentsand devices.	
6	Preparationofvermibedsandtheirmaintenance.	
7	Studyofdifferentvermicompostingmethods.	
8	Harvesting,separationofworms, packaging,transportandstorageof varmicompost.	
9	Vermi-washcollectionandprocessing.	
10	Smallscaleearthwormfarmingfor homegardensandstudyingtheeffectof vermicompostongardenplants.	
11	Budgetandcostscenarioofvermiculture(Project).	
12	Diseasesandnaturalenemiesofearthwormsand theircontrolmeasures.	
13	Roleofvermitechnologyinenvironmentalprotection.	
14	EconomicsandMarketingofvermicompost andvermiwash.	
15	Visittovermiculturefarmtoacquaintwithlatesttechniques.	

TextBooksand references

1. BhattJ.V. &S.R. Khambata(1959) —RoleofEarthworms in Agriculture‖Indian Council ofAgriculturalResearch,NewDelhi
2. Edwards,C.A.andJ.R.Lofty(1977)—BiologyofEarthworms‖ChapmanandHall Ltd., London.
3. Lee,K.E.(1985)—Earthworms:TheirecologyandRelationshipwithSoilsandLand Use‖ AcademicPress,Sydney.
4. Dash,M.C.,B.K.Senapati,P.C.Mishra(1980)—VermsandVermicomposting‖ Proceedings of the National Seminar on Organic Waste Utilization and Vermicomposting Dec.5-8,1984,(Part B),SchoolofLifeSciences,SambalpurUniversity,JyotiVihar, Orissa.
5. Kevin,Aand K.E.Lee(1989)—Earthwormfor GardenersandFisherman‖ (CSIRO,Australia, Division of Soils)
6. Satchel,J.E.(1983)—EarthwormEcology‖ChapmanHall,London.
7. Wallwork,J.A.(1983)—EarthwormBiology‖EdwardArnold(Publishers) Ltd. London.

Pedagogy

1. Demonstration
2. Assignment
3. Groupdiscussion
4. Fieldvisit
5. UseofAudio-Visualaids.

FormativeAssessment	
AssessmentOccasion	**WeightageinMarks**
ClassTest	10
AttendanceandAssignments	05
Visittovermicompostunitandreport	05
Total	20

SchemeofPracticalExaminationI
Semester BSc. Zoology
SkillEnhancementcourse:Vermiculture

Duration:3hours **Max.marks:30**

1. Identifyanddescribethegivensystemofthegivenspecimen/chart'A'given, withneat labelled diagram. (05 marks)

2. IdentifyandcommentonthespottersBtoE(Life cycle/Externals/Devicesused in vermicomposting/ Vermicompost types) (5x5=25 marks)

TOTAL= 30 Marks

SemesterII-ZoologyCoreCourseIContent:

Paper-II: Biochemistry and Physiology

CourseTitle:BiochemistryandPhysiology	**CourseCredits:**4
CourseCode: FSB470	**L-T-Pperweek:**4-0-0
TotalContactHours:56	**DurationofESA:**3Hours
FormativeAssessmentMarks:40	**SummativeAssessmentMarks**:60

Courseoutcomes:

Thestudentatthecompletionofthecoursewilllearn:

1. Todevelopadeepunderstandingofstructureofbiomoleculeslikeproteins,lipidsandcarbohydrates.
2. Howsimplemoleculestogetherformcomplexmacromolecules.
3. Tounderstandthethermodynamicsofenzymecatalyzedreactions.
4. Mechanismsofenergyproductionatcellularandmolecularlevels.
5. Tounderstandvariousfunctionalcomponentsofanorganism.
6. Toexplorethecomplex networkofthesefunctionalcomponents.
7. Tocomprehendtheregulatorymechanisms for maintenanceoffunctioninthebody.

Content	Hours
UnitI	**14**
Chapter1.StructureandFunctionofBiomolecules: • StructureandBiologicalimportanceofcarbohydrates(Classification withexamplesMonosaccharides,Disaccharides,Polysaccharidesand Glycoconjugates). • LipidsClassificationandBiologicalimportance-(saturatedandunsaturated Fatty acids, Tri-acylglycerols, Phospho lipids,Glycolipids and Steroids) Clinical importance of Lipids, HDL & LDL ,TG and Cholesterol • ProteinsStructure,ClassificationandGeneralPropertiesofa-amino acids; Essential and non-essential amino acids, Levels of organization in proteins(Primary, secondary,tertiary and quaternary structure with Haemoglobin as an example) Simple and conjugate proteins.	
Chapter2.Enzyme Actionand Regulation • Nomenclatureandclassificationofenzymes;Cofactors;Specificityof enzyme action. • Isozymes;Mechanismofenzymeaction • Enzymekinetics;Factorsaffectingrateofenzyme-catalyzedreactions ; EquationofMichaela's -Mendon, Concept ofKm and V max, Enzyme inhibition • Allostericenzymesandtheirkinetics;Regulationofenzymeaction.	
Unit2	**14**
Chapter3.MetabolismofCarbohydratesandLipids • MetabolismofCarbohydrates:glycolysis,citricacidcycle,gluconeogenesis, phosphate pentose pathway, Glycogenolysis and Glycogenesis • Lipids-Biosynthesisofpalmiticacid; Ketogenesis,β-oxidationand omega – oxidation of saturated fatty acids with even and oddnumber of carbonatoms	
Chapter4. MetabolismofProteinsandNucleotides • **Catabolismofaminoacids**:Transamination,Deamination, Ureacycle,Nucleotides and vitamins • **Anabolism**-Peptidelinkages	
Unit3	**14**

Chapter5.DigestionandRespirationinhumans • **Digestion**-Structuralorganizationandfunctionsofgastrointestinaltract and associatedglands. • Mechanicalandchemicaldigestionoffood;Absorptionsofcarbohydrates, lipids, proteins, water, minerals and vitamins; Physiology oftrachea and Lung. • **Respiration** -Mechanism of respiration, Pulmonary ventilation; Respiratory volumes andcapacities; Transport of oxygen and carbon dioxideinblood,Respiratorypigments,Dissociationcurvesandthefactors influencing it; Control of respiration.	
Chapter6.CirculationandExcretioninhumans • Componentsofbloodandtheirfunctions; hemopoiesis • **Bloodclotting**:Bloodclottingsystem,Bloodgroups:Rh-factor,ABOandMN • Structureofmammalian heart • Cardiaccycle;Cardiacoutputanditsregulation,Electrocardiogram,Blood pressure and its regulation • Structureofkidneyanditsfunctionalunit;Mechanismofurineformation	
UnitIV	**14**
Chapter7.NervousSystemandEndocrinologyinhumans • Structureofneuron,restingmembrane potential(RMP) • Originofactionpotentialand itspropagationacrossthemyelinatedand unmyelinated nerve fibers. Types of synapse • **Endocrineglands**-pineal,pituitary,thyroid,parathyroid,pancreasand adrenal;hormones secreted by them. • Classificationofhormones;MechanismofHormoneaction.	
Chapter8. MuscularSysteminhumans • Histology of different types of muscle; Ultra structure of skeletal muscle; Molecularandchemicalbasisofmusclecontraction;Characteristicsofmuscle twitch; Motor unit, summation and tetanus	

SuggestedReadings:

I.Nelson&Cox:Leininger'sPrinciplesofBiochemistry:McMillan(2000)
2. Zubayetal:PrinciplesofBiochemistry:WCB(1995)
3. Voet&Voet:BiochemistryVolsl&2:Wiley(2004)
4. Murrayet al:Harper'sIllustratedBiochemistry:McGrawHill(2003)ElliottandElliott: Biochemistryand Molecular Biology: Oxford University Press
5. Guyton,A.C.&Hall, J.E. TextbookofMedicalPhysiology, XlEdition, Hercourt AsiaPTE Ltd. /W.B.Saunders Company. (2006).
6. Tortora,G.J.&Grabowski, S.PrinciplesofAnatomy&Physiology. XIEditionJohnWiley & sons (2006).
7. ChristopherD.Moyes,PatriciaM.Schulte.PrinciplesofAnimalPhysiology.3rdEdition, Pearson Education (2016).
8. Hill,RichardW.,etal.Animalphysiology.Vol.2.Sunderland,MA:SinauerAssociates, (2004).
9. ChatterjeeCCHumanPhysiologyVolumel&2, 11thedition,CBS Publishers(20I6).

ZoologySemesterIICoreCourseLabContent

CourseTitle/Code: Biochemistryand Physiology	**CourseCredits:** 2
CourseCode: FSB470	**L-T-Pperweek:** 0-0-4
TotalContactHours: 56	**DurationofESA:** 3Hours
FormativeAssessmentMarks: 25	**SummativeAssessmentMarks:** 25

CourseOutcomes(COs):

1. Attheendofthecoursethestudentshouldbeabletounderstand:Basicstructureof biomolecules through model making.
2. Developtheskillstoidentifydifferenttypesofbloodcells.
3. Enhancebasiclaboratoryskilllikekeenobservation,analysisanddiscussion.
4. Learnthefunctionalattributesofbiomoleculesinanimalbody.
5. Knowuniquenessofenzymesinanimalbodyandtheirimportancethroughenzyme kinetics

CourseContent

Listoflabstobeconducted	56Hours
1.Preparationofmodelsofnitrogenousbases-nucleosidesandnucleotides.	
2.Preparationofmodelsofaminoacidsanddipeptides.	
3.PreparationofmodelsofDNAandRNA.	
4.QualitativeanalysisofCarbohydrates,ProteinsandLipids.	
5.QualitativeanalysisofNitrogenouswastes–Ammonia,UreaandUricacid.	
6.Separationofamino acidsorproteinsbypaperchromatography.	
7.Determinationoftheactivityofenzyme(Urease)-Effectof[S]and determinationofKmandVmax.	
8. Determinationoftheactivityofenzyme(Urease)-Effectoftemperatureandtime.	
9.Actionofsalivaryamylaseunderoptimumconditions.	
10. QuantitativeestimationofOxygenconsumptionbyfreshwaterCrab.	
11.Quantitativeestimationofsaltgainandsaltloss byfreshwater.	
12.EstimationofHemoglobin inhumanbloodusingSahli‘shaemoglobinometer	
12. CountingofRBC inbloodusingHemocytometer	
13.CountingofWBCinbloodusingHemocytometer	
14.DifferentialstainingofhumanbloodcorpusclesusingLeishmanstain	
15.Recordingofbloodglucoselevelbyusing glucometer	
VirtualLabs(Suggestivesites)	
https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlabwww.onlinelabs.inww w.powershow.com https://vlab.amrita.eduhttps://sites.dartmouth.ed u	

TextBooks

1. Nelson&Cox:Leininger'sPrinciplesofBiochemistry:McMillan(2000)
2. Zubayet al:PrinciplesofBiochemistry:WCB(1995)
3. Voet&Voet:BiochemistryVolsl&2:Wiley(2004)
4. Murrayetal:Harper'sIllustratedBiochemistry:McGrawHill(2003)Elliottand Elliott: Biochemistryand Molecular Biology: Oxford University Press
5. Guyton,A.C.&Hall,J.E.TextbookofMedicalPhysiology,XlEdition, Hercourt Asia PTE Ltd. /W.B.Saunders Company. (2006).
6. Tortora,G.J.&Grabowski,S.PrinciplesofAnatomy&Physiology.XIEditionJohn Wiley & sons (2006).
7. ChristopherD.Moyes,PatriciaM.Schulte.PrinciplesofAnimalPhysiology.3rd Edition, Pearson Education (2016).
8. Hill,RichardW.,etal.Animalphysiology.Vol.2.Sunderland,MA:Sinauer Associates, (2004).
9. ChatterjeeCCHumanPhysiologyVolume l&2, 11thedition, CBSPublishers(20I 6).

Web References:

- MammalianPhysiology–www.biopac.com

TOPICSRECOMMENDEDFORSEMINAR/PROJECTREPORT

1. Biochemicalpathways,theirevolutionarybackgroundandregulation.
2. Bloodgroupsandtheirimportance.
3. Vitalenzymesforhumanbody.
4. Essentialandnonessentialaminoacids.
5. Importantbodylipids.
6. Significanceofanimalproteins.
7. Roleofcarbohydratesinanimalbody.
8. Natureofproteins andnurtureofanimalbody.
9. Roleoflipidsinstructuralandfunctionalorganizationofbody.

SchemeofPracticalExaminationII
Semester BSc. Zoology
Biochemistry and Physiology
Course Code: FSB470

Time:3 hours **Maximummarks:25M**

1. Biochemistryexperimentsbylots
   (Carbohydrates,Proteins&Lipids) **6 Marks**
2. Physiologyexperimentsbylots
   (Nitrogenouswastes/salivaryamylase/activityofureaseenzyme). **6 Marks**
3. DifferentialstainingofhumanbloodcorpusclesOREstimationofbloodglucoselevel **5 Marks**
4. IdentifythespotsA(Haemoglobinometer/Haemocytometer/Paperchromatography) **3Marks**
5. Modelsubmission. **5Marks**

Thecandidate has to submit the duly certified recordat thetime of practical examination. Therecord is for the reference of the examiners, but not for assessment (since it is already assessed for IA)

Assessment:

Weightageforassessments(inpercentage)

TypeofCourse	FormativeAssessment/IA Marks	SummativeAssessmentMarks
Theory	40	60
Practical	25	25

Pedagogy:WrittenAssignment/Presentation/Seminar

FormativeAssessment-Theory	
AssessmentOccasion	**WeightageinMarks**
HouseExamination/Test	C1+C2=10+10=20
WrittenAssignment/Presentation/Seminar	10+10=20
Total	40

Pedagogy:WrittenAssignment/Presentation/Record/Seminar

FormativeAssessment-Practical	
AssessmentOccasion	**WeightageinMarks**
InternalassessmentC1	10
InternalassessmentC2	10
Classrecord	05
Total	25

OpenElectiveCourseContent

Semester**:IIZoology**

CourseTitle:**Parasitology** CourseCode:**FSB920**	CourseCredits:**3**
TotalContactHours**: 42**	DurationofESA:3Hours
FormativeAssessmentMarks:**40**	SummativeAssessmentMarks:**60**

CourseOutcomes(COs):

Attheendofthecoursethestudentswillbeableto:

1. Knowthestagesofthelifecyclesoftheparasitesandinfectivestages.
2. Develop ecological model to know population dynamics of parasite, establishment of parasite population in host body,adaptive radiations and methods adopted by parasite to combat with thehost immune system.
3. Developskillsandrealizesignificanceofdiagnosisofparasiticinfectionandtreatment.
4. UnderstandaboutdiseasescausedbyProtozoa,Helminthes,NematodesandArthropodsatmolecularlevel.
5. Developtheirfuturecareerinmedicalsciencesandrelatedadministrativeservices.

CourseContent

Content	42Hrs
Unit–1	
Chapter1.GeneralConcepts • Introduction,Parasites,parasitoids,host,zoonosis • Originandevolutionofparasites • BasicconceptofParasitism,symbiosis,phoresis,commensalismsand mutualism • Host-parasiteinteractionsandadaptations • Lifecycleofhumanparasites • Occurance, modeofinfectionandprophylaxis **Chapter2.ParasiticPlatyhelminthes** • Studyofmorphology,lifecycle,pathogenicity, prophylaxisandcontrol measures of • *Fasciolopsisbuski* • *Schistosomahaematobium* • *Taeniasolium* • *Hymenolepis nana* **Chapter3.ParasiticProtists** • Studyofmorphology,lifecycle,pathogenicity,prophylaxisandcontrol *measures*of • *Entamoebahistolytica* • *Giardiaintestinalis*	**14**
• *Trypanosomagambiense* • *Plasmodiumvivax*	
Unit–2	**14**
Chapter4.ParasiticNematodes • Studyofmorphology,lifecycle,pathogenicity,prophylaxisandcontrol measures of • *Ascarislumbricoides* • *Ancylostomaduodenale* • *Wuchereriabancrofti* • *Trichinellaspiralis* • Nematodeplantinteraction;Gallformation **Chapter5.ParasiticArthropods** • Biology,importanceandcontrolof • Ticks(Softtick*Ornithodoros*,Hardtick*Ixodes*) • Mites(*Sarcoptes*) • Lice(*Pediculus*) • Flea(*Xenopsylla*) • Bug (*Cimex*) • Parasitoid(Beetles) **Chapter6.ParasiticVertebrates** • CookicutterShark • HoodMockingbirdand Vampirebatandtheirparasiticbehaviorandeffectonhost	
Unit–3	**14**

Chapter7.Moleculardiagnosis&clinicalparasitology
• Generalconceptofmoleculardiagnosisforparasiticinfection
• Advantagesanddisadvantagesofmolecular diagnosis
• Fundamentaltechniquesusedinmoleculardiagnosisofendoparasites
• Immunoassay or serological techniques for laboratory diagnosis of endoparasites on the basis of marker molecules like G.intestinalis, B. coli, E.histolytica, L.donovani,Malarialparasiteusing
  • ELISA,RIA
  • CounterCurrentImmunoelectrophoresis(CCI)
  • ComplementFixationTest(CFT)PCR,DNA,RNAprobe	

SuggestedReadings:

19. Arora,D.RandArora,B.(2001)MedicalParasitology.IIEdition.CBS Publications andDistributors.
20. E.R.NobleandG.A.Noble(1982)Parasitology:Thebiologyofanimal parasites. V Edition, Lea&Febiger.
21. Ahmed,N.,Dawson,M.,Smith,C.andWood,Ed.(2007)BiologyofDisease. Taylor and FrancisGroup.
22. Parija, S. C. Textbookof medicalparasitology, protozoology& helminthology (Text andcolourAtlas),IIEdition,AllIndiaPublishers&Distributers,Medical Books Publishers, Chennai, Delhi.
23. Meyer,Olsen&Schmidt'sEssentialsofParasitology,Murray, D.Dailey, W.C.Brown Publishers.
24. K.D.Chatterjee(2009).Parasitology:ProtozoologyandHelminthology. XIII Edition, CBSPublishers & Distributors (P) Ltd.
25. Gunn,A.andPitt,S.J.(2012).Parasitology:anIntegratedApproach.WileyBlackwell.
26. Noble,E.R.andG.A.Noble(1982)Parasitology: Thebiologyofanimalparasites. V th Edition, Lea&Febiger.
27. Paniker,C.K.J.,Ghosh,S.[Ed}(2013).Paniker‘sTextBookofMedical Parasitology. Jaypee, NewDelhi.
28. Parija,S.C.Textbookofmedicalparasitology,protozoology&helminthology(Textan d color Atlas),IIEdition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi.
29. Roberts,L.SandJanovy, J.(2009).Smith&Robert‘sFoundationofParasitology. 8th. Edn. McGrawHill.

30. Bogitsh,B.J.andCheng,T.C.(2000).HumanParasitology. 2ndEd.AcademicPress,New York.
31. Chandler,A.C.andRead.C.P.(1961).IntroductiontoParasitology,10thed. John Wiley andSonsInc.
32. Cheng,T.C.(1986).GeneralParasitology.2nded. AcademicPress, Inc.Orlando.U.S.A.
33. Schmidt,G.D.andRoberts,L.S.(2001).FoundationofParasitology. 3rd ed. McGraw HillPublishers.
34. Schmidt,G.D.(1989).EssentialsofParasitology.Wm.C.BrownPublishers (Indian print1990,Universal Book Stall).
35. JohnHyde(1996)MolecularParasitologyOpenUniversityPress.
36. JJosephMarrandMiklosMuller (1995)BiochemistryandMolecular Biologyof Parasites 2 ndEdnAcademic Press.

Pedagogy: ChalkandTalk,PPT,Groupdiscussion,Seminar,Interaction,virtuallab,Labvisit

Formative Assessment	
AssessmentOccasion	**Weightage in Marks**
HouseExamination/Test	**20**
WrittenAssignment/Presentation/Project /TermPapers/Seminar	**20**
Total	**40**

Semester:IIZoology

CourseContent

ListofLabtobeconducted		42Hrs
1	Morphologyandtaxonomyofmulberry.	
2	Raisingofsaplings–cuttingpreparation, plantingandmaintenanceof nursery.	
3	Agronomicalpractices inmulberrycultivation-weeding,manuring,irrigation andharvesting.	
4	Diseasesand pestsof mulberry.	
5	Silkproducinginsects–nonmulberryandmulberrysilk worms.	
6	Lifecycleandmorphologyof***Bombyxmori.***	
7	Dissectionofdigestive systemandsilk glandsof***Bombyxmori.***	
8	Silkwormrearing equipments.	
9	Rearingprocess– incubation,chawkirearing,lateagewormrearing, mountingandharvestingofcocoons.	
10	Silkwormdiseasesandpests–Grasserie,Flacherie, Muscardine,Pebrine,Uzi flyandBeetles.	
11	Grainages–productionofsilkwormeggs**.**	
12	Physicaland commercialcharacteristics ofcocoons.	
13	Reelingandweavingprocess–stiffling, cooking,brushing, reelingandre-reeling,differenttypesof looms.	
14	Visit tomulberryfarmandsericulturecentre.	
15	Economicsofsilkproduction(Project)	

TextBooksand References

1. Govindan,R.,Narayanswami,T.KandDevaiah,M.C.1998,Principlesofsilkworm pathology.Ser Publishers ,Banglore.
2. Tazima,Y.1964―Thegeneticsofthesilkworm‖LogosPressLtd.London.
3. TazimaY 1978ThesilkwormanimportantlaboratorytoolKodnashaLtd.Tokyo.
4. GangaG,SulochanaChettyJAnintroductiontosericultureOxfordandIBH Publishing Co.Pvt. Ltd. New Delhi.
5. UllalandNarasimhannaHandbookofpracticlesericulture.
6. FAO Mannualsonsericulturevol.1-4.
7. TazimaY 1958SilkwormeggCSBPublication,Bombay.
8. YashimoroTanaka1964SericologyCSBPublication,Bombay.

Pedagogy

1. Demonstration
2. Assignment
3. Groupdiscussion
4. FieldVisit.
5. UseofAudio-Visualaids.

FormativeAssessment	
AssessmentOccasion	**WeightageinMarks**
ClassTest	10
AttendanceandAssignments	05
VisittoMulberryFarmandSericulture centre.	05
Total	20

Model Curriculum

Fruit Pulp Processing Technician

SECTOR: FOOD PROCESSING
SUB-SECTOR: FRUITS & VEGETABLES
OCCUPATION: PROCESSING
REF ID: FIC/Q0106, V1.0
NSQF LEVEL: 4

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY AND SKILL INITIATIVE (FICSI)

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Fruit Pulp Processing Technician**' QP No. '**FIC/Q0106, NSQF Level 4**'

Date of Issuance: **January 15, 2016**

Valid up to: **July 02, 2016**

** Valid up to the next review date of the Qualification Pack*

Monika Verma

Authorised Signatory
(Food Industry Capacity and Skill Initiative)

TABLE OF CONTENTS

Fruit Pulp Processing Technician

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of a "Fruit Pulp Processing Technician", in the "Food Processing" Sector/Industry and aims at building the following key competencies amongst the learner

Program Name	Fruit Pulp Processing Technician		
Qualification Pack Name & Reference ID. ID	FIC/Q0106, v1.0		
Version No.	1.0	Version Update Date	12/01/2016
Pre-requisites to Training	Preferably Class 8 and 2-3 years' experience in a food processing unit		
Training Outcomes	The programme will help in building the following key competencies amongst the learner: Process fruits to produce fruit pulps manually or through machine operation; Plan, organize, prioritize, inspect, and calculate production requirements; Maintain process parameters to achieve the desired quality and quantity; Follow and maintain food safety and hygiene in the work environment		

This course encompasses 5 out of 5 National Occupational Standards (NOS) of "Fruit Pulp Processing Technician" Qualification Pack FIC/Q0106, Version 1.0 issued by Food Industry Capacity and Skill Initiative".

Sr. No.	Module	Key Learning Outcomes	Equipment Required
1	**Introduction to the training program** **Theory Duration** (hh:mm) 00:30 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code** Bridge Module	Introduce each other and build rapport with fellow participants and the trainer.	White board/Chart papers, marker
2	**Overview of the "Fruit Pulp processing technician" Role** **Theory Duration** (hh:mm) 01:00 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code**	Understanding the roles and responsibilities of fruit pulp processing technician Awareness of the nature and availability of job opportunities	Laptop/computer white board, marker, projector, chart papers
3	**Introduction to the Food Processing Industry** **Theory Duration** (hh:mm) 01:30 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code**	Define food processing List the various sub sectors of food processing industry	Laptop, white/black board, marker, chart papers, projector ,Trainer's guide, Student manual
4	**Introduction to Fruit & Vegetable Processing** **Theory Duration** (hh:mm)	State the need for fruit and vegetable processing State the common methods of fruit and vegetable processing	Laptop, white/black board, marker, chart papers, projector, trainer's guide, student handbook, pictures/charts of

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	02:00 **Practical Duration** (hh:mm) 01:00 **Corresponding NOS Code**		different subsectors in fruit and vegetable processing e.g. pickle, jam and jelly, ketchup, juices, squashes, fruit pulp etc.
5.	**Overview of Fruit Pulp Processing** **Theory Duration** (hh:mm) 03:00 **Practical Duration** (hh:mm) 01:00 **Corresponding NOS Code** FIC/N0120 FIC/N0121 FIC/N0122 FIC/N0123	Define fruit pulping List the various fruits used for pulping Describe the pulping process	Laptop/computer white board, marker, projector, chart papers, Trainer's guide , student handbook
6.	**Organizational standards and norms** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 01:00 **Corresponding NOS Code** FIC/N0120 FIC/N0121 FIC/N0122 FIC/N0123 FIC/N9001	State the roles and responsibilities of a jam, jelly and ketchup processing technician State how to conduct yourself at the workplace State the personal hygiene and sanitation guidelines State the food safety and hygiene standards to follow in an organization	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook, protective gloves, head caps, aprons, safety goggles, safety boots, mouth masks, sanitizer, safety manual
7.	**Prepare and Maintain Work Area and Process Machineries for pulp processing** **Theory Duration** (hh:mm)	• Identify different equipments used in fruit pulp processing • State the materials and equipments used in cleaning and maintenance of the work area and machineries • State the cleaning processes used to clean the work area	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook, authorized sanitizers, cleansers, all equipments for demonstration

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	08:00 **Practical Duration** (hh:mm) 15:00 **Corresponding NOS Code** FIC/N0120 FIC/N0121 FIC/N0122 FIC/N0123 FIC/N9001	• Demonstrate the use of different tools and machineries used for squash and juice • Demonstrate the appropriate method for cleaning and maintain a work area Ensure the work area is safe and hygienic for food processing • Identify and set the machines and tools required for production in working condition • Maintain cleanliness of the process machineries required for production using recommended sanitizers	
8.	**Food Microbiology** **Theory Duration** (hh:mm) 06:00 **Practical Duration** (hh:mm) 02:00 **Corresponding NOS Code**	State the types of food microbes State the causes of food spoilage State the process of food spoilage state the criteria to check food spoilage State the need for food preservation State different types of food preservation processes Explain the method of assessing the quality of produce based on physical parameters	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook, samples of fresh and spoiled food
9..	**Prepare for production of fruit pulp** **Theory Duration** (hh:mm) 06:00 **Practical Duration** (hh:mm) 12:00 **Corresponding NOS Code** FIC/N0121 FIC/N0122	Use basic mathematics for various calculations in day-to-day processes Plan the production schedule as per organizational standards and instructions Organize for raw materials, packaging materials, manpower, equipment and machineries for the scheduled production Identify the raw materials required for production as per production schedule and formation State the methods for storing raw materials for later use Plan the production sequence to maximize capacity, utilization of resources, manpower and machinery Calculate batch size and prioritize urgent orders based on the production schedule and machine capacity	SOP; pH meter(Digital); Thermometer (Digital); Beakers; Measuring Cylinder; Measuring flask; Brinometer; Salinometer, Hydrometer; Weighing Balance (Digital); Brix Meter/ Refractometer; Deep fridge; refrigerator; Gas burner with cylinder; Fruit tray; Stainless steel mug; Pilfer proof capping machine; Cutting knives; mixer/electric mixer; water tank; fruit slicing machine; sealing machine; Vacuum gauge; pressure gauge; seam checking gauge or screw gauge; pressure cooker; coring Knives; Pitting knives;

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		• Check the conformance of raw material quality to company standards • Organize quality raw material as per production process and company standards • Check the raw material quality and grade • Prepare the raw material for production • List the effect on pulp of manhandling fruits	Juice extractor, crown corking machine; pulper; fruit mill; vacuum pan; mechanical peeler/ batch type of fruit and vegetable peeling; steam jacket kettle; baby boiler/ exhausting box; shredder for slicing of fruit and vegetable; liquid filling machine; Autoclaves S.S vessels with lids; micrometer; seam checking gauge; bottle brush washer;
10.	**Produce fruit pulp from various fruits** **Theory Duration** (hh:mm) 15:00 **Practical Duration** (hh:mm) 20:00 **Corresponding NOS Code** FIC/N0122	• Explain the process of pulping fruit Define ripening • Explain fruit ripening process • Demonstrate the process of ripening, sorting, and deseeding fruit • State the procedures used to create the fruit pulp • Demonstrate the process of fruit pulping • State the methods of sterilizing fruit pulp • List the quality control parameters for checking fruit pulp • State the basic categories of packing • State the various types of packaging materials used for packing fruit pulp • State the factors for selecting packaging materials • Explain aseptic packaging in fruit processing industry • Define canning and its purpose • State the process of canning • Demonstrate the canning process of fruit pulp • State the methods for storing raw materials for later use • Explain the process of storing packaged fruit pulp • State the process of maintaining storage conditions • Demonstrate the process of cleaning the work area and machineries after production organizational standards	SOP; pH meter(Digital); Thermometer (Digital); Beakers; Measuring Cylinder; Measuring flask; Brinometer; Salinometer, Hydrometer; Weighing Balance (Digital); Brix Meter/ Refractometer; Deep fridge; refrigerator; Gas burner with cylinder; Fruit tray; Stainless steel mug; Pilfer proof capping machine; Cutting knives; mixer/electric mixer; water tank; fruit slicing machine; sealing machine; Vacuum gauge; pressure gauge; seam checking gauge or screw gauge; pressure cooker; coring Knives; Pitting knives; Juice extractor, crown corking machine; pulper; fruit mill; vacuum pan; mechanical peeler/ batch type of fruit and vegetable peeling; steam jacket kettle; baby boiler/ exhausting box; shredder for slicing of fruit and

Sr. No.	Module	Key Learning Outcomes	Equipment Required
			vegetable; liquid filling machine; Autoclaves S.S vessels with lids; micrometer seam checking gauge; bottle brush washer; protective gloves, head caps, aprons, safety goggles, safety boots, mouth masks, sanitizer, safety manual
11.	**Complete documentation and record keeping** **Theory Duration** (hh:mm) 03:00 **Practical Duration** (hh:mm) 01:00 **Corresponding NOS Code** FIC/N0123	• State the need for documenting and maintaining records of raw materials, processes and finished products • State the method of documenting and recording the details of raw material to final finished product • Document daily records in the ERP system effectively	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook, logbooks, internal audit register, food safety manual, quality policy etc.
12.	**Food Safety, Hygiene and Sanitation** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 04:00 **Corresponding NOS Code** FIC/N9001	State the importance of safety, hygiene and sanitation in the baking industry Follow the industry standards to maintain a safe and hygiene workplace Follow HACCP principles to eliminate food safety hazards in the process and products Follow safety practices in the work area	Laptop, white board, marker, chart papers, projector ,trainer's guide and student handbook, protective gloves, head caps, aprons, safety goggles, safety boots, mouth covers, sanitizer, safety manual ,logbooks etc.
13.	**Professional and Core Skills** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 00:00	Undertake a self-assessment test Identify personal strengths and weaknesses Plan and schedule the work order and manage time effectively to complete the tasks assigned Prevent potential problems from occurring Resolve issues and problems using acquired knowledge and realize the importance of decision making	Laptop, white/black board, marker, chart papers, projector ,Trainer's guide, Student manual

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Corresponding NOS Code	Identify potential problems and make sound and timely decision Improve your reading skills State the importance of listening	
14.	**IT Skills** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 08:00 **Corresponding NOS Code**	Identify parts of the computer Use the computer keyboard effectively to type Use computer applications effectively to record day-to-day activities Use the word processor effectively Use the spreadsheet application effectively Use the computer to document day-to-day activities	Laptop, white/black board, marker, chart papers, projector, Trainer's guide, Student manual
15.	**Field Visits** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 19:00 **Corresponding NOS Code**	Observe the factory location, layout and safety aspects of food processing Observe the storage facilities for raw materials and finished products Observe the various machineries used in pickle processing Observe the various machineries used in pickle processing Observe the cleaning methods and processes followed to maintain the process machineries and tools Observe the raw materials used and their storage procedures Observe the packaging and storage processes of raw material and finished product Observe the post-production cleaning and maintenance process followed in the industry	All the tools and equipment listed above must be available at the site of field visit
16.	**Revision** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 01:00 **Corresponding NOS Code**	Revised the knowledge gained so far	All the tools and equipment listed above must be available at the time of revision
17.	**Evaluation** **Theory Duration** (hh:mm) 08:00	Assess the knowledge and skills acquired by the participants	All the tools and equipment listed above must be available for evaluation

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Practical Duration (hh:mm) 10:00 **Corresponding NOS Code**		
18.	**On-the-job Training** **Theory Duration** (hh:mm) 14:00 **Practical Duration** (hh:mm) 50:00 **Corresponding NOS Code**	Apply the skills and knowledge acquired in the training program in the field	All the tools and equipment listed above must be available on the site at the time of OJT
	Total Duration **240:00** **Theory Duration** **95:00** **Practical Duration** **145:00**	**Unique Equipment Required**: SOP; pH meter(Digital); Thermometer (Digital); Beakers; Measuring Cylinder; Measuring flask; Brinometer; Salinometer, Hydrometer; Weighing Balance (Digital); Brix Meter/ Refractometer; Deep fridge; refrigerator; Gas burner with cylinder; Fruit tray; Stainless steel mug; Pilfer proof capping machine; Cutting knives; mixer/electric mixer; water tank; fruit slicing machine; sealing machine; Vacuum gauge; pressure gauge; seam checking gauge or screw gauge; pressure cooker; coring Knives; Pitting knives; Juice extractor, crown corking machine; pulper; fruit mill; vacuum pan; mechanical peeler/ batch type of fruit and vegetable peeling; steam jacket kettle; baby boiler/ exhausting box; shredder for slicing of fruit and vegetable; liquid filling machine; Autoclaves S.S vessels with lids; micrometer seam checking gauge; bottle brush washer	

Grand Total Course Duration: **240Hours, 0 Minutes**

*(This syllabus/ curriculum has been approved by **SSC: Food Industry Capacity and Skill Initiative**)*

Trainer Prerequisites for Job role: "Fruit Pulp Processing Technician" mapped to Qualification Pack: "FIC/Q0106, v1.0"

Sr. No.	Area	Details
1	**Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack "FIC/Q0106", Version 1.0
2	**Personal Attributes**	An aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training, and pre/post work to ensure competent, employable candidates at the end of the training. Strong communication skills, ability to work as part of a team; a passion for quality and for developing others; well-organized and focused, eager to learn and keep oneself updated with the latest in the mentioned fields.
3	**Minimum Educational Qualifications**	• B.Sc/B.Tech/BE in Food Technology or Food Engineering with 2-3 years of hand on experience in a Pulping Unit or Fruits/Vegetables Processing Unit.
4a	**Domain Certification**	Certified for Job Role: "Fruit Pulp Processing Technician" mapped to QP: "FIC/Q0106, v1.0". Minimum accepted score is 80%
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer", mapped to the Qualification Pack: "SSC/Q1402". Minimum accepted SCORE IS 80 % as per FICSI guidelines.
5	**Experience**	• B.Sc/B.Tech/BE in Food Technology or Food Engineering with 2-3 years of hand on experience in a Pulping Unit or Fruits/Vegetables Processing Unit.

Annexure: Assessment Criteria

Assessment Criteria	
Job Role	Fruit Pulp Processing Technician
Qualification Pack	FIC/Q0106, v1.0
Sector Skill Council	Food Processing

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2	The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre(as per assessment criteria below)
4	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training canter based on this criteria
5	To pass the Qualification Pack, every trainee should score a minimum of 70% (overall) in every QP
6	The marks are allocated PC wise; however, every NOS will carry a weight age in the total marks allocated to the specific QP

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
1. FIC/Q0120: Prepare and maintain work area and process machineries for pulp processing	PC.1 Prepare, clean and maintain the cleanliness of the work area using approved sanitizers and keep it free from dust, waste, flies and pests	**100**	25	10	15
	PC2. Ensure that the work area is safe and hygienic for food		10	3	7
	PC3. Dispose waste materials as per defined SOPs and industry requirements		15	5	10
	PC4. Check the working and performance of all machineries and tools used for the pickle making process such as washer, peeler, vegetable cutter/slicer, blender, packaging machines etc.		15	5	10
	PC5. Clean the machineries and tools used with approved sanitizers following SOP		15	5	10
	PC6. Place the necessary tools required for process		5	2	3
	PC7. Attend the minor repairs/ faults of all machines, if required		15	5	10
	Total		**100**	**35**	**65**
2. FIC/Q0121: Prepare for production of fruit pulp	PC1. Read and understand the production order from supervisor	**100**	10	4	6
	PC2. Check the availability of raw materials, packaging materials , equipment availability and manpower		5	2	3
	PC3. Support in planning production sequence		15	5	10
	PC4. Calculate the batch size based on the production order and machine capacity		5	2	3
	PC5. Calculate the raw material requirement (considering the process loss) to produce the required quantity of finished		5	2	3
	PC6. Calculate the raw materials, packaging materials and manpower requirement for completing the order.		5	2	3
	PC7. Ensure the working and performance of each equipment required for the process		7	2	5
	PC8. Calculate the process time for effective utilization of machineries		7	2	5
	PC9. Plan batch size considering full capacity utilization of machineries		3	1	2
	PC10. Plan to utilize machineries for multiple products without affecting the quality of		3	1	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	the finished products, and to optimize production and save energy				
	PC11.Allot responsibilities and help to assistants and workers		5	1.5	3.5
	PC12. Refer the process chart for products produced		3	1	2
	PC13. Weigh the raw materials required for the batch		3	1	2
	PC14.Check the conformance of raw material quality to organization standards, through physical analysis and by referring the quality analysis report from the supplier/ internal lab analysis report		10	4	6
	PC15. Sharpen cutter blades and change the cutter/slicer blades		2	0.5	1.5
	PC16. Fix, change, clean filters and sieves of processing machinerie		5	2	3
	PC17. Ensure working and performance of required machines and tools.		5	1	4
	PC18. Keep the tools assessable to repair in case of faults/ breakdown		2	0.5	1.5
	Total		**100**	**35**	**65**
3. FIC/Q0122: Produce fruit pulp from various fruits	PC1. Receive fruits from the supplier/vendor and check weight	**100**	1	0.5	0.5
	PC2. Check quality through physical parameters such as appearance, color, texture, maturity		1	0.5	0.5
	PC3. Load fruits in fruit ripening chamber, adjust controls to set required temperature, time, relative humidity to pre-cool the fruit, monitor temperature to ensure the fruit is cooled to required temperature		3	1	2
	PC4. Open and control the regulator of the ethylene generator or use PLC to introduce ethylene into the chamber to initiate ripening of fruit, monitor air circulation system for uniform ethylene flow for specified period, adjust controlling system to maintain required temperature, relative humidity, etc. for specified period, adjust ventilation system at periodic interval by controlling the speed of exhaust fan to remove carbon-di-oxide		3	1	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC5. Open ripening chamber after specified period, start fan to ventilate ethylene gas, stop fan after ventilation, unload the ripened fruit from the ripening chamber, check the quality of ripened fruit and transfer to processing area		2	0.5	1.5
	PC6. Open valves or start pump to fill water in washing tank and control water level, dump fruits into the washing tank for washing		2	0.5	1.5
	PC7. Switch on agitator of revolving screens/blades to immerse each fruit into water to remove dirt, soil, etc		2	0.5	1.5
	PC8. Start the ladder conveyor to lift fruits from the washing tank and transfer to the washing line conveyor		2	0.5	1.5
	PC9. Open valves of the high pressure spraying system for fresh water and adjust pressure to spray water on fruits for rinsing		2	0.5	1.5
	PC10. Adjust controls to transfer washed fruit to sorting/inspecting line, start and adjust speed of sorting/inspecting line conveyor to visually inspect and manually remove damaged, blemished and rotten fruits		2	0.5	1.5
	PC11. Dump sorted fruits in the peeler or corer (depending on the type of fruits), start machine , adjust speed to remove the peel or core of fruits (or) turn valves to introduce steam and adjust controls to maintain pressure for steam peeling		3	1	2
	PC12. Open valve or pump water or open spraying system to wash peeled fruits, observe fruits emerging from peeling /coring machine to ensure removal of peel/core		2	0.5	1.5
	PC13. Cut fruits manually (or) load the fruits in the chopper/cutter/slicer machine, adjust controls to cut fruits to required size, start machine, collect sliced fruits from the discharge chute		2	0.5	1.5
	PC14. In case of mangoes, start conveyor and control speed to allow washed mangoes to pass through mango tip cutting line, cut the mango tip manually, control conveyor speed to dump the tip cut mangoes into		2	0.5	1.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	destoner machine to remove seed and peel				
	PC15.Control speed of waste disposal conveyor to dispose waste following sop		1	0.5	0.5
	PC16.Adjust and maintain speed of pulper conveyor to allow fruits to pass through the pulper cum finisher/ pulper refiner machine for pulping fruits and sieving pulp to required fineness, adjust position of discharge outlet to collect refined pulp in collection tank, check collected pulp to ensure it is free from seeds and fiber		8	3	5
	PC17. Replace damaged or clogged filter screen of pulper cum finisher/ pulper refiner machine		2	0.5	1.5
	PC18.Start pump to transfer measured quantity of pulp from collection tank to steam jacketed kettle/ pre-cooking tank for cooking pulp, check pumped quantity through the level indicator and glass windows of the pre-cooking tank, adjust controls to set pressure, temperature, cooking time, stirrer speed, etc., open valve to allow steam to pass though kettle for pre-cooking/ pre-heating pulp to required temperature, examine pre-cooked fruits through feel/texture		8	3	5
	PC19. Open valves to allow pre-cooked pulp to pass through de-canter machine to remove black specks, set control of the machine such as speed of screw conveyor in machine and speed/ rotation and start machine to remove black specks (in case of mango)		5	2	3
	PC20.Collect the pre-cooked pulp in the collection tank/ holding tank, sample pulp and transfer to quality lab for analysis and conformance to organisation standards		2	0.5	1.5
	PC21. Set controls of de-aerator machine to remove air from pulp for extended shelf-life,startmachine, open valves/start pump to transfer measured quantity of pre-cooked pulp into de-aeration tank to de-aerate pulp		5	2	3

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC22. Set controls of evaporator like flow rate of pulp, temperature, residence time etc to concentrate pulp (for processing concentrated pulp), switch on machine to transfer measured quantity of de-aerated pulp into continuous evaporator for concentrating pulp		5	2	3
	PC23. Open valves/start pump to transfer measured quantity of precooked(or)de-aerated and concentrated pulp into sterilization tank to sterilize pulp before aseptic packing, adjust controls to set temperature, pressure, time, etc. and open valves to allow steam to pass through sterilization tank, switch on machine to start sterilization, observe through glass windows of the sterilization tank, monitor and maintain steam pressure by adjusting gauges to sterilize fruit pulp to organisation standards		4	1	3
	PC24. Set controls to allow the sterilized pulp to pass to the aseptic surge tank for filling, maintain temperature of product surge tank until filling, set controls of the product filler of aseptic filling machine for filling volume, pressure, temperature, etc		4	1	3
	PC25. Place plastic liners in the container (drums, cartons etc), date code aseptic bags with details like date of manufacture, date of expiry etc and place inside the liner for filling pulp, start conveyor and control speed to move the drum with aseptic bags under the aseptic (product) filling machine		2	1	1
	PC26. Fix the spout of the aseptic bag to the filling nozzle of the machine, set controls like pressure, temperature, filling volume etc and start machine to fill hot sterile product and automatically seal/ close with sterile closures		2	0.5	1.5
	PC27. Start conveyor to move the container with filled aseptic bags to the weighing area, check the weight of the container, label the container with details like batch number, date of manufacture, date of expiry, volume/weight etc		2	0.5	1.5
	PC28. Cover the aseptic bags with liner, place lid on drums, close and seal lid,		1	0.5	0.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	transfer to the storage area and store by maintaining storage conditions and following SOP				
	PC29. Operate can reformer, flanger, seamer, can body beader and embossing machines to form cans		1	0.5	0.5
	PC30. Press button to activate machine-lift that raises stacked cans and transfers them onto mechanical conveyor (in mechanical units), observe passing cans and remove defective/ damaged cans from conveyor and discard following SOP		1	0.5	0.5
	PC31. Start machine that automatically feeds empty cans onto conveyors leading to washing, filling and sealing machines (or) set controls like temperature, pressure, conveyor speed of empty can machine, place empty cans in the conveyor and start machine to sterilize cans, collect sterilized cans from other end of the conveyor and transfer to the filling machine		1	0.5	0.5
	PC32. Start conveyor to allow sterilized cans to pass through the filling line (or) place sterilized cans manually in the filling line conveyor		1	0.5	0.5
	PC33. Start pump to fill pre-cooked/preheated pulp into the filling tank, set temperature, volume etc and start machine to fill pulp in cans, control speed of conveyor to transfer filled cans to the can seaming machine (or) manually place lid over the filled cans and seal in cans in can seamer machine		2	0.5	1.5
	PC34. Load the canned product manually in metal baskets, start motor to lower the basket with cans in lager tank with hot water, allow steam to pass through tank to heat continuously to sterilize can to specified temperature and time, mechanically lift basket with sterilised cans from hot water tank and place in cold water tank, open valves to circulate cold water in tanks to cool cans, dry cans manually		2	1	1

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	PC35. Load the canned product into the retort manually or mechanically through push trucks, close retort door or lid, and turn wheels or moves levers to seal chamber, adjust controls to set pressure, temperature and time of the retort chamber to sterilize canned product following sop		2	0.5	1.5
	PC36. Set process parameters like pressure, temperature, sterilization time etc in the retort following SOP, turns valves to admit steam to retort, observe dials and gauges and adjust controls to maintain process parameters, turn valves to release steam and allow cool water into chamber to prevent overcooking		1	0.5	0.5
	PC37. Open retort and move the canned product to the cooling line conveyor, open valves of the water spraying system and adjust pressure to spray cold water on cans passing though cooling line conveyor, transfer cooled cans to drying line conveyor and start conveyor, set and control temperature and air flow to dry adhering water from the cooled cans		2	1	1
	PC38. Load labels in the packaging machine and set date coding machine for batch number, date of manufacture, date of expiry etc, start labeling machine and date codling machine to label and date code cans, sample canned product and transfer to quality lab for analysis, pack labeled cans into cartons and transfer to storage area and store maintaining storage conditions following SOP		1	0.5	0.5
	PC39. Report discrepancies/concerns to department supervisor for immediate action		1	0.5	0.5
	PC40.Clean the work area, machineries, equipment and tools using recommended cleaning agents and sanitizers		2	0.5	1.5
	PC4. Attend minor repairs/faults of all machines (if any)		1	0.5	0.5
	PC42. Ensure periodic (daily/weekly/monthly/quarterly/half yearly/annual) maintenance of all machines		1	0.5	0.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	and equipment following the SOP or following suppliers instructions/manuals				
	Total		**100**	**35**	**65**
4. FIC/Q0123: Complete documentation and record keeping related to production of fruit pulp	PC1. Document and maintain records of details of raw materials and packaging materials as per organizational standards	**100**	10	6	4
	PC2. Document and maintain record on observations (if any) related to raw materials and packaging materials		5	3	2
	PC3. Load the raw material details in ERP for future reference		5	3	2
	PC4. Verify the documents and track from finished products to raw materials, in case of quality concerns and during quality management system audits		5	3	2
	PC5. Document and maintain records of production plan with details		10	6	4
	PC6. Document and maintain records of process details for entire production in process chart or production log for all products produced		15	9	6
	PC7. Document and maintain records of batch size, production yield, wastage of raw materials, energy utilization and final product produced		10	6	4
	PC8. Document and maintain record of observations or deviations		5	3	2
	PC9. Load the production plan and process details in ERP for future reference		5	3	2
	PC10. Verify documents and track from finished product to ingredients, in case of quality concerns and for quality management system audit		5	3	2
	PC11. Document and maintain records of finished products		3	2	1
	PC12. Document and maintain records of the finished product details as per organizational standards		7	4	3
	PC13. Document and maintain record on observations or deviations related to finished products		5	3	2
	PC14. Load the finished product details in ERP for future reference		5	3	2
	PC15. Verify the documents and track from finished product to ingredients, in case of quality concerns and for quality management system audits		5	3	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	Total		**100**	**60**	**40**
5. FIC/N9001: Food Safety, hygiene and sanitation for processing food products	PC1. Comply with food safety and hygiene procedures followed in the organization	**100**	5	2	3
	PC2. Ensure personal hygiene by use of gloves, masks ,hair net, ear plugs, boots etc.		6	1	5
	PC3. Ensure hygienic production of food by inspecting raw materials, ingredients, finished products etc for compliance to physical, chemical and microbiological procedures		5	2	3
	PC4. Pack products in appropriate packaging material, label and store them in designated area free from pests, flies etc.		10	4	6
	PC5. Clean, maintain and monitor food processing equipments periodically, using it only for the specified purpose		5	2	3
	PC6. Use safety equipment such as fire extinguisher, eye wash unit, first aid kit when required		10	4	6
	PC7. Follow housekeeping practices by having designated area for machines/tools		5	2	3
	PC8. Follow industry standards like GMP, HACCP and product recall		10	4	6
	PC9. Attend training on hazard management to understand type of physical, chemical and microbiological hazards		5	1	4
	PC10. Identify, document and report problems such as rodents and pests to management		5	1	4
	PC11. Conduct workplace checklist audit before and after work to ensure safety and hygiene		5	1	4
	PC12. Document and maintain raw material, process, packaging material to maintain the effectiveness of quality system		4	1	3
	PC13. Determine the quality of food using criteria such as odor, color, taste and best before date and take immediate measures to prevent spoilage		5	2	3
	PC14. Store raw materials, finished products and allergens separately to prevent cross contamination		5	2	3

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC15. Label raw materials and finished products and store them in different storage areas according to safe food practices		5	2	3
	PC16.Follow stock rotation based on FEFO/FIFO		10	4	6
	Total		**100**	**35**	**65**
	Grand Total	**500**	**500**	**300**	**200**
	Percentage Weightage		**100**	**60%**	**40%**
	Minimum Pass% to qualify (aggregate):			**70%**	

Model Curriculum

Supervisor-Fruits and Vegetables Processing

SECTOR: FOOD PROCESSING
SUB-SECTOR: FRUITS & VEGETABLES
OCCUPATION: PROCESSING
REF ID: FIC/Q0109, V1.0
NSQF LEVEL: 5

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY AND SKILL INITIATIVE (FICSI)

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Supervisor-Fruits and Vegetables Processing**' QP No. '**FIC/Q0109, NSQF Level 5**'

Date of Issuance: 19 April, 2018
Valid up to: 30 June, 2019

* Valid up to the next review date of the Qualification Pack

S.S. Arya

Authorised Signatory
(Food Industry Capacity and Skill Initiative)

TABLE OF CONTENTS

Supervisor-Fruits and Vegetables Processing

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of a "Supervisor-Fruits and Vegetables processing", in the "Food Processing" Sector/Industry and aims at building the following key competencies amongst the learner

Program Name	**Supervisor-Fruits and Vegetables Processing**		
Qualification Pack Name & Reference ID. ID	FIC/Q0109, v1.0		
Version No.	1.0	**Version Update Date**	01/08/2018
Pre-requisites to Training	Preferably Class 12 and 2 years' experience in fruit and vegetable processing unit		
Training Outcomes	**After completing this programme, participants will be able to:** • ensure preparation of work area and process machineries for fruit & vegetable processing, • execute production planning of fruits & vegetable processing, • supervise and coordinate activities of workers engaged in production of fruits & vegetable products, • perform documentation and record keeping of raw material, ingredients and the finished good, • apply sanitation and hygiene practices in the work environment, • manage and lead the team.		

This course encompasses 6 out of 6 National Occupational Standards (NOS) of "Supervisor-Fruits and Vegetables Processing" Qualification Pack issued by "Food Industry Capacity and Skill Initiative".

Sr. No.	Module	Key Learning Outcomes	Equipment Required
1	**Introduction to Training Program and Overview of Food Processing Industry** **Theory Duration** (hh:mm) 07:00 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code** Bridge Module	• Define food processing • List the various sub sectors of food processing industry • Define fruits and vegetables Processing • List the various units within a fruits and vegetables processing industry • State the roles and responsibilities of supervisor-fruits and vegetables processing	
2	**Organizational Standards and Norms** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 10:00 **Corresponding NOS Code** Bridge Module	• State the roles and responsibilities of a Supervisor-fruits and vegetables processing • State how to conduct yourself at the workplace • State the personal hygiene and sanitation guidelines • State the food safety hygiene standards to follow in a work environment	Protective Gloves, Head Caps, Lab Coat, Safety Goggles, Safety Boots, Mouth Masks, Sanitizer, Food Safety Manual
3	**Ensure Preparation and Maintenance of Work Area and Process Machineries for Production of Fruit and Vegetable Products** **Theory Duration** (hh:mm) 10:00 **Practical Duration** (hh:mm) 20:00	• Check if the work area is cleaned using approved sanitizers • Describe the importance of cleanliness of the work area • Check if the work area is safe and hygienic for food production • Check the working and performance of all machineries and tools used for fruits and vegetables processing • Check if the equipment are washed with approved sanitizers • Check if the disposal of waste material is as per SOP	Fruit Washer, Peeler, Fruit Pulper , Juice Extractor, Clarifier, Filter, Pasteurizer, Steam Jacketed Kettles, Packaging Machines, Protective Gloves, Head Caps, Lab Coat, Safety Goggles, Safety Boots, Mouth Masks, Sanitizer, Food Safety Manual

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Corresponding NOS Code FIC/N0131		
4.	**Execute production planning of Fruit and Vegetable Products** **Theory Duration** (hh:mm) 10:00 **Practical Duration** (hh:mm) 20:00 **Corresponding NOS Code** FIC/N0132	• Perform the grouping of ingredients for same type of products • Plan production sequence • Demonstrate the allotting of responsibilities • Perform calculation for raw material requirement • Perform a check on the availability of raw material, ingredients and packaging materials	Fruit Washer, Peeler, Fruit Pulper , Juice Extractor, Clarifier, Filter, Pasteurizer, Steam Jacketed Kettles, Packaging Machines, Protective Gloves, Head Caps, Lab Coat, Safety Goggles, Safety Boots, Mouth Masks, Sanitizer, Food Safety Manual
5.	**Supervise Production of Fruit and Vegetable Products** **Theory Duration** (hh:mm) 15:00 **Practical Duration** (hh:mm) 40:00 **Corresponding NOS Code** FIC/N0133	• Perform a check if all the machineries are clean and in good working conditions • Demonstrate assembling of all components of machines • Perform a pre check on all machineries • Review of the production order • Check if the production area is clean for processing of fruits and vegetables • Check the quality report of fruits and vegetables to ensure conformance to the industry standards • Demonstrate the monitoring of control panel of each fruits and vegetables processing machinery • Co-ordinate with the maintenance team and ensure machine breakdowns are attended • Check for timely production of the food product • Complete all the documents related to production and pass them on to manager • Demonstrate cleaning the machineries used with recommended sanitizers following CIP (clean-in-place) procedure • Demonstrate cleaning the equipment and tools used using recommended cleaning agents and sanitizers	Fruit Washer, Peeler, Fruit Pulper , Juice Extractor, Clarifier, Filter, Pasteurizer, Steam Jacketed Kettles, Packaging Machines, Protective Gloves, Head Caps, Lab Coat, Safety Goggles, Safety Boots, Mouth Masks, Sanitizer, Food Safety Manual
6.	**Complete Documentation and Record Keeping**	• State the need for documenting and maintaining records of raw materials, processes and finished products • State the method of documenting and	Food Safety Manual, Log Books.

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Related to Packaging Food Products **Theory Duration** (hh:mm) 06:00 **Practical Duration** (hh:mm) 05:00 **Corresponding NOS Code** FIC/N0134	recording the details of raw material to final finished product • Demonstrate the process of documenting records of production plan, process parameters, and finished products	
7.	**Food Safety, Hygiene and Sanitation for Packaging Food Products** **Theory Duration** (hh:mm) 10:00 **Practical Duration** (hh:mm) 35:00 **Corresponding NOS Code** FIC/N9001	• State the importance of safety, hygiene and sanitation in the baking industry • Apply the industry standards to maintain a safe and hygiene workplace • Apply HACCP principles to eliminate food safety hazards in the process and products • Apply safety practices in the work area	Protective Gloves, Head Caps, Aprons, Safety Goggles, Safety Boots, Mouth Covers, Sanitizer, Food Safety Manual ,Log Books etc.
8.	**Leadership Skills** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 10:00 **Corresponding NOS Code** FIC/N9004	• Perform a check if the team is aware about the schedule and expectations from them • Conduct regular meetings with the team members • Tell the team member to participate in various activities organized by the organization • Demonstrate counselling of team members • Conduct training of team members • Provide feedback to the team members	Computer/Laptop, Log Books
9.	**Professional and Core Skills** **Theory Duration** (hh:mm) 04:00	• Plan a general aptitude self-assessment test • Identify personal strengths and weaknesses • Plan and schedule the work order	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Practical Duration (hh:mm) 10:00 **Corresponding NOS Code** Bridge Module	• Manage time effectively to complete the tasks assigned • Identify and resolve potential problems and take preventive measure to prevent it • State the importance of decision making • State the importance of listening	
10.	**IT Skills** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 15:00 **Corresponding NOS Code** Bridge Module	• Identify parts of the computer • Use the computer keyboard effectively to type • Use computer applications effectively to record day-to-day activities • Use the word processor effectively • Use the spreadsheet application effectively • Use the computer to document day-to-day activities	Computer/Laptop
	Total Duration 240:00 **Theory Duration 75:00** **Practical Duration 165:00**	**Unique Equipment Required**: Fruit Washer, Peeler, Fruit Pulper , Juice Extractor, Clarifier, Filter, Pasteurizer, Steam Jacketed Kettles, Packaging Machines, Protective Gloves, Head Caps, Lab Coat, Safety Goggles, Safety Boots, Mouth Masks, Sanitizer, Food Safety Manual, Log Books, Computer/Laptop	

Grand Total Course Duration: **240Hours, 0 Minutes**
Recommend OJT Hours: **60Hours, 0 Minutes**

(This syllabus/ curriculum has been approved by ***SSC: Food Industry Capacity and Skill Initiative)***

Trainer Prerequisites for Job role: "Supervisor- Fruits and Vegetables Processing" mapped to Qualification Pack: "FIC/Q0109, v1.0"

Sr. No.	Area	Details
1	**Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack "FIC/Q0109", Version 1.0
2	**Personal Attributes**	An aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training, and pre/post work to ensure competent, employable candidates at the end of the training. Strong communication skills, ability to work as part of a team; a passion for quality and for developing others; well-organized and focused, eager to learn and keep oneself updated with the latest in the mentioned fields.
3	**Minimum Educational Qualifications**	• B.Sc/B.Tech/BE in Food Technology or Food Engineering with 2-3 years of hands on experience in a Fruits/Vegetables Unit • M.Sc/M.Tech/ME in Food Technology or Food Engineering with 1-2 years of hands on experience in a Fruits/Vegetables Unit
4a	**Domain Certification**	Certified for Job Role: "Supervisor-Fruits & Vegetables Processing" mapped to QP: "FIC/Q0109, v1.0". Minimum accepted score is 80%
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer", mapped to the Qualification Pack: "MEP/Q0102". Minimum accepted score is 80 % as per FICSI guidelines.
5	**Experience**	• B.Sc/B.Tech/BE in Food Technology or Food Engineering with 2-3 years of hands on experience in a Fruits/Vegetables Unit • M.Sc/M.Tech/ME in Food Technology or Food Engineering with 1-2 years of hands on experience in a Fruits/Vegetables Unit

Annexure: Assessment Criteria

Assessment Criteria	
Job Role	Supervisor-Fruits and Vegetables Processing
Qualification Pack	FIC/Q0109, v1.0
Sector Skill Council	Food Processing

Guidelines for Assessment

1 Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC
2. The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3. Assessment will be conducted for all compulsory NOS, as well as the selected elective NOS/set of NOS.
OR
4. Assessment will be conducted for all compulsory NOS, as well as the selected optional NOS/set of NOS.
5. Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training center (as per assessment criteria below)
6. Individual assessment agencies will create unique evaulations for skill practical for every student at each examination/training center based on this criteria
7. To pass the Qualification Pack , every trainee should score a minimum of 70% of aggregate marks to successfully clear the assessment.
8. In case of unsuccessful completion, the trainee may seek reassessment on the Qualification Pack

Total Marks: 600	Compulsory NOS				
Assessable outcomes	**Assessment criteria for outcomes**	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
1. FIC/N0131: Prepare and maintain work area and process machineries for production of fruits & vegetables	PC.1 ensure work area is cleaned using approved sanitizers and cleanliness is maintained to keep it free from dust, waste, flies and pests	**100**	15	5	10
	PC2. Ensure that the work area is safe and hygienic for food processing		20	8	12
	PC3. ensure disposal of waste materials as per defined SOPs and industry requirements		15	6	9
	PC4. ensure the working and performance of all machineries and tools used for production of fruits and vegetable products like washer, peeler, slicer, pulper, pasteurizer, drier,refractometer, salinometer, double jacketed kettle, juice extractor, clarifier, evaporator, retort, packaging machines etc.		20	8	12
	PC5. ensure machineries and tools are cleaned using recommended sanitizers following the SOP		10	4	6
	PC6. ensure tools required for process are placed accessible, to use when necessary		5	1	4
	PC7. ensure minor repairs/ faults of all machines are attended		15	3	12
			100	**35**	**65**
2. FIC/N0132: execute production planning of fruits & vegetable products	PC1. plan production sequence by • grouping products of same type (varieties of juices, pulps, jams, pickles etc) • using same equipment and machinery for various products such that one product does not impact the quality of the other • planning maximum capacity utilization of machineries • considering the process time for each product • planning efficient utilization of resources/manpower • prioritizing urgent orders		27	10	17
	PC2. calculate the batch size based on the production order and machine capacity		7	2	5
	PC3. calculate lead time for production of various products planned		11	3	8
	PC4. prepare shift schedule for assistants/technicians		5	2	3
	PC5. allot responsibilities work to the assistants/technicians and helpers		5	2	3
	PC6. calculate the raw material requirement		5	2	3

Total Marks: 600	Compulsory NOS				
Assessable outcomes	Assessment criteria for outcomes	Total Marks	Out Of	Theory	Skills Practical
	(considering the process loss) to produce finished product(s) as per production order				
	PC7. calculate the raw materials, packaging materials and manpower requirement for completing the order		5	2	3
	PC8. check the availability of raw materials, packaging materials, equipment and manpower		9	3	6
	PC9. prepare indent for issue of raw materials and packaging materials from store		3	1	2
	PC10. ensure transfer of raw materials and packaging materials from store production and packaging area through helpers		2	0.5	1.5
	PC11. ensure checking the weight of raw materials and packaging materials received from store and check its conformance of quality to organisation standards through physical parameters like appearance, colour, texture etc		8	2.5	5.5
	PC12. verify quality documents from supplier and internal lab to ensure its conformance to standards		9	4	5
	PC13. ensure raw materials (including ingredients, additives, preservatives etc) for the batch are weighed accurately following the formulations		4	2	2
			100	**35**	**65**
3. FIC/N0133: Supervise production of fruit and vegetable products	PC1. check and ensure cleanliness and sterilization of all fruit and vegetable processing machineries like washer, peeler, slicer, pulper, drier, juice extractor, juice clarifier, evaporator, retort, pasteurizer, steam jacketed kettle, packaging machines etc	**100**	2	0.5	1.5
	PC2.check and ensure maintenance has been carried out on all fruit and vegetable processing machineries and equipments		2	0.5	1.5
	PC3.check and ensure all process machineries are clean and in good mechanical condition		2	0.5	1.5
	PC4. check assembling of fittings like stirrer, blades, pipes and other parts to equipment and ensure all machineries are ready for production		5	0.5	4.5
	PC5. start each process machineries and ensure its working and performance and check if required tools are kept accessible to attend repairs/faults in case of breakdown		2	0.5	1.5

Total Marks: 600	Compulsory NOS				
Assessable outcomes	Assessment criteria for outcomes	Total Marks	Out Of	Theory	Skills Practical
	PC6. review production orders or schedules to ascertain product details such as type of products to be produced, quantities, specifications of products and scheduled delivery dates in order to plan production operation		2	1	1
	PC7. check and ensure production area is safe and clean		2	0	2
	PC8. verify the quality report on raw materials to ensure its conformance to quality standards		2	1	1
	PC9. monitor control panel of each fruit and vegetable processing machinery and ensure applicable process parameters like temperature, pressure, time etc (as applicable) are set in accordance with standards for production of various fruit and vegetable products		3	1	2
	PC10. observe control points and equipments at regular intervals to ensure operational performance and optimum utilization		3	1	2
	PC11. stop production following stop procedure, in case of machine breakdowns during production		3	1	2
	PC12. co-ordinate with maintenance team and ensure machine breakdowns are attended to immediately in order to prevent operational delays		3	1	2
	PC13. suggest control measures and corrective actions for any problems related to production, process and products, if required consult with manager and resolve problems		4	1.5	2.5
	PC14. ensure product quality by establishing and enforcing organization standards in each stage of production process		3	1	2
	PC15. monitor packaging of finished products, perform random check on weight of packed products, check label details like date of manufacture, batch number, expiry date etc and ensure products are packed as per organisation and regulatory standards		4	1.5	2.5
	PC16. monitor production activities, coordinate with cross function team and ensure production is started and completed as scheduled		4	1.5	2.5
	PC17. ensure timely production with minimum or no wastage, and quality of products		4	1.5	2.5

Total Marks: 600	Compulsory NOS				
Assessable outcomes	**Assessment criteria for outcomes**	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
	produced meets organisation and regulatory standards				
	PC18. analyze production performance records and data, investigate issues related to fruit and vegetable products processing, discuss with manger and identify solutions to prevent/correct problems, and ensure to implement suggested corrective action		4	1.5	2.5
	PC19. evaluate new equipment and techniques while producing new products and on installation of new machineries		4	2	2
	PC20. maintain safe and clean work environment by educating team on procedures to maintain compliance		3	1.5	1.5
	PC21. monitor activities and performance of assistants, technicians, operators and helpers		7	3	4
	PC22. provide production information to the manager by compiling, sorting, and analysing production performance records of all shifts		4	1.5	2.5
	PC23. update manager on day-to-day activities, discuss problem, suggest or understand suggested preventive and corrective action, and implement corrective actions immediately		4	1	3
	PC24. update manager on day-to-day activities, discuss problem, suggest or understand suggested preventive and corrective action, and implement corrective actions immediately		6	2	4
	PC25. monitor cleaning of work area, equipments and tools using recommended cleaning agents and sanitizers		8	3	5
	PC26. ensure minor repairs/faults (if any) of all components and machines are attended to before the start of next production		4	1	3
	PC27. ensure periodic (daily/weekly/monthly/quarterly/half yearly/annual) maintenance of all machines and equipment following the sop or following suppliers instructions/manuals		6	3	3
			100	**35**	**65**
4. FIC/N0134: Complete documentation	PC1. Document and maintain records of details of raw materials type and variety, grown area, grown season, quantity,	**100**	10	6	4

Total Marks: 600	Compulsory NOS				
Assessable outcomes	**Assessment criteria for outcomes**	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
and record keeping related to production of fruit and vegetable products	vendor/supplier details, date of manufacture, expiry date, quality report from supplier and internal lab etc. as per organisation standards				
	PC2. Document and maintain record on observations (if any) related to raw materials and packaging materials		5	3	2
	PC3. Load the raw material details in ERP for future reference		5	3	2
	PC4. Verify the documents and track from finished products to raw materials, in case of quality concerns and during quality management system audits		5	3	2
	PC5. Document and maintain records of production plan with details such as product details, production sequence, equipments and machinery details, efficiency and capacity utilization of equipment		10	6	4
	PC6. Document and maintain records of process details for entire production in process chart or production log for all products produced		15	9	6
	PC7.Document and maintain records of batch size, production yield, wastage of raw materials, energy utilization and final product produced		10	6	4
	PC8. Document and maintain record of observations or deviations (if any) or deviations related to process and production		5	3	2
	PC9. Load the production plan and process details in ERP for future reference		5	3	2
	PC10.Verify documents and track from finished product to ingredients, in case of quality concerns and for quality management system audit		5	3	2
	PC11.Document and maintain records of finished products		3	2	1
	PC12. Document and maintain records of the finished product details as per organizational standards		7	4	3
	PC13. Document and maintain record on observations or deviations related to finished products		5	3	2
	PC14. Load the finished product details in ERP for future reference		5	3	2

Total Marks: 600	Compulsory NOS				
Assessable outcomes	**Assessment criteria for outcomes**	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
	PC15.Verify the documents and track from finished product to ingredients, in case of quality concerns and for quality management system audits		5	3	2
			100	**60**	**40**
5. FIC/N9001: Food Safety, hygiene and sanitation for processing food products	PC1. Comply with food safety and hygiene procedures followed in the organization	**100**	5	2	3
	PC2. Ensure personal hygiene by use of gloves, masks ,hair net, ear plugs, boots etc.		6	1	5
	PC3. Ensure hygienic production of food by inspecting raw materials, ingredients, finished products etc for compliance to physical, chemical and microbiological procedures		5	2	3
	PC4. Pack products in appropriate packaging material, label and store them in designated area free from pests, flies etc.		10	4	6
	PC5. Clean, maintain and monitor food processing equipments periodically, using it only for the specified purpose		5	2	3
	PC6. Use safety equipment such as fire extinguisher, eye wash unit, first aid kit when required		10	4	6
	PC7. Follow housekeeping practices by having designated area for machines/tools		5	2	3
	PC8. Follow industry standards like GMP, HACCP and product recall		10	4	6
	PC9. Attend training on hazard management to understand type of physical, chemical and microbiological hazards		5	1	4
	PC10. Identify, document and report problems such as rodents and pests to management		5	1	4
	PC11.Conduct workplace checklist audit before and after work to ensure safety and hygiene		5	1	4
	PC12.Document and maintain raw material, process, packaging material to maintain the effectiveness of quality system		4	1	3
	PC13.Determine the quality of food using criteria such as odor, color, taste and best before date and take immediate measures to prevent spoilage		5	2	3
	PC14.Store raw materials, finished products and allergens separately to prevent cross contamination		5	2	3
	PC15.Label raw materials and finished products and store them in different storage areas according to safe food practices		5	2	3

Total Marks: 600	Compulsory NOS				
Assessable outcomes	**Assessment criteria for outcomes**	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
	PC16.Follow stock rotation based on FEFO/FIFO		10	4	6
			100	**35**	**65**
6. FIC/N9004 (Manage and lead a team)	PC1. ensure that the team is aware of the schedule and job expectations on a daily basis		12	4	8
	PC2. involve the team in regular meetings to communicate information intended for them		12	4	8
	PC3. ensure communication to the team on any changes in policies/ processes by the organization through required verbal/ written mechanisms		12	4	8
	PC4. ensure participation of the team in various engagement initiatives organized by the organization		8	2	6
	PC5. counsel and address issues among the team for any work related issues		12	4	8
	PC6. support the manager in deployment of the team as per production schedule and the organizational norms and guidelines		6	2	4
	PC7. ensure periodic training of the team and support the team by delivering trainings		6	3	3
	PC8. share knowledge of processes, techniques and products with the team to enhance their skill levels		6	3	4
	PC9. provide feedback to the manager pertaining to performance of the team		6	3	3
	PC10. motivate workers, initiate and develop cooperation within and between departments, develop personal growth opportunities		4	1	3
	PC11. maintain effective supervisor-worker relations, create safe work environment, establish effective communication methods, identify and solve employee problems, manage conflict, respond to grievances		4	2	2
	PC12. manage employees and team performance, provide new employee orientation, educate team on procedures to maintain compliance, train or provide adequate training and motivate employees		4	1	3
	PC13. coach, counsel and discipline employees, initiate, coordinate and enforce systems, policies and procedures through team		4	2	2
	PC14. evaluate, investigate complaints or performance concerns, implement		4	2	2

Total Marks: 600	Compulsory NOS				
Assessable outcomes	**Assessment criteria for outcomes**	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
	disciplinary action as needed in consultation with proper authorities				
			100	**35**	**65**

Model Curriculum

Food Regulatory Affairs Manager

SECTOR: FOOD PROCESSING

SUB-SECTOR: FRUIT & VEGETABLE, FOOD GRAIN MILLING (INCLUDING OILSEEDS), DAIRY PRODUCTS, MEAT & POULTRY, FISH & SEAFOOD, BREAD & BAKERY, ALCOHOLIC BEVERAGES, AERATED WATER/ SOFT DRINKS, SOYA FOOD, PACKAGED FOOD

OCCUPATION: QUALITY ASSURANCE

REF ID: FIC/Q9002, V1.0

NSQF LEVEL: 6

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY AND SKILL INITIATIVE (FICSI)

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Food Regulatory Affairs Manager**'
QP No. '**FIC/Q9002, Version 1.0, NSQF Level 6**'

Date of Issuance: **February 2, 2016**

Valid up to*: March 30, 2019

* Valid up to the next review date of the Qualification Pack

Authorised Signatory
(Food Industry Capacity and Skill Initiative)

TABLE OF CONTENTS

Food Regulatory Affairs Manager

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of a "Food Regulatory Affairs Manager", in the "Food Processing" Sector/Industry and aims at building the following key competencies amongst the learner

Program Name	**Food Regulatory Affairs Manager**		
Qualification Pack Name & Reference ID. ID	FIC/Q9002, v1.0		
Version No.	1.0	**Version Update Date**	23/02/2016
Pre-requisites to Training	Master's degree in food science with 8-10 years' experience in food processing unitor food regulatory matters		
Training Outcomes	**After completing this programme, participants will be able to:** Designing, developing, implementing and changing food regulatory systems in the organisation. Act as a liaison between organisation and government regulatory agencies Ensure that the products produced and distributed comply with regulatory standards.		

This course encompasses 3 out of 3 National Occupational Standards (NOS) of "Food Regulatory Affairs Manager" Qualification Pack issued by "Food Industry Capacity and Skill Initiative".

Sr. No.	Module	Key Learning Outcomes	Equipment Required
1	**Introduction to the training program** **Theory Duration** (hh:mm) 01:30 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code** Bridge Module	Introduce each other and build rapport with fellow participants and the trainer.	White board/Chart papers, marker
2	**Overview of the "Food Regulatory Affairs Manager" Role** **Theory Duration** (hh:mm) 01:00 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code**	Understanding the roles and responsibilities of food regulatory affairs manager Awareness of the nature and availability of job opportunities	Laptop/computer white board, marker, projector, chart papers
3	**Introduction to the Food Processing Industry** **Theory Duration** (hh:mm) 01:00 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code**	Define food processing List the various sub-sectors of food processing industry	Laptop, white/black board, marker, chart papers, projector ,Trainer's guide, Student manual
4	**Introduction to the food regulations and affairs** **Theory Duration** (hh:mm) 05:00 **Practical Duration**	List the terminology used in the food regulation process State various methods to ensure foos regulation State the processes to oversee for ensuring that the food regulations are in compliance	Laptop, white/black board, marker, chart papers, projector, trainer's guide, student handbook

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	(hh:mm) 30:00 **Corresponding NOS Code**	Understand what are regulatory policies of an organization and follow them	
5	**Design, develop and implement regulatory system** **Theory Duration** (hh:mm) 13:00 **Practical Duration** (hh:mm) 21:00 **Corresponding NOS Code** FIC/N9011	Understand food safety regulations and develop regulatory policies for the organisation with clear definitions to increase consistency, legal security and to provide high level of food safety Design regulatory system with focus on risk reduction, risk-based priorities, reflect integrated and economically feasible initiatives, and ensure high quality and transparency Design and develop regulatory system with intuitive approach to food safety such that problem are recognized, understood, dealt, and checked to ensure problem has been dealt efficiently and effectively Design regulatory system with contingency planning like product traceability and product recall in case of problems, procedures for handling containment, with clear attribution of roles like lines of authority and co-ordination mechanism across food chain (from procuring raw materials, production until product reaching consumers) Design regulatory system with improved communication on food safety information in marketing materials, product labels etc, providing science based information to clear up the unjustified fear among consumers Set food safety system involving food producers, processors, distributors, retailers and consumers to recognize their primary responsibility and to share a common goal of ensuring food safety at all stages Design food regulatory system involving GMP, GHP, and monitoring systems like HACCP Design regulatory system that improve efficiency and compliance, build consumer confidence in the safety and quality of food products	Laptop, white/black board, marker, chart papers, projector, trainer's guide, student handbook, quality manual, quality policy

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		produced, processed, marketed, distributed and sold Design and develop regulatory system ensuring food and health standards are followed in each stage of production and produce food products that meet national and international regulatory standards and protect the health of consumers Design regulatory system including provisions for the right of consumers to have access to accurate and sufficient information and make adequate choices Provide strategic advice and cost effective strategies on regulatory aspects/requirements to senior management and project managing teams throughout the development of a new product Interpret regulatory standards and develop organisation standards meeting national and international food safety regulations like FSSAI, FDA, EU food safety regulations, codex alimentarius etc for products produced, exported and imported, and labels of products packed by the organisation Develop and review standard operating procedures (SOPs) and ensure that they are in compliance with current regulatory requirements and provide regulatory support for corporate quality assurance efforts Develop organisation standards for labels of food products produced and packed, promotional marketing materials, products imported and exported by the organisation to meet national and international food regulatory Evaluate labels of packed food products to ensure it meets national and international food regulatory standards and provide approval or recommend changes Evaluate promotional and materials for regulatory impact and provide approval Provide support for review of essential documents, development and review of consent forms for submission to regulatory authorities for clearance	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		Initiate and contribute to process improvements which have an impact on regulatory affairs, quality assurance and other departments Conduct audits on food processing unit for compliance with regulatory, safety and hygiene standards implemented and followed in the organisation Conduct periodic audits to evaluate haccp plans and their implementation in the organisation and ensure it meets the regulatory standards Review internal and external audit reports to check the effectiveness of the present regulatory system and recommend necessary changes in the policies and procedures to reduce failures in the future Identify reason for consumer cases in court related to non-compliance of food products to regulatory standards, collect relevant information's and documents transmitting evidence to produce in court to assist prosecution Monitor company progress toward fulfillment of regulatory commitments Provide training to department managers on organisation policies on food and safety regulations, national and international food laws and regulations, methods and procedures for implementing regulations for procuring raw materials, producing food products, marketing and selling quality products to the consumers Provide training to all department managers on the importance of food regulatory standards and need for its compliance, statutory and regulatory requirements for the products produced, labels of packed products and promotional materials, and the consequences for not following the regulatory requirements Provide training on procedures for collecting evidence in case of problems/consumer complaints/consumer cases in court	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		and handling them with technical and scientific approach Provide training to all department managers on methods to implement and monitor regulatory system in their area of function, writing reports with relevant information and data to present to local food regulatory authorities for any concerns raised / clarification required, methods to approach and maintain relationship with food regulatory authorities Provide training on upgradation and changes in the food regulatory system and methods to implement, monitor and achieve them	
6	**Manage change in food regulatory system** **Theory Duration** (hh:mm) 14:00 **Practical Duration** (hh:mm) 20:00 **Corresponding NOS Code** FIC/N9012	• Identify procedures, systems, structures that need to be changed for effective implementation of food regulatory system • Assess gaps in the current policies and procedures and analyze the future requirements • Identify and assess barriers to change in regulatory system, develop strategies and plans to overcome those barriers • Assess risks and benefits associated with the strategies and plans, and develop contingency arrangements design new work processes, procedures, systems, structures and roles to achieve planned changes in regulatory system • Ensure plan for change in regulatory system include short-term as well as longer-term deliverables • Develop system for monitoring and assessing regulatory system to assess progress in changes implemented • Develop reporting and communicating system to review the effectiveness of the changes in regulatory system and to obtain feedback • Provide training and support to implement changes planned in regulatory system • Communicate reasons, importance and benefits of implementing change in regulatory system, future that can be achieved through	Laptop, white/black board, marker, chart papers, projector, trainer's guide, student handbook, quality manual, quality policy, regulatory policies

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		implementing and following the change, to management and concerned employees • Make the management and employees welcome change in regulatory system as an opportunity to deliver products of national and international quality • Make the management and employees understand the need and importance for change in regulatory system, result expected out of change and its effect on the organisation • Implement the strategies and plans for change in regulatory system with available resources • Make the managers responsible for implementing change in regulatory system understand their responsibilities and commitment, and use their influence and power over employees to implement change • Set and prioritize objectives for the change in regulatory system, identify and deal with obstacles to change, and support employees through the change process • Communicate progress achieved thorough change in regulatory system to everyone involved, and make them understand and enjoy achievement • Review reports on total quality management system to evaluate effectiveness of changes implemented in regulatory system of the organisation • Organize internal and external audit on total quality management system to evaluate effectiveness of the changes implemented in regulatory system • Monitor changes implemented in regulatory system , document and communicate the outcome of implemented change to the management • Recognize and reward employees and teams for implementing regulatory system and achieving results thorough new policies and procedures	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		• Monitor and ensure changes implemented in regulatory system are effective and meet the requirements of the organisation and regulatory system laid by national and international regulatory bodies	
7	**Prepare representations to regulatory authorities and for new product registrations** **Theory Duration** (hh:mm) 09:00 **Practical Duration** (hh:mm) 14:00 **Corresponding NOS Code** FIC/N9013	Prepare simple and complex regulatory documents in accordance with applicable FSSAI regulations by collecting, collating and evaluating scientific data that has been well researched on relevant aspects Review regulatory guidance and requirements pertaining to products produced in the organisation and prepare documents providing thoughtful and accurate comments Prepare regulatory documents to authorities that translate regulatory requirements into practical, workable plans with timelines for development and implementation Coordinate with food regulatory authorities to review disputed matters, negotiation and finalization on products and projects, and for comments and formal approvals Prepare documents that include check lists created and maintained to implement regulatory requirements, technical data, and declarations of conformity Interface with consultants, research organizations, partners, co-manufacturers etc. for preparation, review, compilation, finalization and submission of documents for regulatory approvals Prepare responses to communications and other requests from government food regulatory authorities Prepare safety reports and documents on raw materials, ingredients, additives, flavours etc used in the products produced and marketed by the organisation, for regulatory submissions and clearance Identify reasons related to non-compliance of food products to regulatory standards, collect relevant information's and data,	Laptop, white/black board, marker, chart papers, projector, trainer's guide, student handbook, quality manual, quality policy, audit documents, regulatory policies

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		prepare technical documents with scientific facts and supporting evidence, and submit to relevant authorities, respond to communications from government authorities, and follow up regularly to revoke product ban Interact with various regulatory authorities during concept, development and industrialization stages of projects for clarification and approvals Interact with the notified bodies and competent authorities for developing and reviewing regulatory standards Coordinate with regulatory authorities for reporting, to comment on proposed regulations, and to represent company's interest in the development of standards and guidelines Discuss on the differences that exist in the regulations laid down by different governments and their interpretation by the regulatory agencies and ensure that efficient and economical regulatory standards are planned Identify possible threats or opportunities from upcoming regulations under FSSAI, consumer affairs, other government food policies and regulations and liaise with industry associations to tackle/manage them effectively Participate in seminar, workshops, conferences and meetings organised by FSSAI and other industry association, representing the organisation to maintain, strengthen and expand contacts Work closely with regulatory and trade associations like CII (confederation of indian industries), FICCI (federation of indian chambers of commerce and industries), CIFTI (confederation of indian food trade and industry), AIFPA (all india food processors association), ASSOCHAM(the associated chambers of commerce of india) etc on national and international regulatory changes and challenges that have impact on food products produced in the	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		organisation and to manage them proactively Develop and write clear arguments and explanations for new product license Prepare and present registration documents to regulatory authorities and notified bodies for new product approvals Present written representation for new products and carry out negotiations with regulatory authorities to obtain necessary approvals for new product production and marketing Evaluate, prepare and submit new product registration applications and follow through the application during the evaluation phase to achieve favorable outcome Prepare responses to letter/e-mail communications and other requests from government food regulatory bodies on new product approval Provide regulatory and product compliance report in the area of advertising and label claims for new products	
8	**Field Visits** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 20:00 **Corresponding NOS Code**	Observe the location, layout and safety aspects of food processing Observe the storage facilities for raw materials and finished products Observe the various machineries used in process Observe the various machineries used in process Observe the cleaning methods and processes followed to maintain the process machineries and tools Observe the raw materials used and their storage procedures Observe the packaging and storage processes of raw material and finished product Observe the post-production cleaning and maintenance process followed in the industry	All the tools and equipment listed above must be available at the site of field visit
9	**Revision** **Theory Duration** (hh:mm) 01:00	Revised the knowledge gained so far	Allthe tools and equipment listed above must be available at the time of revision

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Practical Duration (hh:mm) 01:00 **Corresponding NOS Code**		
10	**Evaluation** **Theory Duration** (hh:mm) 06:00 **Practical Duration** (hh:mm) 28:00 **Corresponding NOS Code**	Assess the knowledge and skills acquired by the participants	All the tools and equipment listed above must be available for evaluation
11	**On-the-job Training** **Theory Duration** (hh:mm) 08:00 **Practical Duration** (hh:mm) 24:00 **Corresponding NOS Code**	Apply the skills and knowledge acquired in the training program in the field	All the tools and equipment listed above must be available on the site at the time of OJT
	Total Duration 240:00 **Theory Duration 79:00** **Practical Duration 161:00**	**Unique Equipment Required**: Laptop, white/black board, marker, chart papers, projector, trainer's guide, student handbook, quality manual, quality policy, audit documents, regulatory policies	

Grand Total Course Duration: **240 Hours, 0 Minutes**

(This syllabus/ curriculum has been approved by ***SSC: Food Industry Capacity and Skill Initiative)***

Trainer Prerequisites for Job role: "Food Regulatory Affairs Manager" mapped to Qualification Pack: "FIC/Q9002, v1.0"

Sr. No.	Area	Details
1	**Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack "FIC/Q9002", Version 1.0
2	**Personal Attributes**	An aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training, and pre/post work to ensure competent, employable candidates at the end of the training. Strong communication skills, ability to work as part of a team; a passion for quality and for developing others; well-organized and focused, eager to learn and keep oneself updated with the latest in the mentioned fields.
3	**Minimum Educational Qualifications**	B.Sc/B.Tech/BE in Food Process Engineering/ Food Safety and Quality Management in Food Process Engineering with 5-6 years of hand on experience in QA/regulations of a food Processing Industry or M.Sc/M.Tech/ME or in Food Process Engineering/ Food Safety and Quality Management in Food Safety/Food Process Engineering with 3-4- years of hand on experience in QA/regulations of a food Processing Industry
4a	**Domain Certification**	Certified for Job Role: "Food regulatory affairs Manager" mapped to QP: "FIC/Q9002, v1.0". Minimum accepted score is 80%
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer", mapped to the Qualification Pack: "SSC/Q1402". Minimum accepted SCORE IS 80 % as per FICSI guidelines.
5	**Experience**	B.Sc/B.Tech/BE in Food Process Engineering/ Food Safety and Quality Management in Food Process Engineering with 5-6 years of hand on experience in QA/regulations of a food Processing Industry or M.Sc/M.Tech/ME or in Food Process Engineering/ Food Safety and Quality Management in Food Safety/Food Process Engineering with 3-4- years of hand on experience in QA/regulations of a food Processing Industry

Annexure: Assessment Criteria

Assessment Criteria	
Job Role	**Food regulatory affairs manager**
Qualification Pack	**FIC/Q9002 v1.0**
Sector Skill Council	**Food Processing**

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2	The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre(as per assessment criteria below)
4	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training canter based on this criteria
5	To pass the Qualification Pack, every trainee should score a minimum of 70% (overall) in every QP
6	The marks are allocated PC wise; however, every NOS will carry a weight age in the total marks allocated to the specific QP

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
1. FIC/N9011: Design, develop and implement regulatory system	PC.1 understand food safety regulations and develop regulatory policies for the organisation with clear definitions to increase consistency, legal security and to provide high level of food safety	100	4	1.5	2.5
	PC2. design regulatory system with focus on risk reduction, risk-based priorities, reflect integrated and economically feasible initiatives, and ensure high quality and transparency		4	1.5	2.5
	PC3. design and develop regulatory system with intuitive approach to food safety such that problem are recognized, understood, dealt, and checked to ensure problem has been dealt efficiently and effectively		4	1.5	2.5
	PC4. design regulatory system with contingency planning like product traceability and product recall in case of problems, procedures for handling containment, with clear attribution of roles like lines of authority and co-ordination mechanism across food chain (from procuring raw materials, production until product reaching consumers		4	1.5	2.5
	PC5. design regulatory system with improved communication on food safety information in marketing materials, product labels etc, providing science based information to clear up the unjustified fear among consumers		4	1.5	2.5
	PC6. set food safety system involving food producers, processors, distributors, retailers and consumers to recognize their primary responsibility and to share a common goal of ensuring food safety at all stages		4	1.5	2.5
	PC7. design food regulatory system involving gmp, ghp, and monitoring systems like haccp		4	1.5	2.5
	PC8. design regulatory system that improve efficiency and compliance, build consumer confidence in the safety and quality of food products produced, processed, marketed, distributed and sold		4	1.5	2.5
	PC9. design and develop regulatory system ensuring food and health standards are followed in each stage of production and		4	1.5	2.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	produce food products that meet national and international regulatory standards and protect the health of consumers				
	PC10. design regulatory system including provisions for the right of consumers to have access to accurate and sufficient information and make adequate choices		4	1.5	2.5
	PC11. provide strategic advice and cost effective strategies on regulatory aspects/requirements to senior management and project managing teams throughout the development of a new product		4	1.5	2.5
	PC12. interpret regulatory standards and develop organisation standards meeting national and international food safety regulations like fssai, fda, eu food safety regulations, codex alimentarius etc for products produced, exported and imported, and labels of products packed by the organisation		4	1.5	2.5
	PC13. develop and review standard operating procedures (sops) and ensure sops are in compliance with current regulatory requirements and provide regulatory support for corporate quality assurance efforts		4	1.5	2.5
	PC14. develop organisation standards for labels of food products produced and packed, promotional marketing materials, products imported and exported by the organisation to meet national and international food regulatory		4	1.5	2.5
	PC15. evaluate labels of packed food products to ensure it meets national and international food regulatory standards and provide approval or recommend changes		4	1	3
	PC16. evaluate promotional and materials for regulatory impact and provide approval		4	1	3
	PC17. provide support for review of essential documents, development and review of consent forms for submission to regulatory authorities for clearance		3	1	2
	PC18. initiate and contribute to process improvements which have an impact on		3	1	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	regulatory affairs, quality assurance and other departments				
	PC19. conduct audits on food processing unit for compliance with regulatory, safety and hygiene standards implemented and followed in the organisation		3	1	2
	PC20. conduct periodic audits to evaluate haccp plans and their implementation in the organisation and ensure it meets the regulatory standards		3	1	2
	PC21. review internal and external audit reports to check the effectiveness of the present regulatory system and recommend necessary changes in the policies and procedures to reduce failures in the future		3	1	2
	PC22. identify reason for consumer cases in court related to non-compliance of food products to regulatory standards, collect relevant information's and documents transmitting evidence to produce in court to assist prosecution		3	1	2
	PC23. monitor company progress toward fulfillment of regulatory commitments		3	1	2
	PC24. provide training to department managers on organisation policies on food and safety regulations, national and international food laws and regulations, methods and procedures for implementing regulations for procuring raw materials, producing food products, marketing and selling quality products to the consumers		3	1	2
	PC25. provide training to all department managers on the importance of food regulatory standards and need for its compliance, statutory and regulatory requirements for the products produced, labels of packed products and promotional materials, and the consequences for not following the regulatory requirements		3	1	2
	PC26. provide training on procedures for collecting evidence in case of problems/consumer complaints/consumer cases in court and handling them with technical and scientific approach		3	1	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC27. provide training to all department managers on methods to implement and monitor regulatory system in their area of function, writing reports with relevant information and data to present to local food regulatory authorities for any concerns raised / clarification required, methods to approach and maintain relationship with food regulatory authorities		3	1	2
	PC28. provide training on upgradation and changes in the food regulatory system and methods to implement, monitor and achieve them		3	1	2
			100	**35**	**65**
2. FIC/N9012: Manage change in food regulatory system	PC1. identify procedures, systems, structures that need to be changed for effective implementation of food regulatory system	**100**	5	1	4
	PC2. assess gaps in the current policies and procedures and analyze the future requirements		5	1	4
	PC3. identify and assess barriers to change in regulatory system, develop strategies and plans to overcome those barriers		5	1	4
	PC4. assess risks and benefits associated with the strategies and plans, and develop contingency arrangements		5	1	4
	PC5. design new work processes, procedures, systems, structures and roles to achieve planned changes in regulatory system		5	1	4
	PC6. ensure plan for change in regulatory system include shortterm as well as longer-term deliverables.		4	1.5	2.5
	PC7. develop system for monitoring and assessing regulatory system to assess progress in changes implemented		5	2	3
	PC8. develop reporting and communicating system to review the effectiveness of the changes in regulatory system and to obtain feedback		5	2	3
	PC9. provide training and support to implement changes planned in regulatory system		4	2	2
	PC10. communicate reasons, importance and benefits of implementing change in regulatory system, future that can be achieved through implementing and		5	2	3

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	following the change, to management and concerned employees				
	PC11. make the management and employees welcome change in regulatory system as an opportunity to deliver products of national and international quality		4	1.5	2.5
	PC12. make the management and employees understand the need and importance for change in regulatory system, result expected out of change and its effect on the organisation		5	2	3
	PC13. implement the strategies and plans for change in regulatory system with available resources		5	2	3
	PC14. make the managers responsible for implementing change in regulatory system understand their responsibilities and commitment, and use their influence and power over employees to implement change		5	2	3
	PC15. set and prioritize objectives for the change in regulatory system, identify and deal with obstacles to change, and support employees through the change process		5	2	3
	PC16. communicate progress achieved thorough change in regulatory system to everyone involved, and make them understand and enjoy achievement		4	1.5	2.5
	PC17. review reports on total quality management system to evaluate effectiveness of changes implemented in regulatory system of the organisation		5	2	3
	PC18. organize internal and external audit on total quality management system to evaluate effectiveness of the changes implemented in regulatory system		5	2	3
	PC19. monitor changes implemented in regulatory system , document and communicate the outcome of implemented change to the management		5	2	3
	PC20. recognize and reward employees and teams for implementing regulatory system and achieving results thorough new policies and procedures		4	1.5	2.5
	PC21. monitor and ensure changes implemented in regulatory system are		5	2	3

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	effective and meet the requirements of the organisation and regulatory system laid by national and international regulatory bodies				
			100	**35**	**65**
3. FIC/N9013: Prepare representations to regulatory authorities and for new product registrations	PC1. prepare simple and complex regulatory documents in accordance with applicable FSSAI regulations by collecting, collating and evaluating scientific data that has been well researched on relevant aspects	**100**	5	1	4
	PC2. review regulatory guidance and requirements pertaining to products produced in the organisation and prepare documents providing thoughtful and accurate comments		5	1	4
	PC3. prepare regulatory documents to authorities that translate regulatory requirements into practical, workable plans with timelines for development and implementation		5	1	4
	PC4. coordinate with food regulatory authorities to review disputed matters, negotiation and finalization on products and projects, and for comments and formal approvals		5	1	4
	PC5. prepare documents that include check lists created and maintained to implement regulatory requirements, technical data, and declarations of conformity		4	1.5	2.5
	PC6. interface with consultants, research organizations, partners, co-manufacturers etc for preparation, review, compilation, finalization and submission of documents for regulatory approvals		4	1.5	2.5
	PC7. prepare responses to communications and other requests from government food regulatory authorities		4	1.5	2.5
	PC8. prepare safety reports and documents on raw materials, ingredients, additives, flavours etc used in the products produced and marketed by the organisation, for regulatory submissions and clearance		4	1.5	2.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC9. Identify reasons related to noncompliance of food products to regulatory standards, collect relevant information's and data, prepare technical documents with scientific facts and supporting evidence, and submit to relevant authorities, respond to communications from government authorities, and follow up regularly to revoke product ban		4	1.5	2.5
	PC10.prepare simple and complex regulatory documents in accordance with applicable fssai regulations by collecting, collating and evaluating scientific data that has been well researched on relevant aspects		5	2	3
	PC11. review regulatory guidance and requirements pertaining to products produced in the organisation and prepare documents providing thoughtful and accurate comments		5	2	3
	PC12. prepare regulatory documents to authorities that translate regulatory requirements into practical, workable plans with timelines for development and implementation		5	2	3
	PC13. coordinate with food regulatory authorities to review disputed matters, negotiation and finalization on products and projects, and for comments and formal approvals		5	2	3
	PC14. prepare documents that include check lists created and maintained to implement regulatory requirements, technical data, and declarations of conformity		4	1.5	2.5
	PC15. interface with consultants, research organizations, partners, co-manufacturers etc for preparation, review, compilation, finalization and submission of documents for regulatory approvals		4	1.5	2.5
	PC16. prepare responses to communications and other requests from government food regulatory authorities		5	2	3
	PC17. develop and write clear arguments and explanations for new product license		5	2	3

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC18. prepare and present registration documents to regulatory authorities and notified bodies for new product approvals		5	2	3
	PC19. present written representation for new products and carry out negotiations with regulatory authorities to obtain necessary approvals for new product production and marketing		5	2	3
	PC20. evaluate, prepare and submit new product registration applications and follow through the application during the evaluation phase to achieve favorable outcome		4	1.5	2.5
	PC21. prepare responses to letter/e-mail communications and other requests from government food regulatory bodies on new product approval		4	1.5	2.5
	PC22.Provide regulatory and product compliance report in the area of advertising and label claims for new products		4	1.5	2.5
	Total		**100**	**35**	**65**
	Grand Total	**300**	**300**	**200**	**100**
	Percentage Weightage		**100**	**60%**	**40%**
	Minimum Pass% to qualify (aggregate):			**70%**	

Model Curriculum

Production Manager

SECTOR: FOOD PROCESSING
SUB-SECTOR: FRUIT & VEGETABLE, FOOD GRAIN
OCCUPATION: MILLING (INCLUDING OILSEEDS), DAIRY PRODUCTS, MEAT & POULTRY, FISH & SEAFOOD, BREAD & BAKERY, ALCOHOLIC BEVERAGES, AERATED WATER/ SOFT DRINKS, SOYA FOOD,

PACKAGED FOOD PROCESSING
REF ID: FIC/Q9003, V1.0
NSQF LEVEL: 7

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY AND SKILL INITIATIVE (FICSI)

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Production Manager**'
QP No. '**FIC/Q9003, Version 1.0, NSQF Level 7**'

Date of Issuance: March 30, 2018

Valid up to: March 30, 2019

* Valid up to the next review date of the Qualification Pack

Authorised Signatory
(Food Industry Capacity and Skill Initiative)

TABLE OF CONTENTS

Production Manager

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of a "Production Manager", in the "Food Processing" Sector/Industry and aims at building the following key competencies amongst the learner

Program Name	**Production Manager**		
Qualification Pack Name & Reference ID. ID	FIC/Q9003, v1.0		
Version No.	1.0	**Version Update Date**	30/03/2016
Pre-requisites to Training	Preferably Class 12 and 2-3 years' experience in a food processing unit		
Training Outcomes	**After completing this programme, participants will be able to:** Production of food products through the process of production planning, coordinating and controlling production process to achieve quantity and quality product Reviewing production process to minimize production cost and optimizing production.		

This course encompasses 3 out of 3 National Occupational Standards (NOS) of "Production Manager" Qualification Pack issued by "Food Industry Capacity and Skill Initiative".

Sr. No.	Module	Key Learning Outcomes	Equipment Required
1	**Introduction to the training program** **Theory Duration** (hh:mm) 00:30 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code** Bridge Module	Introduce each other and build rapport with fellow participants and the trainer.	White board/Chart papers, marker
2	**Overview of the "Production Manager" Role** **Theory Duration** (hh:mm) 01:00 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code**	Understanding the roles and responsibilities of production manager Awareness of the nature and availability of job opportunities	Laptop/computer white board, marker, projector, chart papers
3	**Introduction to the Food Processing Industry** **Theory Duration** (hh:mm) 01:30 **Practical Duration** (hh:mm) 00:00 **Corresponding NOS Code**	Define food processing List the various sub sectors of food processing industry	Laptop, white/black board, marker, chart papers, projector ,Trainer's guide, Student manual
4	**Introduction to food processing process** **Theory Duration** (hh:mm) 02:00 **Practical Duration** (hh:mm)	List the common machineries used in food processing Explain the process of testing food for accepted quality standards Demonstrate the test for checking the quality of food Describe the procedure for processing various food	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	04:00 **Corresponding NOS Code**	Identify different equipment used in food industry	
5	**Organizational standards and norms** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 02:00 **Corresponding NOS Code**	State the roles and responsibilities of a production manager State how to conduct yourself at the workplace State the personal hygiene and sanitation guidelines State the food safety hygiene standards to follow in a work environment	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook, protective gloves, head caps, aprons, safety goggles, safety boots, mouth masks, sanitizer, safety manual
6	**Manage production process in food processing unit** **Theory Duration** (hh:mm) 15:00 **Practical Duration** (hh:mm) 11:40 **Corresponding NOS Code** FIC/N9014	• Communicate the organisation policies and goals clearly to the employees of production team, make them understand and commit their energy and expertise to achieve organisation goals • Achieve department targets and organisation goals by understanding the organisation and employees, developing a leadership style and applying them appropriately • Communicate with employees regularly and effectively, help them identify their strengths, provide support to overcome their weakness, listen to their grievances and provide appropriate solutions, and win their trust and support • Motivate and support employees to achieve their work and development objectives, and provide recognition when they are successful • Encourage employees to take responsibilities, to take own decisions within agreed boundaries, to take lead in their own areas of expertise for their development • Initiate personnel actions, such as promotions, transfers, discharges or disciplinary measures • Lead production department and team successfully through difficulties and challenges • Review the sales forecast for the week/month (or) monthly production	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		plan discussed with plant manager (or) customer requirement (as applicable) and identify production priorities to meet market requirement • Identify and confirm resource availability such as raw materials, packing materials, equipment availability and capacity, production capacity, manpower requirement and availability, stock level, storage capacity, transport capacity etc • Plan details of production in terms of output quantity and quality, cost, time and manpower requirements • Analyze the consequences of failing to meet production/delivery timelines to meet the schedule, notify relevant authorities of any possibility that demand cannot be met within required timeframe • Develop production schedule to meet market demands/priorities and delivery timelines within budget and with available resources, consult production plan with inter department heads and production supervisor, instruct supervisor to allocate work to production team • Communicate the production schedule to cross function heads through communication system followed by the organisation such as e-mail or upload in the ERP system • Identify and confirm equipment requirements to meet production target, share production schedule with equipment requirement to maintenance manager/supervisor for maintenance plan that aligns with production plan • Co-ordinate with maintenance manager/supervisor to understand materials, consumables and manpower requirement and availability for maintenance activities, for uninterrupted production • Understand equipment maintenance process and procedure and co-ordinate for maintenance activities during breakdown, emergency response, routine cleaning and servicing, etc. • Analyze equipment maintenance data to interpret equipment	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		performance and arrive at production capability of each process equipment • Co-ordinate with maintenance team to ensure reliable equipment performance with minimal disruption to production, to minimize down time during equipment breakdowns, and to optimize equipment efficiency to achieve production target • Lead and build team spirit between production and maintenance personnel through effective communication to enhance equipment performance and to identify production improvement opportunities • Ensure maintenance procedures are followed meet food safety and environmental requirements • Monitor production process for usage of raw materials, packaging materials, manpower, wastage against production plan and identify reason for variances against plan • Address the reason for variation in achieving production schedule, production target within allocated budget • Adjust production schedule in response to variables affecting achievement of production target • Monitor production output and cost, adjust processes and resources to minimize cost and to achieve quantity and quality product • Reschedule production plan in case of urgent requirement or any unforeseen event, to minimize wastage and to utilize materials/utilities and resources efficiently, discuss and negotiate changes with inter department team on time for their support and team work • Review production schedule and process, consult /discuss with supervisor, team and cross function teams identify opportunities for improvement and develop recommendations for improvement on production process • Set polices, plans and procedures, and take initiative to implement the identified improvement opportunities	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		to control cost and to achieve better yield and quality • Monitor, review and ensure production details are documented to meet the documentation requirements of the organisation, and to meet audit requirements like ISO, HACCP, etc • Understand objective of trial production, trial product processing method and specification, select production team for trial, discuss with cross function team like planning, QA, maintenance etc, clarify roles and responsibilities and level of authority to the team and cross function • Prepare technical production procedures considering all engineering and process parameters for new product trial, educate and train supervisors and operators on trial procedure • Identify and consider all possible hazards, prepare plan and procedures to prevent and control hazards, provide training to trial team to handle hazards • Prepare detailed trial production schedule to manage production process without overlapping/affecting with regular production, and considering availability of raw materials and packaging materials, machine availability and capability, man power availability and competency etc • Monitor trial production against plan to identify variances and factors that need to be adjusted to achieve product of required specification within the planned time • Document and evaluate trial production data and identify process/parameters to be modified/changed to achieve product of required specification • Prepare trial production report with recommendations on improvement opportunities, and share with cross function heads and relevant authorities for suggestion and consideration	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
7	**Manage production optimization and cost efficiency** **Theory Duration** (hh:mm) 08:00 **Practical Duration** (hh:mm) 12:00 **Corresponding NOS Code** FIC/N9015	Review production reports and analyze equipment performance, process capability, change over time, maintenance, consumables, power etc, to identify factors that affect performance of production and recommend improvement opportunities Compile performance data on process and equipment to identify cause for lack of performance, evaluate opportunities to improve, identify cost saving options, propose changes in process, and implement proposal with proper approvals Review production process with supervisor and machine operators to identify reasons for slowdown or stop of production process, provide recommendations to overcome efficiency issues, take feedback, develop plans for implementing recommended changes, monitor changes implemented, and review changes and improvement Calculate utilities and energy usage in production area and for production process, identify methods to minimize usage Develop plans and procedures to minimize use of utilities and energy without affecting the production efficiency Identify energy and utility losses or sources of waste, analyze reason, recommend methods to improve efficient energy/utility application, ensure recommendations are implemented, and monitor improvement Identify areas where utilities and energy can be saved, and Identify methods to save energy like recycling energy and utilities such as steam, heat and water, following proper maintenance methods to avoid leaks and losses etc, and prepare efficient production schedule such that target is met with efficient utilization of energy and utility Analyze usage pattern of energy and other utilities in production area and process against budget allocation, identify cost effective options for	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook ,

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		minimizing wastage, and implement changes Identify system, production process that need to be changed, identify opportunities for implementing change in production process, analyze impact of change on product quality, impact on the team and present production process Communicate with relevant authorities/superiors the need for change, results and benefits expected our of change Design new processes, procedures, systems, structures with roles and responsibilities, key performance indicators, training needs, safety system, contingency plans, monitoring and reporting system to implement planned changes in production process Provide training and support to implement changes, develop a strategy to help teams implement change Monitor changes implemented in production process and ensure changes are effective and meet the organisation and regulatory requirements Document and communicate the progress achieved through implemented change to the management and everyone involved, and make them understand and enjoy achievement Recognize and reward employees and teams for implementing change in production system and achieving better efficiency Manage budget efficiently by managing production with available resource, by avoiding overtime and too many casual workers/helpers Plan effectively to secure, confirm and allocate required manpower to meet production target within budget, monitor resource utilization, to achieve production target within existing resource Identify situations where actual budget exceeds the approved budget, investigate reason for variance and take appropriate	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		corrective action to keep budget under control Identify the impact on budget of production-related decisions like scheduling holidays, adjusting production volume, scheduling equipment maintenance etc, before scheduling production, and identify opportunities to improve performance against budget Identify the causes for any significant variances in budget control, discuss with team and ensure prompt corrective action is taken to keep expenditure under control Encourage team to think and identify ways of reducing expenditure, analyse and pursue the suggested ideas	
8	**Manage documentation system and implement safety and environmental policies** **Theory Duration** (hh:mm) 07:00 **Practical Duration** (hh:mm) 09:00 **Corresponding NOS Code** FIC/N9016	• Establish to production team the importance of documentation, provide training on documentation system, and ensure all documents are maintained systematically • Ensure all relevant records and documents are complete, up-to-date and accessible for audits on production process • During audit provide the auditor with access to all relevant information, records and documents • Ensure corrective actions recommended and implemented are documented to assure production process is carried in accordance with organisation and regulatory standards • Establish methods to track production information from documented and maintained records • Establish to production team importance of safety and environment requirements related to food processing unit, communicate information about safety and environmental policies and related procedures to the team • Co-ordinate with quality team to prepare policies and sops on safety and environment requirements related to production function, and ensure those procedure are followed in production area and during production process	Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook, logbooks, internal audit register, food safety manual, quality policy etc.

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		• Ensure safe work procedures are followed in production area and during production process • Ensure policies and standard operating procedures on safety and environment requirements are accessible to all employees of production team, and are followed to meet the regulatory requirements • Identify safety and environmental hazards relevant to production processes, implement system to handle risks • Provide or organize training through relevant authorities on safety and environmental management system, to understand methods to control and prevent hazards • Conduct inspections in work place on use of protective clothing and accessories, and to ensure safety system is followed during production process • Conduct audits and review records on safety and environmental system to monitor if control systems are followed by production team, and address non-compliance following organisation standards • Implement system on waste management in production area and process, monitor and confirm waste collection, treatment, recycling or disposal is carried out meeting industry requirements and environmental regulations • Respond to environmental management hazard identification and incidents in an appropriate and timely way • Review practice and procedures followed on safety, conduct risk assessments, identify non-compliance, and provide recommendations to address gaps and non-conformances • Review environmental records documents maintained, analyze data to evaluate effectiveness of the environmental management system and identify areas for improvement, plan and implement improvements to meet regulatory requirements	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
9	**Professional and Core Skills** **Theory Duration** (hh:mm) 03:00 **Practical Duration** (hh:mm) 05:00 **Corresponding NOS Code**	Undertake a self-assessment test Identify personal strengths and weaknesses Plan and schedule the work order and manage time effectively to complete the tasks assigned Prevent potential problems from occurring Resolve issues and problems using acquired knowledge and realize the importance of decision making Identify potential problems and make sound and timely decision Improve your reading skills State the importance of listening	Laptop, white/black board, marker, chart papers, projector ,Trainer's guide, Student manual
10	**IT Skills** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 07:00 **Corresponding NOS Code**	Identify parts of the computer Use the computer keyboard effectively to type Use computer applications effectively to record day-to-day activities Use the word processor effectively Use the spreadsheet application effectively Use the computer to document day-to-day activities	Laptop, white/black board, marker, chart papers, projector, Trainer's guide, Student manual
11	**Field Visits** **Theory Duration** (hh:mm) 04:00 **Practical Duration** (hh:mm) 30:00 **Corresponding NOS Code**	Observe the factory location, layout and safety aspects of food processing Observe the storage facilities for raw materials and finished products Observe the various machineries used in process Observe the various machineries used in process Observe the cleaning methods and processes followed to maintain the process machineries and tools Observe the raw materials used and their storage procedures Observe the packaging and storage processes of raw material and finished product Observe the post-production cleaning and maintenance process followed in the industry	All the tools and equipment listed above must be available at the site of field visit
12	**Revision** **Theory Duration** (hh:mm) 02:00	Revised the knowledge gained so far	All the tools and equipment listed above must be available at the time of revision

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Practical Duration (hh:mm) 02:00 **Corresponding NOS Code**		
13	**Evaluation** **Theory Duration** (hh:mm) 08:00 **Practical Duration** (hh:mm) 20:00 **Corresponding NOS Code**	Assess the knowledge and skills acquired by the participants	All the tools and equipment listed above must be available for evaluation
14	**On-the-job Training** **Theory Duration** (hh:mm) 30:00 **Practical Duration** (hh:mm) 65:00 **Corresponding NOS Code**	Apply the skills and knowledge acquired in the training program in the field	All the tools and equipment listed above must be available on the site at the time of OJT
	Total Duration 240:00 **Theory Duration 88:00** **Practical Duration 152:00**	**Unique Equipment Required:** Laptop, white board, marker, chart papers, projector, trainer's guide and student handbook , cleaning machines, destoner, pulverizer, kneader, mixer, roaster, dryer, oven, extruder, packaging machines flaker, machineries blender, Measurement Cane; Weighing balance, Timer, Gas with Burner; Knives, spatulas, packing wrap rolls, measuring cup and spoons, utensils, ladle, ladle with holes, digital hygrometer, Muslin Cloth; Weighing Machine; Milk Stirrer; Thermometer; Test Tube (Glass); Test Tube Holder; Gas with Burner,	

Grand Total Course Duration: **240Hours, 0 Minutes**

*(This syllabus/ curriculum has been approved by **SSC: Food Industry Capacity and Skill Initiative)***

Trainer Prerequisites for Job role: “Production Manager” mapped to Qualification Pack: “FIC/Q9003, v1.0”

Sr. No.	Area	Details
1	**Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack “FIC/Q9003”, Version 1.0
2	**Personal Attributes**	An aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training, and pre/post work to ensure competent, employable candidates at the end of the training. Strong communication skills, ability to work as part of a team; a passion for quality and for developing others; well-organized and focused, eager to learn and keep oneself updated with the latest in the mentioned fields.
3	**Minimum Educational Qualifications**	M.Sc/M.Tech/ME in Food Technology or Food Engineering with 5-6 years of hands on experience in a food industry B.Sc (home Sc) /B.Tech/BE in Food Technology or Food Engineering with 7-8 years of hands on experience in a food industry
4a	**Domain Certification**	Certified for Job Role: “Production Manager” mapped to QP: “FIC/Q9003, v1.0”. Minimum accepted score is 80%
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: “Trainer”, mapped to the Qualification Pack: “SSC/Q1402”. Minimum accepted SCORE IS 80 % as per FICSI guidelines.
5	**Experience**	M.Sc/M.Tech/ME in Food Technology or Food Engineering with 5-6 years of hands on experience in a food industry B.Sc (home Sc) /B.Tech/BE in Food Technology or Food Engineering with 7-8 years of hands on experience in a food industry

Annexure: Assessment Criteria

Assessment Criteria	
Job Role	Production Manager
Qualification Pack	FIC/Q9003, v1.0
Sector Skill Council	Food Processing

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack will be created by the Sector Skill Council. Each Performance Criteria (PC) will be assigned marks proportional to its importance in NOS. SSC will also lay down proportion of marks for Theory and Skills Practical for each PC.
2	The assessment for the theory part will be based on knowledge bank of questions created by the SSC.
3	Individual assessment agencies will create unique question papers for theory part for each candidate at each examination/training centre(as per assessment criteria below)
4	Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training canter based on this criteria
5	To pass the Qualification Pack, every trainee should score a minimum of 70% (overall) in every QP
6	The marks are allocated PC wise; however, every NOS will carry a weight age in the total marks allocated to the specific QP

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
1. FIC/N9014: Manage production process in food processing unit	PC1. Communicate clearly the organisation policies and goals to the employees of production team, make them understand and commit their energy and expertise to achieve organisation goals	100	2.5	1	1.5
	PC2. Achieve department targets and organisation goals by understanding the organisation and employees, developing a leadership style and applying them appropriately		2.5	1	1.5
	PC3. Communicate with employees regularly and effectively, help them identify their strengths, provide support to overcome their weakness, listen to their grievances and provide appropriate solutions, and win their support		3	1	2
	PC4. Motivate and support employees to achieve their work and development objectives, and provide recognition when they are successful		2.5	1	1.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	PC5. Encourage employees to take responsibilities, to take own decisions within agreed boundaries, to take lead in their own areas of expertise for their development		2.5	1	1.5
	PC6. Initiate personnel actions, such as promotions, transfers, discharges or disciplinary measures		3	1	2
	PC7. Lead production department and team successfully through difficulties and challenges		3	1	2
	PC8. Review the sales forecast for the week/month (or) monthly production plan discussed with plant manager (or) customer requirement (as applicable) and identify production priorities to meet market requirement		3	1	2
	PC9. Identify and confirm resource availability like raw materials, packing materials, equipment availability and capacity, production capacity, manpower requirement and availability, stock level, storage capacity, transport capacity etc		3	1	2
	PC10. Plan details of production in terms of output quantity and quality, cost, time and manpower requirements		3	1	2
	PC11. Analyze the consequences of failing to meet production/delivery timelines to meet the schedule, notifying relevant authorities of any possibility that demand cannot be met within required timeframe		3	1	2
	PC12. Develop production schedule to meet market demands/priorities and delivery timelines within budget and with available resources, consult production plan with inter department heads and production supervisor, instruct supervisor to allocate work to production team		3	1	2
	PC13. Communicate the production schedule to cross function heads through communication system followed by the organisation like e-mail or upload in the erp system		**2.5**	**1**	**1.5**
	PC14. Identify and confirm equipment requirements to meet production target, share production schedule with equipment requirement to maintenance manager/supervisor for		**2.5**	**1**	**1.5**

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	maintenance plan that aligns with production plan				
	PC15. Co-ordinate with maintenance manager/supervisor to understand materials, consumables and manpower requirement and availability for maintenance activities, for uninterrupted production		3	1	2
	PC16. Understand equipment maintenance process and procedure and co-ordinate for maintenance activities during breakdown, emergency response, routine cleaning and servicing etc		2.5	1	1.5
	PC17. Analyze equipment maintenance data to interpret equipment performance and arrive at production capability of each process equipment		3	1	2
	PC18. Co-ordinate with maintenance team to ensure reliable equipment performance with minimal disruption to production, to minimize down time during equipment breakdowns, and to optimize equipment efficiency to achieve production target		3	1	2
	PC19. Lead and build team spirit between production and maintenance personnel through effective communication to enhance equipment performance and to identify production improvement opportunities		2.5	1	1.5
	PC20. Ensure maintenance procedures followed meet food safety and environmental requirements		2.5	1	1.5
	PC21. Monitor production process for usage of raw materials, packaging materials, manpower, wastage against production plan and identify reason for variances against plan		3	1	2
	PC22. Address the reason for variation in achieving production schedule, production target within allocated budget		3	1	2
	PC23. Adjust production schedule in response to variables affecting achievement of production target		3	1	2
	PC24. Monitor production output and cost, adjust processes and resources to minimize cost and to achieve quantity and quality product		3	1	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	PC25. Reschedule production plan in case of urgent requirement or any unforeseen event, to minimize wastage and to utilize materials/utilities and resources efficiently, discuss and negotiate changes with inter department team on time for their support and team work		3	1	2
	PC26. Review production schedule and process, consult /discuss with supervisor, team and cross function teams identify opportunities for improvement and develop recommendations for improvement on production process		3	1	2
	PC27. Set polices, plans and procedures, and take initiative to implement the identified improvement opportunities to control cost and to achieve better yield and quality		3	1	2
	PC28. Monitor, review and ensure production details are documented to meet the documentation requirements of the organisation, and to meet audit requirements like iso, haccp etc		3	1	2
	PC29. Understand objective of trial production, trial product processing method and specification, select production team for trial, discuss with cross function team like planning, qa, maintenance etc, clarify roles and responsibilities and level of authority to the team and cross function		3	1	2
	PC30. Prepare technical production procedures considering all engineering and process parameters for new product trial, educate and train supervisors and operators on trial procedure		3	1	2
	PC31. Identify and consider all possible hazards, prepare plan and procedures to prevent and control hazards, provide training to trial team to handle hazards		2.5	1	1.5
	PC32. Prepare detailed trial production schedule to manage production process without overlapping/affecting with regular production, and considering availability of raw materials and packaging materials,		3	1	2

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	machine availability and capability, man power availability and competency etc				
	PC33. Monitor trial production against plan to identify variances and factors that need to be adjusted to achieve product of required specification within the planned time		**3**	**1**	**2**
	PC34. Document and evaluate trial production data and identify process/parameters to be modified/changed to achieve product of required specification		**3**	**1**	**2**
	PC35. Prepare trial production report with recommendations on improvement opportunities, and share with cross function heads and relevant authorities for suggestion and consideration		**3**	**1**	**2**
2. FIC/N9015: Manage production optimization and cost efficiency in food processing unit	PC1. Review production reports and analyze equipment performance, process capability, change over time, maintenance, consumables, power etc, to identify factors that affect performance of production and recommend improvement opportunities	**100**	2	0.5	1.5
	PC2. Compile performance data on process and equipment to identify cause for lack of performance, evaluate opportunities to improve, identify cost saving options, propose changes in process, and implement proposal with proper approvals		3	0.5	2.5
	PC3. Review production process with supervisor and machine operators to identify reasons for slowdown or stop of production process, provide recommendations to overcome efficiency issues, take feedback, develop plans for implementing recommended changes, monitor changes implemented, and review changes and improvement		3	1	2
	PC4. Calculate utilities and energy usage in production area and for production process, identify methods to minimize usage		2	0.5	1.5
	PC5. Develop plans and procedures to minimize use of utilities and energy		2	0.5	1.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	without affecting the production efficiency				
	PC6. Identify energy and utility losses or sources of waste, analyze reason, recommend methods to improve efficient energy/utility application, ensure recommendations are implemented, and monitor improvement		2	0.5	1.5
	PC7. Identify areas where utilities and energy can be saved, and identify methods to save energy like recycling energy and utilities such as steam, heat and water, following proper maintenance methods to avoid leaks and losses etc, and prepare efficient production schedule such that target is met with efficient utilization of energy and utility		3	1	2
	PC8. Analyze usage pattern of energy and other utilities in production area and process against budget allocation, identify cost effective options for minimizing wastage, and implement changes		3	1	2
	PC9. Identify system, production process that need to be changed, identify opportunities for implementing change in production process, analyze impact of change on product quality, impact on the team and present production process		3	1	2
	PC10. Communicate with relevant authorities/superiors the need for change, results and benefits expected our of change		1	0.5	0.5
	PC11. Design new processes, procedures, systems, structures with roles and responsibilities, key performance indicators, training needs, safety system, contingency plans, monitoring and reporting system to implement planned changes in production process		1	0.5	0.5
	PC12. Provide training and support to implement changes, develop a strategy to help teams implement change		2	0.5	1.5
	PC13. Monitor changes implemented in production process and ensure		4	1.5	2.5

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation Theory	Skills Practical
	changes are effective and meet the organisation and regulatory requirements				
	PC14. Document and communicate the progress achieved through implemented change to the management and everyone involved, and make them understand and enjoy achievement		4	1.5	2.5
	PC15. Recognize and reward employees and teams for implementing change in production system and achieving better efficiency		5	2	3
	PC16. Manage budget efficiently by managing production with available resource, by avoiding overtime and too many casual workers/helpers		4	1.5	2.5
	PC17. Plan effectively to secure, confirm and allocate required manpower to meet production target within budget, monitor resource utilization, to achieve production target within existing resource		4	1.5	2.5
	PC18. Identify situations where actual budget exceeds the approved budget, investigate reason for variance and take appropriate corrective action to keep budget under control		1	0.5	0.5
	PC19. Identify the impact on budget of production-related decisions like scheduling holidays, adjusting production volume, scheduling equipment maintenance etc, before scheduling production, and identify opportunities to improve performance against budget		1	0.5	0.5
	PC20. Identify the causes for any significant variances in budget control, discuss with team and ensure prompt corrective action is taken to keep expenditure under control		3	1	2
	PC21. Encourage team to think and identify ways of reducing expenditure, analyze and pursue the suggested ideas		4	1	3
			100	**35**	**65**
3. FIC/N9016: Manage documentation system and implement	PC1. Establish to production team the importance of documentation, provide training on documentation system, and ensure all documents are maintained systematically	**100**	6	2	4

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
safety and environmental policies in food processing unit	PC2. Ensure all relevant records and documents are complete, up-todate and accessible for audits on production process		6	2	4
	PC3. During audit provide the auditor with access to all relevant information, records and documents		6	3	3
	PC4. Ensure corrective actions recommended and implemented are documented to assure production process is carried in accordance with organisation and regulatory standards		6	2	4
	PC5. Establish methods to track production information from documented and maintained records		5	2	3
	PC6. Establish to production team importance of safety and environment requirements related to food processing unit, communicate information about safety and environmental policies and related procedures to the team		6	2	4
	PC7. Co-ordinate with quality team to prepare policies and sops on safety and environment requirements related to production function, and ensure those procedure are followed in production area and during production process		6	2	4
	PC8. Ensure safe work procedures are followed in production area and during production process		6	2	4
	PC9. Ensure policies and standard operating procedures on safety and environment requirements are accessible to all employees of production team, and are followed to meet the regulatory requirements		5	2	3
	PC10. Identify safety and environmental hazards relevant to production processes, implement system to handle risks		6	2	4
	PC11. Provide or organize training through relevant authorities on safety and environmental management system, to understand methods to control and prevent hazards		6	2	4
	PC12. Conduct inspections in work place on use of protective clothing and accessories, and to ensure safety		6	2	4

Assessable Outcome	Assessment Criteria	Total Mark (600)	Out Of	Marks Allocation	
				Theory	Skills Practical
	system is followed during production process				
	PC13. Conduct audits and review records on safety and environmental system to monitor if control systems are followed by production team, and address non-compliance following organisation standards		6	2	4
	PC14. Implement system on waste management in production area and process, monitor and confirm waste collection, treatment, recycling or disposal is carried out meeting industry requirements and environmental regulations		6	2	4
	PC15. Respond to environmental management hazard identification and incidents in an appropriate and timely way		6	2	4
	PC16. Review practice and procedures followed on safety, conduct risk assessments, identify non-compliance, andprovide recommendations to address gaps and non-conformances		6	2	4
	PC17. Review environmental records documents maintained, analyze data to evaluate effectiveness of the environmental management system and identify areas for improvement, plan and implement improvements to meet regulatory requirements		6	2	4
	Total		**100**	**35**	**65**
	Grand Total	**400**	**400**	**300**	**100**
	Percentage Weightage		**100**	**60%**	**40%**
	Minimum Pass% to qualify (aggregate):			**70%**	

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE

(An Autonomous College of University of Mysore)

Re-accredited by NAAC with 'A' grade

OOTY ROAD, MYSORE-570 025, KARNATAKA

SYLLABUS

Programme: B. Voc. (Software Development)

Model Curriculum

JUNIOR SOFTWARE DEVELOPER

JUNIOR SOFTWARE DEVELOPER

SECTOR: **IT-ITeS**
SUB-SECTOR: **IT Services**
OCCUPATION: **Application Development**
REFERENCE ID: **SSC/Q0508, version 1.0** NSQF LEVEL: **4**

Model Curriculum for Junior Software Developer

Table of Contents

Junior Software Developer

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of **Junior Software Developer** in the **IT-ITeS** Sector/Industry and aims at building the following key competencies in the learner.

Program Name	Junior Software Developer		
Qualification Pack Name & Reference ID.	Junior Software Developer SSC/Q0508, version 1.0		
Version No.	1.0	**Version Update Date**	31/12/2015
Pre-requisites to Training	10th Standard		
Training Outcomes	**After completing this programme, participants will be able to:** • assist in performing software construction and software testing entry-level tasks in the IT Services industry • manage work to meet requirements • maintain a healthy, safe and secure working environment		

The Course encompasses all six National Occupational Standards (NOS) of **Junior Software DeveloperSSC/Q0508** Qualification Pack issued by **IT-ITeS Sector Skills Council NASSCOM**.

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
1	Basics of IT	05:00	15:00	Candidates will be able to: • Demonstrate basic computer and internet literacy including operating a computer, describing its major components and how they work, using Windows and Linux OS, operating a browser, searching the internet, managing mails and using	SSC/N0506	Refer to Unique Equipment Required section

				social internet media.		
2	Problem Solving and Program Design	30:00	60:00	Candidates will be able to: - Demonstrate aptitude for analysing information and making logical conclusions.	SSC/N0506	Refer to Unique Equipment Required section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• Demonstrate knowledge of the foundational mathematical concepts in computing.		
3	Basic Algorithms and Application Development	30:00	60:00	Candidates will be able to: • Design algorithms to solve problems and convert them into code using the appropriate programming language constructs. • Read and execute a test case and record the outcome in the appropriate template. • Communicate effectively with appropriate people w.r.t. assigned roles in simple English – both oral and written.	SSC/N0506	Refer to Unique Equipment Required section
4	Self and work Management	30:00	70:00	Candidates will be able to: • Establish and agree work requirements with appropriate people • Keep immediate work area clean and tidy • Utilize time effectively • Use resources correctly and efficiently • Treat confidential information correctly • Work in line with organization's policies and procedures • Work within the limits of job role • Obtain guidance from appropriate people, where necessary • Ensure work meets the agreed requirements	SSC/N9001	Refer to Unique Equipment Required section
5	Team Work and	12:00	38:00	Candidates will be able to: • Obtain guidance from	SSC/N9002	Refer to Unique

	Communication			appropriate people to agree the analysis to be performed on the data • Obtain advice and guidance from appropriate people on issues with data analysis		Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				outside their area of competence or • Review the results of their analysis with appropriate people • Undertake modifications to your analysis based on inputs from appropriate people • Communicate with colleagues clearly, concisely and accurately • Work with colleagues to integrate their work effectively with them • Pass on essential information to colleagues in line with organizational requirements • Work in ways that show respect for colleagues • Carry out commitments they have made to colleagues • Let colleagues know in good time if they cannot carry out your commitments, explaining the reasons • Identify any problems they have working with colleagues and take the initiative to solve these problems • Follow the organization's policies and procedures for working with colleagues		

6	Managing Health and Safety	12:00	38:00	Candidates will be able to: • Comply with organization's current health, safety and security policies and procedures • Report any identified breaches in health, safety, and security policies and procedures to the designated person • Identify and correct any hazards that can deal with	SSC/N9003	Refer to Unique Equipment Required section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				safely, competently and within the limits of authority • Report any hazards that one is not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected • Follow their organization's emergency procedures promptly, calmly, and efficiently • Identify and recommend opportunities for improving health, safety, and security to the designated person • Complete any health and safety records legibly and accurately		

7	Data and Information Management	15:00	35:00	Candidates will be able to: • Establish and agree with appropriate people the data/information they need to provide, the formats in which you need to provide it, and when they need to provide it • Obtain the data/information from reliable sources • Check that the data/information is accurate, complete and up-to-date • Obtain advice or guidance from appropriate people where there are problems with the data/information • Carry out rule-based analysis of the data/information, if required • Insert the data/information into the agreed formats • Check the accuracy of work, involving colleagues where required • Report any unresolved anomalies in the	SSC/N9004	Refer to Unique Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				data/information to appropriate people • Provide complete, accurate and up-to-date data/information to the appropriate people in the required formats on time		

8	Learning and Self Development	05:00	20:00	Candidates will be able to: • Obtain advice and guidance from appropriate people to develop your knowledge, skills and competence • Identify accurately the knowledge and skills they need for your job role • Identify accurately their current level of knowledge, skills and competence and any learning and development needs • Agree with appropriate people a plan of learning and development activities to address their learning needs • Undertake learning and development activities in line with their plan • Apply new knowledge and skills in the workplace, under supervision • Obtain feedback from appropriate people on their knowledge and skills and how effectively you apply them • Review their knowledge, skills and competence regularly and take appropriate action	SSC/N9005	Refer to Unique Equipment Required Section
	Total Duration:	**114:00**	**286:00**	**Unique Equipment Required:** Training room should be fully furnished with the following equipment / tools / accessories. Additional / specific resources, wherever applicable (e.g. Hardware, software) are indicated in the main text corresponding to relevant learning outcome.		
Sr. No.	**Module**	**Theory Duration (hh:mm)**	**Practical Duration (hh:mm)**	**Key Learning Outcomes**	**Corresponding NOS Code**	**Equipment Required**

				For Domain NOS, For NOS SSC/N0506 – HTML, C++ / Java, IDE General: • Comfortable seats with adequate lighting, controlled temperature and acoustics for training and learning • White Board, Markers and Eraser • Projector with screen • Flip chart with markers • Faculty's PC/Laptop with latest configuration and internet connection • Supporting software / applications for projecting audio, video, recording, • Presentation Tools to support learning activities: • Intranet • Email • IMs • Learning management system e.g. Moodle, Blackboard to enable blended learning • Microphone / voice system for lecture and class activities • Handy Camera • Stationery kit – Staples, Glue, Chart Paper, Sketch Pens, Paint Box, Scale, A4 Sheets ✓For IT Lab sessions: Computer Lab with 1:1 PC : trainee ratio and having internet connection, MS Office / Open office, Browser, Outlook / Any other Email Client and chat tools. • Assessment and Test Tools for day to day online Tests and Assessments • For team discussions: Adequate seating arrangement in full / half circle format for one or more teams as per planned team composition. • Reading Resources: Access to relevant sample documents and learning forums to enable self-study before and after each training session.

Grand Total Course Duration: **400 Hours 0 Minutes**

*(This Syllabus/Curriculum has been approved by **IT-ITeS Sector Skills Council NASSCOM**.)*

Notes from IT-ITeS Sector Skills Council NASSCOM

1. This document outlines the broad scope of coverage. This should be linked with OBF and training delivery plan. OBF (Outcome based framework) reflects the pedagogy used to ensure an expected outcome. Training delivery plan focuses on the sequence of delivery.
2. Though many NOSs have some seemingly common outcomes, notably core/generic, professional and technical skills, it is imperative to understand the contextual difference between them. For example, writing skills required to document program structure and code (in SSC/N0506) are different from the writing skills required to prepare a time plan (in SSC/N9001). Training providers are advised to,
    a. Embed such skills development in the learning pedagogy for each expected outcome
    b. Prepare a detailed session plan for training delivery with focus on sequence and duration of training
    c. Run a diagnostic test to assess prior learning of students and help trainers / students identify the need for gap training, optimal duration and suitable training methodology. Accordingly, more introductory level sessions may be included in guided or self-paced mode of learning. E.g. adding some sessions on Functional English or Use of Internet and MS Office.

Annexure1: Assessment Criteria

Assessment Criteria for Junior Software Developer	
Job Role	**Junior Software Developer**
Qualification Pack	**SSC/Q0508**
Sector Skill Council	**IT-ITeS**

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack (QP) will be created by the Sector Skill Council (SSC). Each performance criteria (PC) will be assigned Theory and Skill/Practical marks proportional to its importance in NOS.
2	The assessment will be conducted online through assessment providers authorised by SSC.
3	Format of questions will include a variety of styles suitable to the PC being tested such as multiple choice questions, fill in the blanks, situational judgment test, simulation and programming test.
4	To pass a QP, a trainee should pass each individual NOS. Standard passing criteria for each NOS is 70%.
5	For latest details on the assessment criteria, please visit www.sscnasscom.com.

				MARKS ALLOCATION	
ASSESSMENT OUTCOME (NOS CODE AND DESCRIPTION)	**Assessment criteria** (PC)	**Total Marks**	**Out Of**	**Theory**	**Skills Practical**
1.SSC/N0506 (Deal remotely with customer queries - Domestic)	PC1. greet customers and verify details, following your organization's procedures	**120**	12.5	2.5	10
	PC2. read carefully, summarize, and obtain **customer** confirmation of, your understanding of queries		12.5	2.5	10
	PC3. express your concern for any difficulties caused and your commitment to resolving queries		15	0	15
	PC4. record and categorize queries accurately using your organization's query management tool		5	0	5
	PC5. refer queries outside your area of competence or authority promptly to appropriate people		2.5	0	2.5
	PC6. access your organization's knowledge		2.5	0	2.5

	base for solutions to queries, where available				
	PC7. resolve queries within your area of competence or authority in line with organizational guidelines and service level agreements (SLAs)		15	0	15
	PC8. obtain advice and guidance from appropriate people, where necessary		2.5	0	2.5
	PC9. obtain confirmation from customers that queries have been resolved to satisfaction		10	0	10
	PC10. record the resolution of queries accurately using your organization's query management tool		35	15	20
	PC11. comply with relevant standards, policies, procedures and guidelines when dealing remotely with customer queries		7.5	0	7.5
		NOS Total	**120**	**20**	**100**
2.SSC/N9001 (Manage your work to meet requirements)	PC1. establish and agree your work requirements with appropriate people	**40**	10	5	5
	PC2. keep your immediate work area clean and tidy		5	0	5
	PC3. utilize your time effectively		5	5	0
	PC4. use resources correctly and efficiently		5	2.5	2.5
	PC5. treat confidential information correctly		5	0	5
	PC6. work in line with your organization's policies and procedures		2.5	0	2.5
	PC7. work within the limits of your job role		2.5	0	2.5
	PC8. obtain guidance from appropriate people, where necessary		2.5	0	2.5
	PC9. ensure your work meets the agreed requirements		2.5	0	2.5
		NOS Total	**40**	**12.5**	**27.5**
3.SSC/N9003 (Maintain a healthy, safe and secure working environment)	PC1. comply with your organization's current health, safety and security policies and procedures	**40**	10	5	5
	PC2. report any identified breaches in health, safety, and security policies and procedures to the designated person		5	0	5
	PC3. identify and correct any hazards that you can deal with safely, competently and within the limits of your authority		10	5	5

	PC4. report any hazards that you are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected		5	0	5
	PC5. follow your organization's emergency procedures promptly, calmly, and efficiently		5	0	5
	PC6. identify and recommend opportunities for improving health, safety, and security to the designated person		2.5	0	2.5
	PC7. complete any health and safety records legibly and accurately		2.5	0	2.5
		NOS Total	**40**	**10**	**30**

Annexure2: Trainer Prerequisites for Job role: Junior Software Developer mapped to Qualification Pack: SSC/Q0508

Sr. No.	Area	Details
1	**Job Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack SSC/Q0508.
2	**Personal Attributes**	Aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training. Strong communication skills, interpersonal skills, ability to work as part of a team; a passion for quality and for developing others; well-organised and focused, eager to learn and keep oneself updated with the latest in this field.
3	**Minimum Educational Qualifications**	Minimum 12thStandard; Preferred Master's degree in any discipline
4a	**Domain Certification**	Minimum accepted score in SSC Assessment is 90% per NOS being taught in QP SSC/Q0508. Additional certification in customer orientation, dealing with difficult customers, written communication etc. will be an added advantage.
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer" mapped to the Qualification Pack: "SSC/Q1402". Minimum accepted score is 70% per NOS.

5	**Experience**	Field experience: Minimum 2 years' experience in the same domain Training experience: 1 year preferred

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

IT-ITES SECTOR SKILLS COUNCIL NASSCOM

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Junior Software Developer**' QP No. '**SSC/Q0508 NSQF Level 4**'

Date of Issuance: December 31st, 2015

Valid up to*: December 31st, 2016

* Valid up to the next review date of the Qualification Pack

Authorised Signatory
Lakshmi Narayan
(Chairman, IT-ITeS Sector Skills Council NASSCOM)

4E-Vandana Building (4th Floor)
11, Tolstoy Marg
New Delhi-110001
Phone: 91-11- 4151 9230/60
Fax: 91-11- 4151 9240
Email: ssc@nasscom.in

Model Curriculum

WEB DEVELOPER

WEB DEVELOPER

SECTOR:	**IT-ITeS**
SUB-SECTOR:	**IT Services**
OCCUPATION:	**Application Development**
REFERENCE ID:	**SSC/Q0503, version 1.0**
NSQF LEVEL:	**5**

Format: ModCur_2015_1_0

Model Curriculum for Web Developer SSC/Q0503

Table of Contents

Web Developer

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of **Web Developer** in the **IT-ITeS** Sector/Industry and aims at building the following key competencies in the learner.

Program Name	**Web Developer**		
Qualification Pack Name & Reference ID.	Web Developer SSC/Q0503, version 1.0		
Version No.	1.0	**Version Update Date**	31/12/2015
Pre-requisites to Training	Graduate degree/ diploma in web design/ media design or any other related field		
Training Outcomes	**After completing this programme, participants will be able to:** • Contribute to the design of software products and applications • Develop media content and graphic designs for software products and Applications • Manage their work to meet requirements • Work effectively with colleagues • Maintain a healthy, safe and secure working environment • Provide data/information in standard formats • Develop their knowledge, skills and competence		

The Course encompasses all seven National Occupational Standards (NOS) of **Web Developer SSC/Q0503** Qualification Pack issued by **IT-ITeS Sector Skills Council NASSCOM**.

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
1	Programming for the Web	20:00	30:00	Candidates will be able to: - Design basic programming structures to implement functionalityin line with requirements defined in BRS/URS, SRS and HLD	SSC/N0501	Refer to Unique Equipment Required Section

IT - ITeS SSC NASSCOM

N·S·D·C National Skill Development Corporation Transforming the skill landscape

2	Analysis and Design of Web based Applications	20:00	30:00	Candidates will be able to: • Check their understanding of the Business Requirements Specification (BRS)/User	SSC/N0501	Refer to Unique Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				Requirements Specification (URS) with appropriate people • Check their understanding of the Software Requirements Specification (SRS) with appropriate people • Check their understanding of High Level Design (HLD) with appropriate people • Review their designs with appropriate people • Analyse inputs from appropriate people to identify, resolve and record design defects and inform future designs • Document their designs using standard templates and tools • Comply with their organization's policies, procedures and guidelines when contributing to the design of software products and applications		

3	Media Content and Graphics Design	20:00	80:00	Candidates will be able to: • Check their understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people • Access reusable components, media and graphical packages and tools from their organization's knowledge base	SSC/N0503	Refer to Unique Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• Convert requirements into media content and graphic designs, leveraging reusable components where available • Review media content and graphic designs with appropriate people and analyze their feedback • Record any defects and corrective actions taken to inform future work • Rework media content and graphic designs, incorporating feedback • Submit media content timely and graphic designs for approval by appropriate people • Update their organization's knowledge		

				base with their experiences of the media content and graphic designs developed • Comply with their organization's policies, procedures and guidelines when developing media content and graphic designs for software products and applications		
4	Self and work Management	12:00	38:00	Candidates will be able to: • Establish and agree their work requirements with appropriate people • Keep their immediate work area clean and tidy • utilize their time effectively	SSC/N9001	Refer to Unique Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• Use resources correctly and efficiently • Treat confidential information correctly • Work in line with organization's policies and procedures • Work within the limits of their job role • Obtain guidance from appropriate people, where necessary • Ensure their work meets the agreed requirements		

IT - ITeS SSC NASSCOM

N·S·D·C National Skill Development Corporation Transforming the skill landscape

5	Team Work and Communication	12:00	38:00	Candidates will be able to: • Communicate with colleagues clearly, concisely and accurately • Work with colleagues to integrate their work effectively with them • Pass on essential information to colleagues in line with organizational requirements • Work in ways that show respect for colleagues • carry out commitments they have made to colleagues • Let colleagues know in good time if they cannot carry out their commitments, explaining the reasons • Identify any problems they have working with colleagues and take the initiative to solve these problems • Follow the organization's policies and procedures for working with colleagues	SSC/N9002	Refer to Unique Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required

6	Managing and Health Safety	05:00	20:00	Candidates will be able to: • Comply with their organization's current health, safety and security policies and procedures • Report any identified breaches in health, safety, and security policies and procedures to the designated person • Identify and correct any hazards that they can deal with safely, competently and within the limits of their authority • Report any hazards that they are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected • Follow their organization's emergency procedures promptly, calmly, and efficiently • Identify and recommend opportunities for improving health, safety, and security to the designated person • Complete any health and safety	SSC/ N 9003	
7	Data and Information Management	15:00	35:00	Candidates will be able to: • Establish and agree with appropriate people the data/information they need to provide, the formats in which they need to provide it, and when they need to provide it	SSC/N9004	Refer to Unique Equipment Required Section

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• Obtain the data/information from reliable sources • Check that the data/information is accurate, complete and up-to-date • Obtain advice or guidance from appropriate people where there are problems with the data/information • Carry out rule-based analysis of the data/information, if required • Insert the data/information into the agreed formats • Check the accuracy of their work, involving colleagues where required • Report any unresolved anomalies in the data/information to appropriate people • Provide complete, accurate and up-to-date data/information to the appropriate people in the required formats on time		
8	Learning and Self Development	5:00	20:00	Candidates will be able to: • Obtain advice and guidance from appropriate people to develop their knowledge, skills and competence • Identify accurately the knowledge and skills they	SSC/N9005	Refer to Unique Equipment Required Section

				need for their job role • Identify accurately their current level of knowledge, skills and		

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				competence and any learning and development needs • Agree with appropriate people a plan of learning and development activities to address their learning needs • Undertake learning and development activities in line with their plan • Apply their new knowledge and skills in the workplace, under supervision • Obtain feedback from appropriate people on their knowledge and skills and how effectively they apply them • Review their knowledge, skills and competence regularly and take appropriate action		

IT - ITeS SSC
NASSCOM

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

	Total Duration:	**109:00**	**291:00**	**Unique Equipment Required**: Training room should be fully furnished with the following equipment / tools / accessories. Additional / specific resources, wherever applicable (e.g. Hardware, software) are indicated in the main text corresponding to relevant learning outcome. For Domain NOSs: • NOS SSC/N0501: HTML5, Javascript, CSS, SQL, Web Builder, Word Press, Joomla and modelling tools such as Visio, UML • NOS SSC/N0503: HTML5, CSS, Flash, Photoshop, Windows media player, Eclipse, XAMPP General: • Comfortable seats with adequate lighting, controlled temperature and acoustics for training and learning

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• White Board, Markers and Eraser • Projector with screen • Flip chart with markers • Faculty's PC/Laptop with latest configuration and internet connection • Supporting software / applications for projecting audio, video, recording, • Presentation Tools to support learning activities: ○ Intranet ○Email ○IMs ○ Learning management system e.g. Moodle, Blackboard to enable blended learning • Microphone / voice system for lecture and class activities ✓ Handy Camera • Stationery kit – Staples, Glue, Chart Paper, Sketch Pens, Paint Box, Scale, A4 Sheets • For IT Lab sessions: Computer Lab with 1:1 PC:trainee ratio and having internet connection, MS Office / Open office, Browser, Outlook/ other Email Clients • Assessment and Test Tools for day to day online Tests and Assessments • For team discussions: Adequate seating arrangement in full / half circle format for one or more teams as per planned team composition. • Reading Resources: Access to relevant sample documents and learning forums to enable self-study before and after each training session.		

Grand Total Course Duration: **400 Hours 0 Minutes**

*(This Syllabus/Curriculum has been approved by **IT-ITeS Sector Skills Council NASSCOM**.)* **Notes from IT-ITeS Sector Skills Council**

1. This document outlines the broad scope of coverage. This should be linked with OBF and training delivery plan. OBF (Outcome based framework) reflects the pedagogy used to ensure an expected outcome. Training delivery plan focuses on the sequence of delivery.

2. Though many NOSs have some seemingly common outcomes, notably core/generic, professional and technical skills, it is imperative to understand the contextual difference between them. For example, writing skills required write design specifications (in SSC/N0501) are different from the writing skills required to prepare a time plan (in SSC/N9001). Training providers are advised to,
    a. Embed such skills development in the learning pedagogy for each expected outcome
    b. Prepare a detailed session plan for training delivery with focus on sequence and duration of training
    c. Run a diagnostic test to assess prior learning of students and help trainers / students identify the need for gap training, optimal duration, and suitable training methodology. Accordingly, more introductory level sessions may be included in guided or self-paced mode of learning. E.g. adding some sessions on Functional English or Use of Internet and MS Office.

Annexure 1: Assessment Criteria

Assessment Criteria for Web Developer	
Job Role	**Web Developer**
Qualification Pack	**SSC/Q0503**
Sector Skill Council	**IT-ITeS**

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack (QP) will be created by the Sector Skill Council (SSC). Each performance criteria (PC) will be assigned Theory and Skill/Practical marks proportional to its importance in NOS.
2	The assessment will be conducted online through assessment providers authorised by SSC.
3	Format of questions will include a variety of styles suitable to the PC being tested such as multiple choice questions, fill in the blanks, situational judgment test, simulation and programming test.
4	To pass a QP, a trainee should pass each individual NOS. Standard passing criteria for each NOS is 70%.
5	For latest details on the assessment criteria, please visit www.sscnasscom.com.

				MARKS ALLOCATION	
ASSESSMENT OUTCOME (NOS CODE AND DESCRIPTION)	**ASSESSMENT CRITERIA** (PC)	**TOTAL MARKS**	**OUT OF**	**THEORY**	**SKILLS PRACTICAL**
1. SSC/N0501 (Contribute to the design of software products and applications)	PC1. check their understanding of the Business Requirements Specification (BRS)/User Requirements Specification (URS) with appropriate people	**100**	10	10	0
	PC2. check their understanding of the Software Requirements Specification (SRS) with appropriate people		10	10	0
	PC3. check their understanding of High Level Design (HLD) with appropriate people		10	10	0
	PC4. design basic programming structures to implement functionality in line with requirements defined in BRS/URS, SRS and HLD		30	0	30
	PC5. review their designs with appropriate people		5	5	0
	PC6. analyze inputs from appropriate people to identify, resolve and record design defects and inform future designs		15	5	10

	PC7. document their designs using standard templates and tools		10	0	10
	PC8. comply with their organization's policies, procedures and guidelines when contributing to the design of software products and applications		10	0	10
		Total	100	40	60
2. SSC/N0503 (Develop media content and graphic designs for software products and Applications)	PC1. check their understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people	**100**	10	10	0
	PC2. access reusable components, media and graphical packages and tools from their organization's knowledge base		10	0	10
	PC3. convert requirements into media content and graphic designs, leveraging reusable components where available		20	0	20
	PC4. review media content and graphic designs with appropriate people and analyze their feedback		10	5	5
	PC5. record any defects and corrective actions taken to inform future work		10	0	10
	PC6. rework media content and graphic designs, incorporating feedback		10	5	5
	PC7. submit media content and graphic designs for approval by appropriate people		10	0	10
	PC8. update their organization's knowledge base with their experiences of the media content and graphic designs developed		10	0	10
	PC9. comply with their organization's policies, procedures and guidelines when developing media content and graphic designs for software products and applications		10	0	10
		Total	100	20	80
3.SSC/N9001 (Manage their work to meet requirements)	PC1. establish and agree their work requirements with appropriate people	**100**	7.5	0	7.5
	PC2. keep their immediate work area clean and tidy		15	7.5	7.5
	PC3. utilize their time effectively		15	7.5	7.5
	PC4. use resources correctly and efficiently		15	7.5	7.5

IT - ITeS SSC
NASSCOM

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

	PC5. treat confidential information correctly		7.5	0	7.5
	PC6. work in line with their organization's policies and procedures		15	0	15
	PC7. work within the limits of their job role		7.5	0	7.5
	PC8. obtain guidance from appropriate people, where necessary		7.5	0	7.5
	PC9. ensure their work meets the agreed requirements		10	0	10
		Total	100	22.5	77.5
4.SSC/N9002 (Work effectively with colleagues)	PC1. communicate with colleagues clearly, concisely and accurately	**100**	20	0	20
	PC2. work with colleagues to integrate their work effectively with theirs		10	0	10
	PC3. pass on essential information to colleagues in line with organizational requirements		10	10	0
	PC4. work in ways that show respect for colleagues		20	0	20
	PC5. carry out commitments you have made to colleagues		10	0	10
	PC6. let colleagues know in good time if you cannot carry out their commitments, explaining the reasons		10	10	0
	PC7. identify any problems you have working with colleagues and take the initiative to solve these problems		10	0	10
	PC8. follow the organization's policies and procedures for working with colleagues		10	0	10
		Total	100	20	80
5.SSC/N9003 (Maintain a healthy, safe and secure working environment)	PC1. comply with their organization's current health, safety and security policies and procedures		20	10	10
	PC2. report any identified breaches in health, safety, and security policies and procedures to the designated person		10	0	10
	PC3. identify and correct any hazards that you can deal with safely, competently and within the limits of their authority		20	10	10
	PC4. report any hazards that you are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected	**100**	10	0	10
	PC5. follow their organization's emergency		20	10	10

	procedures promptly, calmly, and efficiently				
	PC6. identify and recommend opportunities for improving health, safety, and security to the designated person		10	0	10
	PC7. complete any health and safety records legibly and accurately		10	0	10
		Total	100	30	70
6.SSC/N9004 (Provide data/information in standard formats)	PC1. establish and agree with appropriate people the data/information you need to provide, the formats in which you need to provide it, and when you need to provide it		15	15	0
	PC2. obtain the data/information from reliable sources		15	0	15
	PC3. check that the data/information is accurate, complete and up-to-date	**100**	15	5	10
	PC4. obtain advice or guidance from appropriate people where there are problems with the data/information		5	5	0
	PC5. carry out rule-based analysis of the data/information, if required		20	0	20
	PC6. insert the data/information into the agreed formats		10	0	10
	PC7. check the accuracy of their work, involving colleagues where required		10	0	10
	PC8. report any unresolved anomalies in the data/information to appropriate people		5	5	0
	PC9. provide complete, accurate and up-to-date data/information to the appropriate people in the required formats on time		5	0	5
		Total	100	30	70
7.SSC/N9005 (Develop their knowledge, skills and competence)	PC1. obtain advice and guidance from appropriate people to develop their knowledge, skills and competence	**100**	20	7	13
	PC2. identify accurately the knowledge and skills you need for their job role		14	7	7
	PC3. identify accurately their current level of knowledge, skills and competence and any learning and development needs		14	0	14
	PC4. agree with appropriate people a plan of learning and development activities to address their learning needs		7	0	7
	PC5. undertake learning and development activities in line with their plan		12	0	12

	PC6. apply their new knowledge and skills in the workplace, under supervision		12	0	12
	PC7. obtain feedback from appropriate people on their knowledge and skills and how effectively you apply them		7	0	7
	PC8. review their knowledge, skills and competence regularly and take appropriate action		14	7	7
		Total	100	21	79

Annexure 2: Trainer Prerequisites for Job role: Web Developer mapped to Qualification Pack: SSC/Q0503

Sr. No.	Area	Details
1	**Job Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack SSC/Q0503.
2	**Personal Attributes**	Aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training. Strong communication skills, interpersonal skills, ability to work as part of a team; a passion for quality and for developing others; well-organised and focused, eager to learn and keep oneself updated with the latest in this field.
3	**Minimum Educational Qualifications**	Minimum Graduate degree/ diploma in web design/ media design or any other related field; Preferred Master's Degree in Media Design
4a	**Domain Certification**	Minimum accepted score in SSC Assessment is 90% per NOS being taught in QP SSC/Q0503. Certification in relevant software competencies: Software Development Certifications in C++, Embedded, C#, C, Java etc., is an added advantage.
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer" mapped to the Qualification Pack: "SSC/1402". Minimum accepted score is 70%.
5	**Experience**	Field experience: Minimum 2 years' experience in the same domain Training experience: 1 year preferred

IT - ITeS SSC
NASSCOM

N·S·D·C
National Skill Development Corporation
Transforming the skill landscape

Skill India

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

IT-ITES SECTOR SKILLS COUNCIL NASSCOM

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Web Developer**' QP No. '**SSC/Q0503 NSQF Level 5**'

Date of Issuance: **December 31st, 2015**

Valid up to*: **December 31st, 2016**

* *Valid up to the next review date of the Qualification Pack*

Authorised Signatory
Lakshmi Narayan
(Chairman, IT-ITeS Sector Skills Council NASSCOM)

4E-Vandana Building (4th Floor)
11, Tolstoy Marg
New Delhi-110001
Phone: 91-11- 4151 9230/60
Fax: 91-11- 4151 9240
Email: ssc@nasscom.in

Model Curriculum

Software Developer

SECTOR: IT-ITES

OCCUPATION: SUB-SECTOR: IT SERVICES DATA SCIENTISTS

REF. ID: SSC/Q0401, VERSION 1.0

NSQF LEVEL: 7

IT - ITeS SSC
NASSCOM

Skill India

Government of India
Ministry of Skill Development & Entrepreneurship

N·S·D·C
National Skill Development Corporation
Transforming the skill landscape

Certificate

CURRICULUM COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

IT-ITES SECTOR SKILLS COUNCIL NASSCOM

for the

MODEL CURRICULUM

Complying to National Occupational Standards of
Job Role/ Qualification Pack: '**Software Developer**' QP No. '**SSC/Q0501 NSQF Level 7**'

Date of Issuance:	December 31st, 2015
Valid up to*:	December 31st, 2016

* Valid up to the next review date of the Qualification Pack

Authorised Signatory
Lakshmi Narayan
(Chairman, IT-ITeS Sector Skills Council NASSCOM)

TABLE OF CONTENTS

Software Developer

CURRICULUM / SYLLABUS

This program is aimed at training candidates for the job of **Software Developer** in the **IT-ITeS** Sector/Industry and aims at building the following key competencies in the learner.

Program Name	Software Developer		
Qualification Pack Name & Reference ID.	Software Developer SSC/Q0501, version 1.0		
Version No.	1.0	**Version Update Date**	31/12/2015
Pre-requisites to Training	BSc (Stat, Math, Physics, Chemistry, Geology) or BE/ BTech		
Training Outcomes	**After completing this programme, participants will be able to:** • Contribute to the design of software products and applications • Develop software code to specification • Manage their work to meet requirements • Work effectively with colleagues • Maintain a healthy, safe and secure working environment • Provide data/information in standard formats • Develop their knowledge, skills and competence		

The Course encompasses all seven National Occupational Standards (NOS) of Software Developer SSC/Q0501 Qualification Pack issued by IT-ITeS Sector Skills Council NASSCOM.

Sr. No.	Module	Key Learning Outcomes	Equipment Required
1	**Programming and Algorithms** **Theory Duration** (hh:mm) 20:00 **Practical Duration** (hh:mm) 30:00 **Corresponding NOS Code** SSC/N0501	Candidates will be able to: •Design basic programming structures to implement functionality in line with requirements defined in BRS/URS, SRS and HLD	Refer to Unique Equipment Required Section
2	**Analysis and Design of Software Applications** **Theory Duration** (hh:mm) 20:00 **Practical Duration** (hh:mm) 30:00 **Corresponding NOS Code** SSC/N0501	Candidates will be able to: • Check their understanding of the Business Requirements Specification (BRS)/User Requirements Specification (URS) with appropriate people • Check their understanding of the Software Requirements Specification (SRS) with appropriate people • Check their understanding of High Level Design (HLD) with appropriate people • Review their designs with appropriate people • Analyse inputs from appropriate people to identify, resolve and record design defects and inform future designs • Document designs using standard templates and tools • Comply with organization's policies, procedures and guidelines when contributing to the design of software products and applications	Refer to Unique Equipment Required Section

3	**Application Development** **Theory Duration** (hh:mm) 20:00 **Practical Duration** (hh:mm) 80:00 **Corresponding NOS Code** SSC/N0502	Candidates will be able to: • Check their understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people • Access reusable components, code generation tools and unit testing tools from their organization's knowledge base • Convert technical specifications into code to meet the requirements, leveraging reusable components, where available • Create appropriate unit test cases (UTCs) • Review codes and UTCs with appropriate people • Execute UTCs and document results • Rework the code and UTCs to fix identified defects	Refer to Unique Equipment Required Section

Sr. No.	Module	Key Learning Outcomes	Equipment Required
		• Analyse inputs from appropriate people to inform future designs • Record corrective actions for identified defects to inform future designs • Submit tested code timely for approval by appropriate people • Update their organization's knowledge base with their experiences of the code developed • Comply with their organization's policies, procedures and guidelines when developing software code to specification	
4	**Self and work Management** **Theory Duration** (hh:mm) 12:00 **Practical Duration** (hh:mm) 38:00 **Corresponding NOS Code** SSC/N9001	Candidates will be able to: • Establish and agree their work requirements with appropriate people • Keep their immediate work area clean and tidy • utilize their time effectively • Use resources correctly and efficiently • Treat confidential information correctly • Work in line with organization's policies and procedures • Work within the limits of their job role • Obtain guidance from appropriate people, where necessary • Ensure their work meets the agreed requirements	Refer to Unique Equipment Required Section

5	**Team Work and Communication** **Theory Duration** (hh:mm) 12:00 **Practical Duration** (hh:mm) 38:00 **Corresponding NOS Code** SSC/N9002	Candidates will be able to: • Communicate with colleagues clearly, concisely and accurately • Work with colleagues to integrate their work effectively with them • Pass on essential information to colleagues in line with organizational requirements • Work in ways that show respect for colleagues • carry out commitments they have made to colleagues • Let colleagues know in good time if they cannot carry out their commitments, explaining the reasons • Identify any problems they have working with colleagues and take the initiative to solve these problems • Follow the organization's policies and procedures for working with colleagues	Refer to Unique Equipment Required Section
6	**Managing Health and Safety** **Theory Duration** (hh:mm) 05:00	Candidates will be able to: • Comply with their organization's current health, safety and security policies and procedures • Report any identified breaches in health, safety, and security policies and procedures to the designated person • Identify and correct any hazards that they can deal	

Sr. No.	Module	Key Learning Outcomes	Equipment Required
	Practical Duration (hh:mm) 20:00 **Corresponding NOS Code** SSC/ N 9003	with safely, competently and within the limits of their authority • Report any hazards that they are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected • Follow their organization's emergency procedures promptly, calmly, and efficiently • Identify and recommend opportunities for improving health, safety, and security to the designated person • Complete any health and safety	

7	**Data and Information Management** **Theory Duration** (hh:mm) 15:00 **Practical Duration** (hh:mm) 35:00 **Corresponding NOS Code** SSC/N9004	Candidates will be able to: • Establish and agree with appropriate people the data/information they need to provide, the formats in which they need to provide it, and when they need to provide it • Obtain the data/information from reliable sources • Check that the data/information is accurate, complete and up-to-date • Obtain advice or guidance from appropriate people where there are problems with the data/information • Carry out rule-based analysis of the data/information, if required • Insert the data/information into the agreed formats • Check the accuracy of their work, involving colleagues where required • Report any unresolved anomalies in the data/information to appropriate people • Provide complete, accurate and up-to-date data/information to the appropriate people in the required formats on time	Refer to Unique Equipment Required Section
8	**Learning and Self Development** **Theory Duration** (hh:mm) 05:00 **Practical Duration** (hh:mm) 20:00 **Corresponding NOS Code SSC/N9005**	Candidates will be able to: • Obtain advice and guidance from appropriate people to develop their knowledge, skills and competence • Identify accurately the knowledge and skills they need for their job role • Identify accurately their current level of knowledge, skills and competence and any learning and development needs • Agree with appropriate people a plan of learning and development activities to address their learning needs • Undertake learning and development activities in line with their plan • Apply their new knowledge and skills in the workplace, under supervision • Obtain feedback from appropriate people on their	Refer to Unique Equipment Required Section
Sr. No.	**Module**	**Key Learning Outcomes**	**Equipment Required**
		knowledge and skills and how effectively they apply them • Review their knowledge, skills and competence regularly and take appropriate action	

	Total Duration **Theory Duration** **109:00** **Practical Duration** **291:00**	**Unique Equipment Required:** Training room should be fully furnished with the following equipment / tools / accessories. Additional / specific resources, wherever applicable (e.g. Hardware, software) are indicated in the main text corresponding to relevant learning outcome. **For Domain NOSs:** • For NOS SSC/N0501: C/C++, UML tools such as Rational suite • For NOS SSC/N0502: JDK / Eclipse General: • Comfortable seats with adequate lighting, controlled temperature and acoustics for training and learning • White Board, Markers and Eraser • Projector with screen • Flip chart with markers • Faculty's PC/Laptop with latest configuration and internet connection • Supporting software / applications for projecting audio, video, recording, • **Presentation Tools to support learning activities:** o Intranet o Email o IMs o Learning management system e.g. Moodle, Blackboard to enable blended learning • Microphone / voice system for lecture and class activities • Handy Camera • Stationery kit – Staples, Glue, Chart Paper, Sketch Pens, Paint Box, Scale, A4 Sheets • For IT Lab sessions: Computer Lab with 1:1 PC: trainee ratio and having internet connection, MS Office / Open office, Browser, Outlook/ other Email Clients • Assessment and Test Tools for day to day online Tests and Assessments • For team discussions: Adequate seating arrangement in full / half circle format for one or more teams as per planned team composition. • Reading Resources: Access to relevant sample documents and learning forums to enable self-study before and after each training session.

Grand Total Course Duration: 400 Hours 0 Minutes
(This Syllabus/Curriculum has been approved by IT-ITeS Sector Skills Council NASSCOM.)

Notes from IT-ITeS Sector Skills Council

1. This document outlines the broad scope of coverage. This should be linked with OBF and training delivery plan.OBF (Outcome based framework) reflects the pedagogy used to ensure an expected outcome. Training delivery plan focuses on the sequence of delivery.

2. Though many NOSs have some seemingly common outcomes, notably core/generic, professional and technical skills, it is imperative to understand the contextual difference between them. For example, writing skills

required to communicate results of testing (in SSC/N0501) are different from the writing skills required to prepare a time plan (in SSC/N9001). Training providers are advised to,

a. Embed such skills development in the learning pedagogy for each expected outcome
b. Prepare a detailed session plan for training delivery with focus on sequence and duration of training
c. Run a diagnostic test to assess prior learning of students and help trainers / students identify the need for gap training, optimal duration, and suitable training methodology. Accordingly, more introductory level sessions may be included in guided or self-paced mode of learning. E.g. adding some sessions on Functional English or Use of Internet and MS Office.

Trainer Prerequisites for Job role: Software Developer mapped to Qualification Pack: SSC/Q0501

Sr. No.	Area	Details
1	**Job Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack SSC/Q0501.
2	**Personal Attributes**	Aptitude for conducting training, and pre/ post work to ensure competent, employable candidates at the end of the training. Strong communication skills, interpersonal skills, ability to work as part of a team; a passion for quality and for developing others; well-organised and focused, eager to learn and keep oneself updated with the latest in this field.
3	**Minimum Educational Qualifications**	Minimum Bachelor's Degree in Computer Science or any related field; Preferred Master's Degree in Computer Science
4a	**Domain Certification**	Minimum accepted score in SSC Assessment is 90% per NOS being taught in QP SSC/Q0501. Certification in relevant software competencies: Software Development Certifications in C++, Embedded, C#, C, Java etc., is an added advantage.
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer" mapped to the Qualification Pack: "SSC/Q1402". Minimum accepted score is 70%.
5	**Experience**	Field experience: Minimum 2 years' experience in the same domain Training experience: 1 year preferred

Annexure: Assessment Criteria

Assessment Criteria for Software Developer	
Job Role	**Software Developer**
Qualification Pack	**SSC/Q0501**
Sector Skill Council	**IT-ITeS**

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack (QP) will be created by the Sector Skill Council (SSC). Each performance criteria (PC) will be assigned Theory and Skill/Practical marks proportional to its importance in NOS.
2	The assessment will be conducted online through assessment providers authorised by SSC.
3	Format of questions will include a variety of styles suitable to the PC being tested such as multiple choice questions, fill in the blanks, situational judgment test, simulation and programming test.
4	To pass a QP, a trainee should pass each individual NOS. Standard passing criteria for each NOS is 70%.
5	For latest details on the assessment criteria, please visit www.sscnasscom.com.

				MARKS ALLOCATION	
ASSESSMENT OUTCOME (NOS CODE AND DESCRIPTION)	ASSESSMENT CRITERIA (PC)	TOTAL MARKS	OUT OF	THEORY	SKILLS PRACTICAL
1.SSC/N0501 (CONTRIBUTE TO THE DESIGN OF SOFTWARE PRODUCTS AND APPLICATIONS)	PC1. check their understanding of the Business Requirements Specification (BRS)/User Requirements Specification (URS) with appropriate people	**100**	10	10	0
	PC2. check their understanding of the Software Requirements Specification (SRS) with appropriate people		10	10	0
	PC3. check their understanding of High Level Design (HLD) with appropriate people		10	10	0
	PC4. design basic programming structures to implement functionality in line with		30	0	30

	requirements defined in BRS/URS, SRS and HLD				
	PC5. review their designs with appropriate people		5	5	0
	PC6. analyze inputs from appropriate people to identify, resolve and record design defects and inform future designs		15	0	15
	PC7. document their designs using standard templates and tools		10	0	10
	PC8. comply with their organization's policies, procedures and guidelines when contributing to the design of software products and applications		10	0	10
		Total	100	35	65
2.SSC/N0502 (DEVELOP SOFTWARE CODE TO SPECIFICATION)	PC1. check their understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people	**100**	5	5	0
	PC2. access reusable components, code generation tools and unit testing tools from their organization's knowledge base		5	0	5
	PC3. convert technical specifications into code to meet the requirements, leveraging reusable components, where available		30	0	30
	PC4. create appropriate unit test cases (UTCs)		10	0	10
	PC5. review codes and UTCs with appropriate people		5	5	0
	PC6. execute UTCs and document results		5	0	5
	PC7. rework the code and UTCs to fix identified defects		10	0	10
	PC8. analyze inputs from appropriate people to inform future designs		5	5	0
	PC9. record corrective actions for identified defects to inform future designs		10	0	10
			5	5	0

				MARKS ALLOCATION	
ASSESSMENT OUTCOME (NOS CODE AND DESCRIPTION)	ASSESSMENT CRITERIA (PC)	TOTAL MARKS	OUT OF	THEORY	SKILLS PRACTICAL
	PC10. submit tested code for approval by appropriate people				
	PC11. update their organization's knowledge base with their experiences of the code developed		5	0	5

	PC12. comply with their organization's policies, procedures and guidelines when developing software code to specification		5	0	5
		Total	100	20	80
3.NOS/N9001 (MANAGE THEIR WORK TO MEET REQUIREMENTS)	PC1. establish and agree their work requirements with appropriate people	**100**	6.25	0	6.25
	PC2. keep their immediate work area clean and tidy		12.5	6.25	6.25
	PC3. utilize their time effectively		12.5	6.25	6.25
	PC4. use **resources** correctly and efficiently		18.75	6.25	12.5
	PC5. treat confidential information correctly		6.25	0	6.25
	PC6. work in line with their organization's policies and procedures		12.5	0	12.5
	PC7. work within the limits of their job role		6.25	0	6.25
	PC8. obtain guidance from appropriate people, where necessary		6.25	0	6.25
	PC9. ensure their work meets the agreed requirements		18.75	6.25	12.5
		Total	**100**	**25**	**75**
4.SSC/N9002 (WORK EFFECTIVELY WITH COLLEAGUES)	PC1. communicate with colleagues clearly, concisely and accurately	**100**	20	0	20
	PC2. work with colleagues to integrate their work effectively with theirs		10	0	10
	PC3. pass on essential information to colleagues in line with organizational requirements		10	10	0
	PC4. work in ways that show respect for colleagues		20	0	20
	PC5. carry out commitments you have made to colleagues		10	0	10
	PC6. let colleagues know in good time if you cannot carry out their commitments, explaining the reasons		10	10	0
	PC7. identify any problems you have working with colleagues and take the initiative to solve these problems		10	0	10
	PC8. follow the organization's policies and procedures for working with colleagues		10	0	10
		Total	**100**	**20**	**80**
5.SSC/N9003 (MAINTAIN A	PC1. comply with their organization's current health, safety and security policies and procedures	**100**	20	10	10

				MARKS ALLOCATION	
ASSESSMENT OUTCOME (NOS CODE AND	ASSESSMENT CRITERIA (PC)	TOTAL MARKS	OUT OF	THEORY	SKILLS PRACTICAL

DESCRIPTION)					
HEALTHY, SAFE AND SECURE WORKING ENVIRONMENT)	PC2. report any identified breaches in health, safety, and security policies and procedures to the designated person		10	0	10
	PC3. identify and correct any hazards that you can deal with safely, competently and within the limits of their authority		20	10	10
	PC4. report any hazards that you are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected		10	0	10
	PC5. follow their organization's emergency procedures promptly, calmly, and efficiently		20	10	10
	PC6. identify and recommend opportunities for improving health, safety, and security to the designated person		10	0	10
	PC7. complete any health and safety records legibly and accurately		10	0	10
		Total	**100**	**30**	**70**
6.SSC/N9004 (PROVIDE DATA/INFORMATION IN STANDARD FORMATS)	PC1. establish and agree with appropriate people the data/information you need to provide, the formats in which you need to provide it, and when you need to provide it	**100**	12.5	12.5	0
	PC2. obtain the data/information from reliable sources		12.5	0	12.5
	PC3. check that the data/information is accurate, complete and up-to-date		12.5	6.25	6.25
	PC4. obtain advice or guidance from appropriate people where there are problems with the data/information		6.25	0	6.25
	PC5. carry out rule-based analysis of the data/information, if required		25	0	25
	PC6. insert the data/information into the agreed formats		12.5	0	12.5
	PC7. check the accuracy of their work, involving colleagues where required		6.25	0	6.25
	PC8. report any unresolved anomalies in the data/information to appropriate people		6.25	6.25	0
	PC9. provide complete, accurate and up-todate data/information to the appropriate people in the required formats on time		6.25	0	6.25
		Total	**100**	**25**	**75**
7.SSC/N9005 (DEVELOP THEIR KNOWLEDGE, SKILLS AND COMPETENCE)	PC1. obtain advice and guidance from appropriate people to develop their knowledge, skills and competence	**100**	10	0	10
	PC2. identify accurately the knowledge and skills you need for their job role		10	0	10
	PC3. identify accurately their current level of		20	10	10

				MARKS ALLOCATION	
ASSESSMENT OUTCOME (NOS CODE AND DESCRIPTION)	ASSESSMENT CRITERIA (PC)	TOTAL MARKS	OUT OF	THEORY	SKILLS PRACTICAL
	knowledge, skills and competence and any learning and development needs				
	PC4. agree with appropriate people a plan of learning and development activities to address their learning needs		10	0	10
	PC5. undertake learning and development activities in line with their plan		20	10	10
	PC6. apply their new knowledge and skills in the workplace, under supervision		10	0	10
	PC7. obtain feedback from appropriate people on their knowledge and skills and how effectively you apply them		10	0	10
	PC8. review their knowledge, skills and competence regularly and take appropriate action		10	0	10
		Total	**100**	**20**	**80**

IT-ITeS Sector Skill Council

4E-Vandana Building (4th Floor) 11, Tolstoy Marg, New Delhi-110001

Model Curriculum

User Interface (UI) Developer

User Interface (UI) Developer

SECTOR: **IT-ITeS**
SUB-SECTOR: **IT Services**
OCCUPATION: **Application Development**
REFERENCE ID: **SSC/Q0502**
NSQF LEVEL: **7**

Table of Contents

User Interface (UI) Developer

Curriculum / Syllabus

This program is aimed at training candidates for the job of a **User Interface (UI) Developer** in the **IT-ITeS** Sector/Industry and aims at building the following key competencies amongst the learner.

Program Name	**User Interface (UI) Developer**		
Qualification Pack Name & Reference ID.	User Interface (UI) Developer SSC/Q0502		
Version No.	1.0	**Version Update Date**	31/01/2015
Pre-requisites to Training	Bachelor's Degree in Science/Technology/Computers or any graduate course		
Training Outcomes	**After completing this programme, participants will be able to:** • Contribute to the design of software products and applications • Develop software code to specification • Develop media content and graphic designs for software products and applications • Manage your work to meet requirements • Work effectively with colleagues • Maintain a healthy, safe and secure working environment • Provide data/information in standard formats • Develop your knowledge, skills and competence		

This course encompasses all Eight National Occupational Standards (NOS) of **User Interface (UI) Developer** Qualification Pack issued by **IT-ITeS Sector Skills Council NASSCOM**.

Sr. No.	**Module**	**Theory Duration (hh:mm)**	**Practical Duration (hh:mm)**	**Key Learning Outcomes**	**Corresponding NOS Code**	**Equipment Required**
1.	Contribute to the design of software products and applications	17:00	33:00	Candidates will be able to: • check your understanding of the Business Requirements Specification (BRS)/User Requirements Specification (URS) with appropriate people • check your understanding of the Software Requirements Specification (SRS) with appropriate people • check your understanding of High Level Design (HLD) with appropriate people • design basic programming structures to implement functionality in line with requirements defined in BRS/URS,	SSC/N0501	Refer to Unique Equipment Required

				SRS and HLD • review your designs with appropriate people		

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• analyze inputs from appropriate people to identify, resolve and record design defects and inform future designs • document your designs using standard templates and tools • comply with your organization's policies, procedures and guidelines when contributing to the design of software products and applications		
2.	Develop software code to specification	20:00	80:00	Candidates will be able to: • check your understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people • access reusable components, code generation tools and unit testing tools from your organization's knowledge base • convert technical specifications into code to meet the requirements, leveraging reusable components, where available • create appropriate unit test cases (UTCs) • review codes and UTCs with appropriate people • execute UTCs and document results • rework the code and UTCs to fix identified defects • analyze inputs from appropriate people to inform future designs • record corrective actions for identified defects to inform future designs • submit tested code for approval by appropriate people • update your organization's knowledge base with your experiences of the code developed • comply with your organization's policies, procedures and guidelines when developing software code to specification	SSC/N0502	

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
3.	Develop media content and graphic designs for software products and applications	12:00	38:00	Candidates will be able to: • check your understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people • access reusable components, media and graphical packages and tools from your organization's knowledge base • convert requirements into media content and graphic designs, leveraging reusable components where available • review media content and graphic designs with appropriate people and analyze their feedback • record any defects and corrective actions taken to inform future work • rework media content and graphic designs, incorporating feedback • submit media content and graphic designs for approval by appropriate people • update your organization's knowledge base with experiences of the media content and graphic designs developed • comply with your organization's policies, procedures and guidelines when developing media content and graphic designs for software products and applications	SSC/N0503	

4.	Manage your work to meet requirements	12:00	38:00	Candidates will be able to: • establish and agree your work requirements with appropriate people • keep your immediate work area clean and tidy • utilize your time effectively • use resources correctly and efficiently • treat confidential information correctly • work in line with your organization's policies and procedures • work within the limits of your job role • obtain guidance from appropriate people, where necessary • ensure your work meets the agreed requirements	SSC/N9001	

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
5.	Work effectively with colleagues	10:00	40:00	Candidates will be able to: • communicate with colleagues clearly, concisely and accurately • work with colleagues to integrate your work effectively with theirs • pass on essential information to colleagues in line with organizational requirements • work in ways that show respect for colleagues • carry out commitments you have made to colleagues • let colleagues know in good time if you cannot carry out your commitments, explaining the reasons • identify any problems you have working with colleagues and take the initiative to solve these problems • follow the organization's policies and procedures for working with colleagues	SSC/N9002	

6.	Maintain a healthy, safe and secure working environment	7:00	18:00	Candidates will be able to: • comply with your organization's current health, safety and security policies and procedures • report any identified breaches in health, safety, and security policies and procedures to the designated person • identify and correct any hazards that you can deal with safely, competently and within the limits of your authority • report any hazards that you are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected • follow your organization's emergency procedures promptly, calmly, and efficiently • identify and recommend opportunities for improving health, safety, and security to the designated person	SSC/N9003	

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• complete any health and safety records legibly and accurately		
7.	Provide data/information in standard formats	12:00	38:00	Candidates will be able to: • establish and agree with appropriate people the data/information you need to provide, the formats in which you need to provide it, and when you need to provide it • obtain the data/information from reliable sources • check that the data/information is accurate, complete and up-to-date • obtain advice or guidance from appropriate people where there are problems with the data/information • carry out rule-based analysis of the	SSC/N9004	

				data/information, if required • insert the data/information into the agreed formats • check the accuracy of your work, involving colleagues where required • report any unresolved anomalies in the data/information to appropriate people • provide complete, accurate and upto-date data/information to the appropriate people in the required formats on time		
8.	Develop your knowledge, skills and competence	5:00	20:00	Candidates will be able to: • obtain advice and guidance from appropriate people to develop your knowledge, skills and competence • identify accurately the knowledge and skills you need for your job role • identify accurately your current level of knowledge, skills and competence and any learning and development needs • agree with appropriate people a plan of learning and development activities to address your learning needs • undertake learning and development activities in line with your plan • apply your new knowledge and skills in the workplace, under supervision • obtain feedback from appropriate people on your knowledge and skills and how effectively you apply them	SSC/N9005	

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				• review your knowledge, skills and competence regularly and take appropriate action		

Total Duration:	**95:00**	**305:00**	**Unique Equipment Required:** Training room should be fully furnished with the following equipment / tools / accessories. Additional / specific resources, wherever applicable (e.g. Hardware, software) are indicated in the main text corresponding to relevant learning outcome. **Domain NOS requirements** • Visio, UML, freeminds, mockingbird • HTML 5, CSS, Java Script and SQL • IDEs such as Web Builder, Word Press, Joomla ✓Wordpress, psdGraphics etc. • HTML, CSS, Flash, Photoshop, Windows media player, Eclipse, XAMPP **Common requirements** • Comfortable seats with adequate lighting, controlled temperature and acoustics for training and learning • White Board, Markers and Eraser • Projector with screen • Flip chart with markers • Faculty's PC/Laptop with latest configuration and internet connection • Supporting software / applications for projecting audio, video, recording, • Presentation Tools to support learning activities: o Intranet oEmail oIMs o Learning management system e.g. Moodle, Blackboard to enable blended learning • Microphone / voice system for lecture and class activities ✓Handy Camera • Stationery kit – Staples, Glue, Chart Paper, Sketch Pens, Paint Box, Scale, A4 Sheets • For IT Lab sessions: Computer Lab with 1:1 PC:trainee ratio and having internet connection, MS Office / Open office, Browser, Outlook / Any other Email Client and chat tools. • Assessment and Test Tools for day to day online Tests and Assessments • For team discussions: Adequate seating arrangement in full / half circle format for one or more teams as per planned team composition.

Grand Total Course Duration: **400 Hours 0 Minutes**

Sr. No.	Module	Theory Duration (hh:mm)	Practical Duration (hh:mm)	Key Learning Outcomes	Corresponding NOS Code	Equipment Required
				˅Reading Resources: Access to relevant sample documents and learning forums to enable self-study before and after each training session.		

(This syllabus/ curriculum has been approved ***IT-ITeS Sector Skills Council NASSCOM****.)*

Notes from IT-ITeS Sector Skills Council NASSCOM

1. This document outlines the broad scope of coverage. This should be linked with OBF and training delivery plan. OBF (Outcome based framework) reflects the pedagogy used to ensure an expected outcome. Training delivery plan focuses on the sequence of delivery.
2. Though many NOSs have some seemingly common outcomes, notably core/generic, professional and technical skills, it is imperative to understand the contextual difference between them. Training providers are advised to,

a. Embed such skills development in the learning pedagogy for each expected outcome

b. Prepare a detailed session plan for training delivery with focus on sequence and duration of training

3. Run a diagnostic test to assess prior learning of students and help trainers / students identify the need for gap training and suitable training methodology. Accordingly, more introductory level sessions may be included in guided or self-paced mode of learning. E.g. adding some sessions on Functional English or Use of Internet and MS Office.

Annexure1: Assessment Criteria

Assessment Criteria for <QP Name>	
Job Role	**User Interface (UI) Developer**
Qualification Pack	**SSC/Q0502**
Sector Skill Council	**IT-ITeS**

Sr. No.	Guidelines for Assessment
1	Criteria for assessment for each Qualification Pack (QP) will be created by the Sector Skill Council (SSC). Each performance criteria (PC) will be assigned Theory and Skill/Practical marks proportional to its importance in NOS.
2	The assessment will be conducted online through assessment providers authorised by SSC.
3	Format of questions will include a variety of styles suitable to the PC being tested such as multiple choice questions, fill in the blanks, situational judgment test, simulation and programming test.
4	To pass a QP, a trainee should pass each individual NOS. Standard passing criteria for each NOS is 70%.
5	For latest details on the assessment criteria, please visit www.sscnasscom.com.

Assessable Outcomes	Assessment criteria for the outcome	Total Mark	Out of	Theory	Skills Practical
1. SSC/N0501 (Contribute to the design of software products and applications)	PC1. check your understanding of the Business Requirements Specification (BRS)/User Requirements Specification (URS) with appropriate people	**100**	10	10	0
	PC2. check your understanding of the Software Requirements Specification (SRS) with appropriate people		10	10	0
	PC3. check your understanding of High Level Design (HLD) with appropriate people		10	10	0
	PC4. design basic programming structures to implement functionality in line with requirements defined in BRS/URS, SRS and HLD		30	0	30
	PC5. review your designs with appropriate people		5	5	0
	PC6. analyze inputs from appropriate people to identify, resolve and record design defects and inform future designs		15	0	15
	PC7. document your designs using standard templates and tools		10	0	10
	PC8. comply with your organization's policies, procedures and guidelines when contributing to the design of software products and applications		10	0	10
		Total	100	35	65

2. SSC/N0502 (Develop software code to specification)	PC1. check your understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people	**100**	5	5	0
	PC2. access reusable components, code generation tools and unit testing tools from your organization's knowledge base		10	0	10

Assessable Outcomes	Assessment criteria for the outcome	Total Mark	Out of	Theory	Skills Practical
	PC3. convert technical specifications into code to meet the requirements, leveraging reusable components, where available		10	0	10
	PC4. create appropriate unit test cases (UTCs)		10	0	10
	PC5. review codes and UTCs with appropriate people		5	5	0
	PC6. execute UTCs and document results		10	0	10
	PC7. rework the code and UTCs to fix identified defects		10	0	10
	PC8. analyze inputs from appropriate people to inform future designs		5	5	0
	PC9. record corrective actions for identified defects to inform future designs		10	0	10
	PC10. submit tested code for approval by appropriate people		5	5	0
	PC11. update your organization's knowledge base with your experiences of the code developed		10	0	10
	PC12. comply with your organization's policies, procedures and guidelines when developing software code to specification		10	0	10
		Total	100	20	80
3. SSC/N0503 (Develop media content and graphic designs for software products and Applications)	PC1. check your understanding of the Business Requirements Specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate people	**100**	10	10	0
	PC2. access reusable components, media and graphical packages and tools from your organization's knowledge base		10	0	10
	PC3. convert requirements into media content and graphic designs, leveraging reusable components where available		25	0	25
	PC4. review media content and graphic designs with appropriate people and analyze their feedback		10	10	0
	PC5. record any defects and corrective actions taken to inform future work		10	0	10
	PC6. rework media content and graphic designs, incorporating feedback		10	0	10
	PC7. submit media content and graphic designs for		5	5	0

	approval by appropriate people				
	PC8. update your organization's knowledge base with your experiences of the media content and graphic designs developed		10	0	10
	PC9. comply with your organization's policies, procedures and guidelines when developing media content and graphic designs for software products and applications		10	0	10
		Total	100	25	75
4.SSC/N9001 (Manage your work to meet requirements)	PC1. establish and agree your **workrequirements** with **appropriate people**	**100**	6.25	0	6.25
	PC2. keep your immediate work area clean and tidy		12.5	6.25	6.25
	PC3. utilize your time effectively		12.5	6.25	6.25
	PC4. use **resources** correctly and efficiently		18.75	6.25	12.5

Assessable Outcomes	Assessment criteria for the outcome	Total Mark	Out of	Theory	Skills Practical
	PC5. treat confidential information correctly		6.25	0	6.25
	PC6. work in line with your organization's policies and procedures		12.5	0	12.5
	PC7. work within the limits of your job role		6.25	0	6.25
	PC8. obtain guidance from **appropriate people**, where necessary		6.25	0	6.25
	PC9. ensure your work meets the agreed requirements		18.75	6.25	12.5
		Total	**100**	**25**	**75**
5.SSC/N9002 (Work effectively with colleagues)	PC1. communicate with colleagues clearly, concisely and accurately	**100**	20	0	20
	PC2. work with colleagues to integrate your work effectively with theirs		10	0	10
	PC3. pass on essential information to colleagues in line with organizational requirements		10	10	0
	PC4. work in ways that show respect for colleagues		20	0	20
	PC5. carry out commitments you have made to colleagues		10	0	10
	PC6. let colleagues know in good time if you cannot carry out your commitments, explaining the reasons		10	10	0
	PC7. identify any problems you have working with colleagues and take the initiative to solve these problems		10	0	10
	PC8. follow the organization's policies		10	0	10

	and procedures for working with colleagues				
		Total	**100**	**20**	**80**
6.SSC/N9003 (Maintain a healthy, safe and secure working environment)	PC1. comply with your organization's current health, safety and security policies and procedures	**100**	20	10	10
	PC2. report any identified breaches in health, safety, and security policies and procedures to the designated person		10	0	10
	PC3. identify and correct any hazards that you can deal with safely, competently and within the limits of your authority		20	10	10
	PC4. report any hazards that you are not competent to deal with to the relevant person in line with organizational procedures and warn other people who may be affected		10	0	10
	PC5. follow your organization's **emergency procedures** promptly, calmly, and efficiently		20	10	10
	PC6. identify and recommend opportunities for improving health, safety, and security to the designated person		10	0	10
	PC7. complete any health and safety records legibly and accurately		10	0	10
		Total	**100**	**30**	**70**
	PC1. establish and agree with appropriate people the data/information you need to provide, the formats	**100**	12.5	12.5	0
Assessable Outcomes	**Assessment criteria for the outcome**	**Total Mark**	**Out of**	**Theory**	**Skills Practical**
7.SSC/N9004 (Provide data/information in standard formats)	in which you need to provide it, and when you need to provide it				
	PC2. obtain the data/information from reliable sources		12.5	0	12.5
	PC3. check that the data/information is accurate, complete and up-to-date		12.5	6.25	6.25
	PC4. obtain advice or guidance from appropriate people where there are problems with the data/information		6.25	0	6.25
	PC5. carry out rule-based analysis of the data/information, if required		25	0	25
	PC6. insert the data/information into the agreed formats		12.5	0	12.5
	PC7. check the accuracy of your work, involving colleagues where required		6.25	0	6.25
	PC8. report any unresolved anomalies in the data/information to appropriate people		6.25	6.25	0
	PC9. provide complete, accurate and up-to-date data/information to the appropriate people in the required formats on time		6.25	0	6.25
		Total	**100**	**25**	**75**

8.SSC/N9005 (Develop your knowledge, skills and competence)	PC1. obtain advice and guidance from appropriate people to develop your knowledge, skills and competence	**100**	10	0	10
	PC2. identify accurately the knowledge and skills you need for your job role		10	0	10
	PC3. identify accurately your current level of knowledge, skills and competence and any learning and development needs		20	10	10
	PC4. agree with appropriate people a plan of learning and development activities to address your learning needs		10	0	10
	PC5. undertake learning and development activities in line with your plan		20	10	10
	PC6. apply your new knowledge and skills in the workplace, under supervision		10	0	10
	PC7. obtain feedback from appropriate people on your knowledge and skills and how effectively you apply them		10	0	10
	PC8. review your knowledge, skills and competence regularly and take appropriate action		10	0	10
		Total	**100**	**20**	**80**

Annexure2: Trainer Prerequisites for Job role: User Interface (UI) Developer mapped to Qualification Pack:SSC/Q0502

Sr. No.	Area	Details
1	**Job Description**	To deliver accredited training service, mapping to the curriculum detailed above, in accordance with the Qualification Pack SSC/Q0502.
2	**Personal Attributes**	Aptitude to conduct training, and pre/ post work to ensure competent, employable candidates at the end of the training. Strong communication skills, interpersonal skills, ability to work as part of a team; a passion for quality and for developing others; well-organised and focused, eager to learn and keep oneself updated with the latest in the mentioned field. The individual should be result oriented. The individual should also be able to demonstrate skills for communication, creative and logical thinking.
3	**Minimum Educational Qualifications**	Bachelor's Degree in Science/Technology/Computers or any graduate course
4a	**Domain Certification**	Minimum accepted score in SSC Assessment is 90% per NOS being taught in SSC/Q0502.

		Additional certification in computers/technology/ animation/graphics
4b	**Platform Certification**	Recommended that the Trainer is certified for the Job Role: "Trainer" mapped to the Qualification Pack: "SSC/Q1402". Minimum accepted score is 70% per NOS.
5	**Experience**	Field experience: Minimum 2 years' experience in the same domain Training experience: 1 year preferred

IT-ITeS Sector Skills Council NASSCOM
4E-Vandana Building (4th Floor), 11, Tolstoy Marg, New Delhi-110001
T +91 11 41519230/60 | F +91 11 41519240
|

SYLLABUS
Short Term Training at CSIR-Central Food Technological Research Institute

M.Voc (Food Processing and Engineering) 2020 -21 Batch
NSQF Level : 9
Job Role : Plant Manager
Sub Sector: Multi Sectorial

PRACTICALS:

1. Demonstration of Ultra High Pressure System for Food Preservation.
2. Demonstration of Non-Aqueous Applications of Membrane Technology.
3. Demonstration of Process of Smart Packaging.
4. Demonstration of MPACK Software.
5. Demonstration of process of Vacuum Frying System.
6. Demonstration of bottling process of various Beverages.
7. Demonstration of different methods of Advanced Drying Techniques.
8. Demonstration of process of Carbonated Beverages.
9. Demonstration of different methods of Twin screw extrusion equipment, Cryogenic grinding system, drying systems, Roasting systems and forming machinery.
10. Determination of proximate composition, nutritional analysis (oils and fats, milk and milk products, sweets and confectionaries), analysis of food additives (preservatives, synthetic colours, artificial sweeteners, antioxidants, etc.), Food Testing.
11. Demonstration of microbiological safety for food products.
12. Demonstration of Post-Harvest Technologies for Fruits & Vegetables. Demonstration of different tools and machineries (fruit washer, peeler, slicer, fruit pulper, steam jacketed kettles, boiler for steam production, packaging machines, etc) used for fruit pulp processing.
13. Demonstration of aseptic packaging of fruit pulp.
14. Demonstration of can reformer, flanger, seamer, can body beader and embossing machines to form cans and complete canning process of fruit pulp (fruits of regional importance).

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE

(AUTONOMOUS)

OOTY ROAD, MYSURU-570 025

(Autonomous under University of Mysore: Re-accredited by NAAC with 'A' Grade)

MASTERS OF VOCATIONAL COURSE

M.Voc (Software Development)

Department of M.Voc

JSS College of Arts, Commerce and Science

Ooty Road, Mysore-25

2018-19

NOS Code : SSC/N0502

Develop Software code to specification

C, Java

Course Outcomes: At the end of the course students will be able to:

CO1. Check your understanding of the Business Requirements specification (BRS), Software Requirements Specification (SRS), High Level Design (HLD) and Low Level Design (LLD) with appropriate peopleaccess reusable components, code generation tools and unit testing tools from your organization's knowledge base.

CO2. Convert technical specifications into code to meet the requirements, leveraging reusable components, where available

CO3. Create appropriate Unit test cases (UTCs)

CO4. Review codes and UTCs with appropriate people

CO5. Analyze inputs from appropriate people to inform future designs

CO6. Submit tested code for approval by appropriate people

Mango DB on AWS **Hr:-15**

- Introduction
- Creating, reading and updating data
- Schema design
- Performance
- Aggregation framework
- Application engineering
- Case studies

Credit Matrix, Course of Study and Scheme of Examination for M.Sc. Degree Programme in Biochemistry

(With effect from 2021-22)

Programme Code: BIC

Course Type	Credits to be earned				Total Credits
	I Semester	II Semester	III Semester	IV Semester	
Hard Core Course	12	12	12	16	**52**
Soft Core Course	08	08	04	–	**20**
Open Elective Course*	–	–	04	–	**04**
Semester Total	**20**	**20**	**20**	**16**	**76**

*An Open Elective course offered by PG Dept. of Biochemistry to the students of other Depts.

Course Code	Course Type	Course Title	Credit Pattern (L:T:P)	Credits
		Semester – I		
BCA040	HC	Analytical Biochemistry–I	3:1:0	4
BCA050	HC	Chemistry and Metabolism of Proteins and Nucleic Acids	3:1:0	4
BCA060	HC	Experiments in Biochemical Techniques and Enzymology** and Seminar	0:0:4	4
BCA230	SC	Enzymology	3:1:0	4
BCA250	SC	**Choose any ONE from the following** (i) Chemical Principles and Biochemical Reactions (ii) Plant Biochemistry (iii) Microbial Biochemistry	3:1:0	4
			Semester Total Credits	**20**

Course Code	Course Type	Course Title	Credit Pattern (L:T:P)	Credits
		Semester – II		
BCB040	HC	Analytical Biochemistry–II	3:1:0	4
BCB050	HC	Chemistry and Metabolism of Carbohydrates and Lipids	3:1:0	4
BCB060	HC	Experiments in Immunology and Biochemical Estimations** and Seminar	0:0:4	4
BCB250	SC	Immunology and Microbiology	3:1:0	4
BCB260	SC	**Choose any ONE from the following** (i) Human Physiology and Nutrition (ii) Research Methodology and Biostatistics (iii) Clinical Research Methods and Industrial Biochemistry	3:1:0	4
			Semester Total Credits	**20**

Course Code	Course Type	Course Title	Credit Pattern (L:T:P)	Credits
Semester – III				
BCC070	HC	Cell Biology, Endocrinology and Cell Signaling	3:1:0	4
BCC050	HC	Clinical Biochemistry	3:1:0	4
BCC060	HC	Experiments in Clinical Biochemistry and Molecular Biology** and Research Paper Presentation	0:0:4	4
BCC220	**Choose any ONE from the following**		4:0:0	4
	SC	(i) Genomics, Proteomics and Bioinformatics (ii) Biotechnology and Research Methodology (iii) Pharmaceutical Biochemistry		
BCC630	OE	Nutrition and Health	4:0:0	4
			Semester Total Credits	**20**

Course Code	Course Type	Course Title	Credit Pattern (L:T:P)	Credits
Semester – IV				
BCD010	HC	Molecular Biology and Gene Regulation	3:1:0	4
BCD070	HC	Genetics and Genetic Engineering	3:1:0	4
BCD060	HC	Project Work OR Dissertation***	0:4:4	8*
			Semester Total Credits	**16**
			Total CREDITS to be earned for M.Sc. BIOCHEMISTRY	**76**

* Grade Point will be calculated with respect to the allotted credits

HC	Hard Core Course
SC	Soft Core Course
OE	Open Elective Course
C1	Component 1 of Internal Assessment (IA)
C2	Component 2 of Internal Assessment (IA)
C3	Component 3 (Semester-end Exam)
L	Lecture (1 Credit=1 hr)
T	Tutorial (1 Credit=2 hrs)
P	Practical (1 Credit=2 hrs)

** Weekly Four hrs of practical for Two days

*** Project work OR Dissertation should be in-house only and may be allotted to the students in the 2nd/3rd semester

Note: Two Practical examinations of four hrs duration each for C3 (component 3) of Hardcore Course with Practical Component Only.

SCHEME OF ASSESSMENT

Course Code	Course Type	Course Title	Exam Hrs	Max. Marks			
				IA		Exam C3	Total
				C1*	C2*		
Semester - I							
BCA040	HC	Analytical Biochemistry–I	3	15	15	70	100
BCA050	HC	Chemistry and Metabolism of Proteins and Nucleic Acids	3	15	15	70	100
BCA060	HC	Experiments in Biochemical Techniques and Enzymology ** and Seminar	4	15	15	70	100
BCA230	SC	Enzymology	3	15	15	70	100
BCA250	**Choose any ONE from the following**		3	15	15	70	100
	SC	(i) Chemical Principles and Biochemical Reactions (ii) Plant Biochemistry (iii) Microbial Biochemistry					
Semester Total Marks							**500**

Course Code	Course Type	Course Title	Exam Hrs	Max. Marks			
				IA		Exam C3	Total
				C1*	C2*		
Semester - II							
BCB040	HC	Analytical Biochemistry–II	3	15	15	70	100
BCB050	HC	Chemistry and Metabolism of Carbohydrates and Lipids	3	15	15	70	100
BCB060	HC	Experiments in Immunology and Biochemical Estimations** and Seminar	4	15	15	70	100
BCB250	SC	Immunology and Microbiology	3	15	15	70	100
BCB260	**Choose any ONE from the following**		3	15	15	70	100
	SC	(i) Human Physiology and Nutrition (ii) Research Methodology and Biostatistics (iii) Clinical Research Methods and Industrial Biochemistry					
Semester Total Marks							**500**

Course Code	Course Type	Course Title	Exam Hrs	Max. Marks			
				IA		Exam C3	Total
				C1*	C2*		
Semester - III							
BCC070	HC	Cell Biology, Endocrinology and Cell Signaling	3	15	15	70	100
BCC050	HC	Clinical Biochemistry	3	15	15	70	100
BCC060	HC	Experiments in Clinical Biochemistry and Molecular Biology** and Research Paper Presentation	4	15	15	70	100
BCC220	SC	**Choose any ONE from the following** (i) Genomics, Proteomics and Bioinformatics (ii) Biotechnology and Research Methodology (iii) Pharmaceutical Biochemistry	3	15	15	70	100
BCC630	OE	Nutrition and Health	3	15	15	70	100
						Semester Total Marks	**500**

Course Code	Course Type	Course Title	Exam Hrs	Max. Marks			
				IA		Exam C3	Total
				C1*	C2*		
Semester - IV							
BCD010	HC	Molecular Biology and Gene Regulation	3	15	15	70	100
BCD070	HC	Genetics and Genetic Engineering	3	15	15	70	100
BCD060	HC	Project Work OR Dissertation***	–	15	15	70	100
						Semester Total Marks	**300**

- C1* & C2* Internal test will be conducted for 20 marks (if MCQs are used as assessment pattern, then there will be 30 MCQs carrying one mark each conducted through LMS of one hour duration and in both the cases the scored marks is reduced to 10 marks and 5 marks for continuous assessment is added, making a total of 15 marks each for C1 and C2.
- Continuous assessment comprise of assignments, group discussions, seminars and tutorials
- ** The Project evaluation is as below

  Component 1 (C1): Periodic Progress Report (15%)
  Component 2 (C2): Periodic Progress Report (15%)
  Component 3 (C3): Final Viva-Voce and Evaluation (70%)
  (The report evaluation is for 40% and the Viva-Voce examination is for 30%)

Program Outcome(s):

PO1: Provides with the necessary knowledge and skills to undertake a career in research, either in industry or in an academic setting
PO2: Provides the breadth and depth of scientific knowledge in Biochemistry and allied areas
PO3: Equips to apply for a PhD or to gain employment in biochemistry and allied areas
PO4: Provides a substantial element of hands-on research experience, with enhanced experimental skills
PO5: Demonstrates detailed knowledge and understanding of the principles and theories of biochemistry
PO6: Helps to understand the principle techniques of biomolecular structural characterization, including spectroscopy

Program Specific Outcome(s): The Specific Outcome of this programme is to train and provide the candidate with knowledge related to

PSO1: Global level research opportunities to pursue PhD programme targeted approach of CSIR-NET examination
PSO2: Enormous job opportunities at all level of chemical, pharmaceutical, food products, life oriented material industries
PSO3: Specific placements in R&D and quality control or analysis division of nutraceutical, pharmaceutical industries and allied division

Course Code	Title of the Course	Credits
BCA040	ANALYTICAL BIOCHEMISTRY–I	4

COURSE OUTCOME(S):

CO1	Specify in depth cell fractionation techniques
CO2	Write down in details with application, if applicable, chromatography and spectroscopy
CO3	Write down in details with application, if applicable, principle and applications of electrophoresis
CO4	Understand the classification and characteristics of centrifugation and microscopy

		No. of Lectures
Unit I:		08
1.1	**Cell Fractionation**	
1.1.1	Cell fractionation techniques: Preparation of extracts for biochemical investigations. Physico-chemical properties of solvents, solubility and miscibility, salting–in and salting–out.	
1.1.2	Choice of solvent for solvent extraction, mixed solvents, solid phase extraction. Cell lysis, dialysis, precipitation and ultra filtration.	

Unit II:		14
2.1	**Chromatography and Spectroscopy**	
2.1.1	Adsorption *vs.* Partition chromatography. Paper, TLC, Ion exchange, Reverse phase, Gel filtration, Affinity, HPLC, and Gas chromatographic techniques.	
2.1.2	Beer-Lamberts Law, Its verifications and Deviations, Concept of Absorptions, Transmission, Scattering, Phosphorescence, Fluorescence, Luminescence, Diffraction Spectra.	
2.1.3	Principle, instrumentation, working and applications of– UV and Visible Spectroscopy,	
2.1.4	Turbidometry and Nephlometry.	

Unit III:		12
3.1	**Electrophoresis**	
3.1.1	Theory of electrophoresis, continuous and discontinuous PAGE, SDS-PAGE.	
3.1.2	Other electrophoretic methods–Isoelectric focusing, 2–dimensional gel electrophoresis, Capillary electrophoresis and PFGE.	
3.1.3	Agarose gel electrophoresis of nucleic acids. Isotachophoresis.	
3.1.4	Separation of proteins, lipoproteins, visualizing separated	

	components–staining, fluorescence, PAS staining, zymogram and reverse zymogram,	

Unit IV:		
4.1	**Centrifugation and Microscopy**	**14**
4.1.1	Analytical and Preparative Ultracentrifuge–Principle, instrumentation and applications.	
4.1.2	Analysis of subcellular fractions, marker enzymes and determination of relative molecular mass–Svedberg's constant, sedimentation velocity and sedimentation equilibrium.	
4.1.3	Theories of Tissue Fixation and Staining Techniques. Principles of Transmission and Scanning Electron Microscopy.	
4.1.4	Principles of Phase Contrast and Fluorescence Microscopy, Confocal Microscopy	

References

[1] Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)

[2] Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).

[3] Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).

[4] Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),

[5] Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)

[6] Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).

[7] Basic Mathematics for Biochemists; Cornish Bowden, Oxford University Press (1998),.

[8] Biophysical Tools for Biologists *In Vivo* Techniques; John Correia H. Detrich, III Elsevier (2008).

[9] Practical Biochemistry by Keith Wilson and Walker 5th ed. Cambridge.

[10] Biophysical chemistry, Upadhyaya, A., Upadhyaya, K. and Nath, N. Himalayan Publishing House.

[11] Practical biochemistry- Principles and Techniques. Wilson and Walker. J.Cambridge Uni. Press.

[12] Physical Biochemistry-David Freifelder, 2nd Edition.

[13] Principles of Instrumental Analysis. 5th Ed. Douglas A Skoog, James Holler and Timothy A Nieman.

[14] Introduction to Electron Microscopy for Biologists; Terry Allen, Academic Press (2008).

Course Code	Title of the Course	Credits
BCA050	CHEMISTRY AND METABOLISM OF PROTEINS AND NUCLEIC ACIDS	4

COURSE OUTCOME(S):

CO1	Identify the details of amino acids and proteins
CO2	Understand in details with application, if applicable, nitrogen metabolism and degradation
CO3	Write down the classification and characteristics of synthesis of amino acids and proteins
CO4	Write down in details with application, if applicable, metabolism of nucleic acids

		No. of Lectures
Unit I:		10
1.1	**Chemistry of Amino acids and Proteins**	
1.1.1	Classification and structure of 20 amino acids, newly discovered amino acids, essential, non–essential, unusual and non-protein	
1.1.2	General properties of aa, acid–base titrations, pKa Peptide bond–stability and formation, chemical synthesis of peptide. Primary structure and determination, GN Ramachandran plots	
1.1.3	Secondary structure and motifs, α helix, β sheet, Leucine zipper, Zinc finger	
1.1.4	Tertiary & Quaternary structure (myoglobin, hemoglobin) Protein-protein interactions (actin, tubulin) Small peptides (glutathione, peptide hormones), Cyclic peptides (Gramicidin)	
1.1.5	Classification of proteins-globular, fibrous, membrane, metallo–proteins, Denaturation (pH, temperature, chaotropic agents), refolding, Role of chaperones in folding	
Unit II:		14
2.1	**Nitrogen Metabolism and Degradation of Amino Acids**	
2.1.1	Nitrogen cycle, Nitrogen fixation – symbiotic and non-symbiotic, Nitrogenase complex. Assimilation of ammonia	
2.1.2	Metabolic fate of dietary proteins and amino acids Degradations to glucose and ketone bodies	
2.1.3	Amino acids degraded to Pyruvate, Oxaloacetate	
2.1.4	Amino acids degraded to Acetyl-CoA, Succinyl-CoA Metabolism of branched chain amino acids, urea cycle, regulation of urea cycle	
2.1.5	Genetic defects in metabolism of amino acids (albinism, Phenylketonuria, maple syrup urine disease, homocystinuria alkaptonuria, methyl malonic Acidemia)	

Unit III:		
3.1	**Biosynthesis of Amino Acids and Protein Degradation**	**08**
3.1.1	Biosynthesis of amino acids and regulation of amino acid metabolism	
3.1.2	Biosynthesis and degradation of heme	
3.1.3	Biosynthesis of polyamines, creatine, gramicidine and glutathione	
3.1.4	Biosynthesis and degradation of glycoproteins and proteoglycans	
3.1.5	Protein degradation pathway–Ubiquitin–Proteosome pathway, lysosomal pathway	

Unit IV:		
4.1	**Chemistry and Metabolism of Nucleic Acids**	**16**
4.1.1	Purines, pyrimidines, nucleosides, nucleotides, unusual bases. Structure of DNA – Watson Crick Model, A- and Z- forms.	
4.1.2	Supercoiling of DNA – negative and positive, linking number	
4.1.3	Structure of RNA, tRNA, rRNA, siRNA / miRNA Denaturation and renaturation, Tm (factors affecting Tm) and Cot curves, Isolation and purification of nucleic acids from biological sources.	
4.1.4	Biosynthesis of purines and pyrimidines, Degradation of purines and pyrimidines, Regulation: de novo, salvation, nucleotide analogs, conversion of nucleotides to deoxynucleotides, mechanism of action of methotrexate, 5–flurouridine, azathymidine.	
4.1.5	Gout and Lesch–Nyhan syndrome	
4.1.6	Biosynthesis of NAD, FAD and Co–enzyme A	

References

[1] Lehninger Principles of Biochemistry 4th Ed By David L. Nelson and Michael M. Cox, WH Freeman and Company.
[2] Biochemistry by Lubert Stryer. WH Freeman and Co.
[3] Biochemistry: The Molecular Basis of Life by Trudy McKee and James R McKee. Publisher: McGraw-Hill Higher education.
[4] Biochemistry and Molecular biology By William H. Elliott and Daphne C. Elliott. Oxford University Press.
[5] Biochemistry 3rd Ed. By Donald J. Voet and Judith G. Voet. John Wiley and Sons.
[6] Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 by D Voet. John Wiley and Sons.

Course Code	Title of the Course	Credits
BCA060	EXPERIMENTS IN BIOCHEMICALTECHNIQUES AND ENZYMOLOGY AND SEMINAR	4

COURSE OUTCOME(S):

CO1 Identify the details of spectrophotometer

CO2 Identify the details of specific activity of enzymes

CO3 Deliberate the characteristics of gel electrophoresis

CO4 Deliberate the characteristics of use of pipettes

Group I:	1. Determination of Normality, Molarity and Molality of solutions 2. Preparation of buffers: Acetate, Phosphate and Tris buffer 3. Colorimetry–Beer's law and its applications 4. Determination of Molar Extinction Coefficient 5. Chromatography–Separation of amino acids by ascending, descending, circular paper chromatography 6. TLC of amino acids 7. Gel filtration, Ion exchange chromatography	
Group II:	8. Estimation of protein by Lowry's method. 9. Estimation of protein by Biuret reagent method. 10. Estimation of amino acids by Ninhydrin method 11. Isolation of casein from milk and its quantification 12. Electrophoresis–Separation of proteins by Native and SDS-PAGE 13. Determination of *pKa* and *pI* of amino acid, formal titration. 14. Separation of nucleic acids by agarose gel electrophoresis	
Group III:	15. Isolation of microbes from air, soil and water 16. Gram's staining 17. Determination of growth curve of bacteria 18. Antibiotic sensitivity tests 19. Determination of specific activity of (i) Acid Phosphatase (ii) Alkaline Phosphatase (iii) Salivary Amylase (iv) Protease (v) Invertase (vi) Aminotransferase	

Group Study	Extraction, Isolation, Purification and enzyme characterization. Determination of specific activity, optimum pH, temperature, time and energy of activation. Determination of *Km* and *Vmax* Enzyme inhibition studies	

References

[1] Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011).
[2] Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
[3] Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
[4] Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
[5] Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
[6] Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
[7] Physical Biochemistry, Kansal Edward Van Halde. Prentice Hall.
[8] Modern Experimental Biochemistry R.F.Boyer [Ed.] (1986) Addition Wesley.
[9] Analytical Biochemistry; D.J. Holme and H. Pick Longman (1983).
[10] Principles and techniques of Biochemistry and Molecular Biology; Keith Wilson and John Walker; 6th Edn. (2005) Cambridge University Press.
[11] Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.

Course Code	Title of the Course	Credits
BCA230	**ENZYMOLOGY**	**4**

COURSE OUTCOME(S):

CO1 Write down in details with examples enzyme kinetics

CO2 Identify in details with examples enzyme catalysed reactions

CO3 Identify the characteristics of cooperativity reactions

CO4 Learn the classification and characteristics of multienzyme complex reactions

		No. of Lectures
Unit I:		16
1.1	**Enzyme Kinetics and Inhibition**	
1.1.1	Nature of enzymes, Nomenclature and IUB classification of enzymes, Units of enzyme activity, IU and activity and specific activity. Localization, isolation, purification and characterization of enzymes. Criteria of purity of enzymes. Assay methods–coupled enzyme assays, continuous, end point and kinetic assay.	
1.1.2	Enzyme Kinetics: Rate of a reaction, order and molecularity. Michaelis Menten equation, initial velocity approach, steady state approach. Vmax, Km and their significance. Linear transformation of Michaelis Menten equation–Lineweaver Burk plot, Eadie Hofstee, Haynes–Wolf and Cornish–Bowden.	
1.1.3	Inhibition: Reversible inhibition–Competitive, Non competitive and Uncompetitive, product inhibition, irreversible inhibition–suicide inhibition. Determination of *Ki.* Fast reactions–Stopped flow, temperature jump method with examples of enzymes.	
Unit II:		08
2.1	**Enzyme Catalyzed Reactions**	
2.1.1	Bisubstrate enzyme catalysed reactions–Cleland's notation with examples for ordered, ping pong, and random.	
2.1.2	General rate equation. Primary and secondary plots. Mechanisms of enzyme catalysis–Active site structure and its investigation.	
2.1.3	Methods of determining active site structure–isolation of ES/EI complex, affinity labeling, chemical modification studies.	

Unit III:		
3.1	**Enzyme Catalysis and Cooperativity**	**12**
3.1.1	Nature of enzyme catalysis: Transition state theory, proximity and orientation, orbital steering, acid base catalysis, covalent catalysis, metal ion catalysis, nucleophilic and electrophilic catalysis, intramolecular catalyses, entropy effects.	
3.1.2	Effect of temperature and pH on enzyme catalyzed reactions.	
3.1.3	Oligomeric proteins and Cooperativity: Binding of ligands to macromolecules–Scatchard plot, Positive and Negative cooperativity. Oxygen binding to hemoglobin.	
3.1.4	Hill equation, homotropic and heterotropic effectors. Allosteric enzyme–Aspartyl transcarbamylase.	

Unit IV:		
4.1	**Multienzyme Complex and Coenzymes**	**12**
4.1.1	Mechanisms of action of specific enzyme: Chymotrypsin zymogen activation, acid–base catalysis, charge relay net work. Lysozyme, alcohol dehydrogenase, ribonuclease, Carboxypeptidase–A, RNA as enzyme, coenzymic action of NAD+ FAD, TPP, PLP, biotin, CoA, folic acid and lipoic acid.	
4.1.2	Multienzyme complexes: Isoenzymes, eg. LDH. Multifunctional enzyme (DNA polymerase) multi enzyme complex (PDC)	
4.1.3	Metabolic regulation of enzyme activity–Feedback regulation.	

References

[1] Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).
[2] Enzymes; Trevor Palmer, East − West Press Pvt. Ltd., Delhi (2004).
[3] Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley-VCH Publishers (2000).
[4] Enzyme Kinetics and Mechanism; Paul F. Cook, W. W. Cleland, Garland Science (2007).
[5] Enzyme Kinetics; Roberts, D.V. (1977), Cambridge University Press.
[6] The Enzymes; Boyer, Academic Press, (1982).
[7] Principles of Enzymology for Food Sciences; Whitaker, Marcel Dekker (1972) Academic Press.
[8] Introduction to Enzyme and Co-enzyme Chemistry. Ed. T. Bugg, (2000), Blackwell Science.

Course Code	Title of the Course	Credits
BCA250	**CHEMICAL PRINCIPLES AND BIOCHEMICAL REACTIONS**	**4**

COURSE OUTCOME(S):

CO1 Specify in details with examples chemical principles and bonding

CO2 Write down in depth thermodynamics

CO3 Learn in details with application, if applicable, stereochemistry

CO4 Deliberate in depth secondary metabolites

		No. of Lectures
Unit I:		**16**
1.1	**Chemical Principles and Bonding**	
1.1.1	Chemical principles: Acids and bases, Buffers. Buffering capacity. Ionic strength- Molarity, Normality, Mole concept, Avogadro number, structure and special properties of water.	
1.1.2	Bonding: Covalent bond, ionic bond, Coordinate bond. Coordinate bond formation by transition metals in biological complex structures.	
1.1.3	Crystal field theory, ligand field theory, valence bond theory.	
1.1.4	Bonding of iron in hemoglobin and cytochromes, cobalt in Vit B12, and Mg2+ in chlorophyll. Chelates and complexes.	

Unit II:		**08**
2.1	**Thermodynamics**	
2.1.1	Physiological importance of electrolytes: Osmotic pressure, vapour pressure, vapour pressure osmometer, Donnan membrane equilibrium.	
2.1.2	Introduction to thermodynamics: I, II and III law. Enthalpy, entropy and free energy. Free energy and chemical equilibrium	
2.1.3	Electrodes: Hydrogen electrode, oxygen electrode, oxidation and reduction reactions, redox potential.	

Unit III:		**12**
3.1	**Stereochemistry and Heterocyclic Compounds**	
3.1.1	Importance of Stereochemistry, position and order of groups around carbon. Geometric and optical isomerism, absolute and relative configuration.	
3.1.2	Symmetry view of chirality, relation between chirality and optical activity, representation of chiral structures by Fischer.	
3.1.3	Structure and stereochemistry of glucose–anomers, epimers and sterioisomers, D and L, + and – R and S notations.	
3.1.4	Heterocyclic Compounds: Chemistry, biological	

	occurrence of furan, indole, thiazole, pterine, pteridine, isoalloxazine, pyrrole.	

Unit IV:		12
4.1	**Organic Reactions and Secondary Metabolites**	
4.1.1 4.1.2 4.1.3	Mechanism of Organic Reactions: Classification of organic reactions. Reaction intermediates, reaction energetics, rate, order and molecularity of reactions. Mechanisms and stereochemistry of substitution, addition, and elimination. Rearrangements reactions. Mechanisms of ester hydrolysis. Aromaticity and resonance structure. Hydrogenation- homogenous and heterogenous hydrogenation Secondary metabolites: Phytochemicals, terpenes, polyphenols, procyanidins, flavonoids, xanthones, alkaloids and pigments.	

References

[1] Basic principles of organic chemistry- Robers and Caserio
[2] Organic chemistry, Hendrickson, Cram and Hammonal.
[3] Organic chemistry, I. L. Finar, Longman group Ltd.
[4] Organic chemistry, Morrison and Boyd, 4th edition Allyn and Bacon Inc.

Course Code	Title of the Course	Credits
BCA250	**PLANT BIOCHEMISTRY**	**4**

COURSE OUTCOME(S):

CO1 Specify in details with examples Photosynthetic pathways and its regulations

CO2 Write down in depth plant growth hormones in the agriculture

CO3 Learn in details with application, if applicable, Medicinal plants

CO4 Deliberate in depth secondary metabolites of plants and its significance

		No. of Lectures
Unit I:		**12**
1.1	**Plant Cell and Photosynthesis**	
1.1.1	Plant cell–Structure and functions of subcellular organelles, plant cell wall, Mechanism of water absorption, Ascent of sap. Transpiration - types, stomatal opening, Mechanism and factors affecting transpiration.	
1.1.2	Photosynthesis–Photosynthetic pigments, Photo synthetic apparatus, Light reactions, cyclic and non cyclic Phosphorylation. Calvin cycle, Hatch–Slack cycle, CAM plants.	
1.1.3	Regulation of photosynthesis, Photorespiration.	

Unit II:		**12**
2.1	**Cycles of elements**	
2.1.1	Nitrogen cycle, Biochemistry of symbiotic and non symbiotic nitrogen fixation, Sulphur cycle, Phosphorus cycle.	
2.1.2	Plant nutrition–Biological functions of micro and macro nutrients in plants and their deficiency symptoms.	

Unit III:		**16**
3.1	**Growth Regulators**	
3.1.1	Plant growth regulators–chemistry, biosynthesis, mode of action, distribution and physiological effects of Auxins, Gibberellins, Cytokinins, ABA and Ethylene.	
3.1.2	Biochemistry of seed dormancy, Seed germination,	
3.1.3	Fruit ripening and Senescence.	

Unit IV:		
4.1	**Medicinal Importance**	**08**
4.1.1	Medicinal value of different parts of plants.	
4.1.2	Basic methods to identify the secondary metabolites. Role of secondary metabolites in Ayurvedha and Siddha treatment.	
4.1.3	Medicinal value of Amla, Stevia, Aswagandha, Turmeric and other Indian medicinal plants.	

References

[1] Plant physiology, Verma, 7th Revised edition, Emkay Publications 2001.
[2] Plant Physiology, S. N. Pandey and B.K. Sinha, Vikas Publishing House Pvt. Ltd, 3rd edition, 1999.
[3] Plant Biochemistry and Molecular Biology, Peter Jhea, Richard C. Leegood,
[4] Introduction to plant physiology, William. G.Hopkins, Norman. P.A. Hunger, 3rd edition
[5] A Handbook of Medicinal Plants –Prajapathi, Purohit,Sharma, Kumar
[6] Medicinal Plants –a compendium of 500 species.

Course Code	Title of the Course	Credits
BCA250	MICROBIAL BIOCHEMISTRY	4

COURSE OUTCOME(S):

CO1	Specify in details with examples staining techniques used for the identification of microbes
CO2	Write down in depth Molecular biology of prokaryotes
CO3	Learn in details with application, if applicable, Operon systems in gene regulation of bacteria
CO4	Deliberate in depth antimicrobial drugs are used for the microbial infections

		No. of Lectures
Unit I:		10
1.1	**Pure Culture, Staining Technique and Growth**	
1.1.1	Principles of microbial nutrition: Nutritional requirements, different kinds of media, factors affecting growth.	
1.1.2	Enrichment culture techniques for isolation of chemoautotroph's, chemoheterotroph's and photosynthetic microorganisms. Modes of reproduction,	
1.1.3	Biosynthesis of cell wall components, enumeration, growth curve, generation time, synchronous growth, Chemostat. Adaptation to stationary phase, heat and cold shock, osmolarity and salinity, oxidative stress.	
1.1.4	Gram, Acid fast & flagellar staining. Mechanism of bacterial motility.	

Unit II:		14
2.1	**Regulation of Genes in Bacteria**	
2.1.1	Nucleic Acids as Carriers of Genetics Information, Arrangement and Organization of Gene in Prokaryotes:	
2.1.2	Operon Concept, Catabolite Repression, Instability of Bacterial RNA, Inducers and Co repressors E. coli Lac Operon: Negative Regulation and Positive Regulation, E. Coli Arabinose Operon: Regulation by Attenuation, His and Trp Operons: Anti-termination,	
2.1.3	Genetic Transfer: Conjugation, Transformation and Transduction.	

Unit III:		
3.1	**Virology and Biological Nitrogen Fixation**	**16**
3.1.1	Introduction to Virus, Classification, Assay Methods, Properties and Characteristic of Bacterial, Plant and Animal Viruses	
3.1.2	Virus Host Interaction, Acute Virus Infections, Persistent of Virus Infection, Influenza, Herpes, Hepatitis A and B.	
3.1.3	Nitrogen Metabolism: Mechanism and Regulation of Utilization of Ammonia, Nitrate and other Nitrogen Source	
3.1.4	Nitrogen Fixation: Mechanism and Regulation of Nitrogen Fixation, Symbiotic and Asymbiotic Nitrogen Fixation and Biochemistry of Nitrogenase.	

Unit IV:		
4.1	**Antimicrobial Agents**	**08**
4.1.1	The Development of Antimicrobial Agents, Past, Present and Future, Selection of Antimicrobial Agents	
4.1.2	Synthetic Organic Antimicrobials, β-Lactam Antibiotics, Amino glycoside Antibiotics, Antifungal Drugs, Antiviral Drugs	
4.1.3	Resistance to Antimicrobial Drugs	

References

[1] Microbial physiology, 2nd Edn. I.W. Dawes and I.W. Sutherland (1991) Blackwell Scientific.
[2] Microbial physiology, 4th Edn. Albert G. Moat, John W. Foster and Michael P. Spector, Wiley-Liss (2002).
[3] Biology of Microorganisms, Brock Prentice Hall (1996).
[4] Microbiology: Lansing M. Prescot, Hartley and Klein, 5th Edn. McGraw Hill (2002).
[5] General Microbiology, Stainer *et al.,* 4th Edn. McMillan (1975).
[6] Microbiology, Pelczer, Reid and Kreig Tata McGraw Hill (1996).

Course Code	Title of the Course	Credits
BCB040	**ANALYTICAL BIOCHEMISTRY–II**	**4**

COURSE OUTCOME(S):

CO1 Identify in details with application, if applicable, flow cytometry

CO2 Specify the characteristics of biosensor technology

CO3 Understand in details with examples spectroscopy

CO4 Write down the details of x-ray crystallography

		No. of Lectures
Unit I:		**08**
1.1	**Flow Cytometry and Model Systems**	
1.1.1	Flow Cytometry: Principle and design of flow cytometer, cell sorting.	
1.1.2	Animal models: Choice of animals, types of studies, mutant organisms, cultured cells, plant as models and tissue culture models.	

Unit II:		**16**
2.1	**Biosensor Technology and Radioactivity**	
2.1.1	Concept and design of biosensors, types and uses of biosensors.	
2.1.2	Principle and applications of biosensors for glucose, triglyceride, uric acid, cholesterol and oxalate.	
2.1.3	Units of radioactivity. Detection and measurement of radioactivity–solid and liquid scintillation counting, scintillation cocktails and sample preparation. Cerenkov counting. Applications of radioisotopes in biology. Radiation hazards.	
2.1.4	Principle and Applications of Autoradiography	

Unit III:		**10**
3.1	**Spectroscopy**	
3.1.1	Principle, instrumentation, working and application of– Spectrofluorimetry, Flame Spectrophotometry, Atomic Absorption Spectrometry.	
3.1.2	IR spectroscopy: Physical basis of IR spectroscopy. Instrumentation, use of IR in structure determination, Fourier Transfer–IR spectroscopy.	
3.1.3	NMR: Principle, effect of atomic, identity on NMR, chemical shift, spin coupling NMR, measurement of NMR spectra, biochemical application of NMR.	
3.1.4	ESR: Principle, measurement of ESR spectra, biochemical application of ESR.	
3.1.5	Principle, instrumentation and applications of ORD and CD	

Unit IV:		
4.1	**Mass spectroscopy, X-ray Crystallography and Nanoparticles**	**14**
4.1.1 4.1.2 4.1.3 4.1.4 4.1.5	Theory and construction of mass spectrometer. Ionization, fragmentation, *m/z*, time of flight, MALDI and ESI. Other methods: MS/MS, LC/MS, GC/MS, Peptide mapping, post translation modification analysis, determination of disulfide bridges X-ray crystallography–Bragg's law, Unit cell, Isomorphous replacement, Fibre pattern of DNA. Introduction to Nanoscience: Importance and fundamental science behind nanotechnology. Applications of Nanoparticles: Tools to make nanostructures, Nanoscale lithography, E–beam lithography, molecular synthesis, self assembly. Drug and Gene delivery for human health, Biosensors and sensors, cleaning environment (for heavy metal & Bioremediation).	

References

[1] Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
[2] Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
[3] Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
[4] Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
[5] Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
[6] Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
[7] Basic Mathematics for Biochemists; Cornish Bowden, Oxford University Press (1998),.
[8] Biophysical Tools for Biologists *In Vivo* Techniques; John Correia H. Detrich, III Elsevier (2008).
[9] Practical Biochemistry by Keith Wilson and Walker 5th ed. Cambridge.
[10] Biophysical chemistry, Upadhyaya, A., Upadhyaya, K. and Nath, N. Himalayan Publishing House.
[11] Practical biochemistry- Principles and Techniques. Wilson and Walker. J.Cambride Uni. Press.
[12] Physical Biochemistry-David Freifelder, 2nd Edition.
[13] Principles of Instrumental Analysis. 5th Ed. Douglas A Skoog, James Holler and Timothy A Nieman.

Course Code	Title of the Course	Credits
BCB050	CHEMISTRY AND METABOLISM OF CARBOHYDRATES AND LIPIDS	4

COURSE OUTCOME(S):

CO1 Understand the classification and characteristics of chemistry of carbohydrates

CO2 Deliberate the classification and characteristics of bioenergetics

CO3 Write down the characteristics of chemistry of lipids

CO4 Learn in depth metabolism of lipids

		No. of Lectures
Unit I:		10
1.1	**Chemistry of Carbohydrates**	
1.1.1	Classification, monosaccharides (aldoses & ketoses) Configuration and conformation of monosaccharides (pyranose & furanose, chair & boat).	
1.1.2	Reducing and optical properties of sugars. Stability of glycosidic bond disaccharides, oligosaccharides.	
1.1.3	Structural polysaccharides–cellulose, hemicellulose, pectin, lignin, chitin, chitosan	
1.1.4	Storage polysaccharides: starch, glycogen, inulin Steric factors in polysaccharides folding, blood group polysaccharides and lectins. Glycosaminoglycans, mucopolysaccharides, hyaluronic acid Chondroitin sulfate, keratan sulfate, dermatan sulfate. Bacterial cell wall polysaccharides, proteoglycans (syndecan and agrecan)	

Unit II:		14
2.1	**Metabolism of Carbohydrates and Bioenergetics**	
2.1.1	Reactions and energy balance in Glycolysis, Gluconeogenesis, TCA cycle, HMP Shunt pathway, Pasteur and Crabtree effect, Anapleurotic reactions	
2.1.2	Glyoxylate cycle, Glucuronic acid cycle, Glycogen metabolism.	
2.1.3	Photosynthesis reactions for biosynthesis of glucose C3 and C4 cycle in plants	
2.1.4	Mitochondrial ETC–Organization of respiratory chain complexes, P/O ratio, ATP synthesis, Mitchell's hypothesis, uncouplers and inhibitors.	

Unit III:		12
3.1	**Chemistry of Lipids**	
3.1.1	Classification & biological significance of lipids, fatty acids and Steroids	
3.1.2	Bile acids and salts, Phospholipids, Oils, waxes, isoprene units, Lipoproteins, Glycolipids, Sphingolipids	

3.1.3	Cerebrosides, Gangliosides, Prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes, cysteinyl leukotrienes	

Unit IV:		
4.1	**Metabolism of Lipids**	**12**
4.1.1	Fate of dietary lipids and Apo-lipoproteins Fatty acid biosynthesis, Desaturation of fatty acids Beta oxidation, breakdown of odd chain fatty acids, energy yields	
4.1.2	Regulation of β–oxidation, ώ–oxidation & α–oxidation Metabolism of phospholipids &Sphingolipids Regulation and Biosynthesis of cholesterol, action of statins	
4.1.3	Fate of acetyl CoA, formation of ketone bodies and ketosis	
4.1.4	Biosynthesis of prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes, Action of aspirin	
4.1.5	Genetic defects in lipid metabolism, Medium chain acyl coenzyme A dehydrogenase deficiency MCAD, Long–chain 3–hydroxyacyl–CoA dehydrogenase (LCHAD) deficiency, Familial hypercholesterolemia	

References

[1] Lehninger Principles of Biochemistry 4th Ed By David L. Nelson and Michael M. Cox, WH Freeman and Company.
[2] Biochemistry by Lubert Stryer. WH Freeman and Co.
[3] Biochemistry: The Molecular Basis of Life by Trudy McKee and James R McKee. Publisher: McGraw-Hill Higher education.
[4] Biochemistry and Molecular biology By William H. Elliott and Daphne C. Elliott. Oxford University Press.
[5] Biochemistry 3rd Ed. By Donald J. Voet and Judith G. Voet. John Wiley and Sons.
[6] Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 by D Voet. John Wiley and Sons.

Course Code	Title of the Course	Credits
BCB060	**EXPERIMENTS IN IMMUNOLOGY AND BIOCHEMICAL ESTIMATIONS**	4

COURSE OUTCOME(S):

CO1 Understand in details with examples antigen antibody reactions

CO2 Specify in details with application, if applicable, oils and fats estimation

CO3 Understand in depth acid value principle and determination

CO4 Identify in details with examples mitosis and meiosis

Group I:	1. Demonstration of Ag-Ab interaction: Radial immuno-diffusion and ODD. 2. Demonstration of direct agglutination reaction using human blood group antigens. 3. Demonstration of indirect agglutination reaction–latex agglutination. 4. Fluorescence emission of proteins and vitamins 5. UV–Vis spectra of proteins, nucleic acids and other aromatic compounds 6. Extraction of neutral lipids, phospholipids 7. TLC of lipids and estimation of phospholipids	
Group II:	8. Iodine No. of Oils/Fats 9. Saponification Value of Oils/Fats 10. Acid Value/Peroxide Value of Oils/Fats 11. Estimation of α-Keto-acid 12. Estimation of ascorbic acid 13. Estimation of Iron 14. Estimation of Calcium	
Group III:	15. Isolation of Starch from potato and purity determination 16. Colorimetric estimation of reducing sugars (DNS reagent method) 17. Estimation of reducing sugar: Hegedorn and Jensen Method 18. Estimation of Phosphate 19. Mitosis in onion root tips 20. Meiosis in *tradescantia*/grasshopper testis 21. Total and Differential Cell Counting of blood	

Group Study	Preparation of antigen adjuvant mixture, injection and raising antibodies in rat. Purification of antibodies Antibody titer and ELISA	

References

[1] Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011).
[2] Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
[3] Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
[4] Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
[5] Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
[6] Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
[7] Physical Biochemistry. Kansal Edward Van Halde. Prentice Hall.
[8] Modern Experimental Biochemistry R.F. Boyer [Ed.] (1986) Addition Wesley.
[9] Analytical Biochemistry; D.J. Holme and H. Pick Longman (1983).
[10] Principles and techniques of Biochemistry and Molecular Biology; Keith Wilson and John Walker; 6th Edn. (2005) Cambridge University Press.
[11] Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
[12] Methods in Immunology and Immunochemistry; Curtis Williams, Academic Press (1971).
[13] Immuno Assay Hand Book; David Wild, Elsevier (2013).

Course Code	Title of the Course	Credits
BCB250	IMMUNOLOGY AND MICROBIOLOGY	4

COURSE OUTCOME(S):

CO1 Identify in details with examples antigens and antibodies

CO2 Understand the details of cellular basis of immunity

CO4 Identify the classification and characteristics of MHC Complex

CO4 Learn in depth basic concepts of microbiology

		No. of Lectures
Unit I:		12
1.1	**Antigens and Antibodies**	
1.1.1	Introduction: Historical development and milestones in immunology. Barriers to infection–skin, mucous membrane, Definitions–Antigenicity, Immunogenicity, primary and secondary lymphoid organs, self and non self discrimination. Innate and acquired immunity.	
1.1.2	Antigens and Antibodies: Haptens and determinants–Epitopes and paratopes. Antigenicity, carbohydrates, proteins, nucleic acids, and cells as antigens. Valency of antigen.	
1.1.3	Classes and subclasses of immunoglobulins, structure of immunoglobulins, hyper variable region, isotypic, allotypic and idiotypic variations.	
Unit II:		12
2.1	**Complement and Cellular Basis of Immunity**	
2.1.1	Complement: Structure, components, properties and functions of complement pathways, biological consequences of complement activation.	
2.1.2	Hyper sensitivity reactions (Type I, II, III and IV).	
2.1.3	Cellular basis of immunity: Primary and secondary immune response. Reticuloendothelial system. T, B and accessory cells. Subsets of T (T–helper cells, T–killer cells, T–suppressor cells) and B cells. Development of T and B cells. T and B cell receptors, antigen processing and presentation.	
2.1.4	Cytokines and co–stimulatory molecules–Lymphokines, interleukins structure and function of IL-2, TNFα. T and B interaction. Suppression of immune response, immunoglobulin, diversity of gene rearrangement, factors affecting diversity, class switching and clonal selection theory of Burnet.	

Unit III:		
3.1	**MHC, Transplantation, Tumor Immunology and Vaccines**	**16**
3.1.1	MHC: MHC gene and its polymorphism, role of MHC in immune response.	
3.1.2	Transplantation: Autograft, isograft, allograft and xenograft, Graft rejection, graft *Vs* host reaction, MHC in transplantation.	
3.1.3	Immunochemical techniques: Precipitation, agglutination, complement fixation, immunodiffusion, immunoelectrophoresis, immunofluorescence, RIA, ELISA.	
3.1.4	Tumor immunology: Tumor associated antigens, factors favoring tumor growth, immune surveillance. Tumor necrosis factors α and β Disorders of immunity: Immunological tolerance, auto immune disorders, AIDS, SCID, lupus erythematosus Vaccines: Adjuvants; vaccines and their preparations. Polyclonal and monoclonal antibodies–hybridoma technique.	
Unit IV:		
4.1	**Microbiology**	**08**
4.1.1	Historical aspects - Discovery of microorganisms. Theory of spontaneous generation. Era of Louis Pasteur. Microbes and fermentation. Microbes and diseases-Koch's Postulates.	
4.1.2	General characteristics: Morphology, nomenclature and classification of bacteria, virus, yeasts and fungi.	
4.1.3	Microbial nutrition-Factors influencing growth, growth curve of bacteria. Measurement of growth, continuous culture, synchronous culture and chemostat. Auxotrophs, autotrophs, heterotrophs. Methods of cultivations and preservation of microorganisms.	
4.1.4	Methods of control of microorganisms-Sterilization Techniques: Definitions of physical methods, heat (dry & moist) filtration, radiation; chemical agents-phenols, alcohols, halogens, heavy metals, aldehydes, quaternary ammonium compounds & gases.	

References

[1] Antibodies–A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press (2014).
[2] Basic and Clinical Immunology; Stites *et al.,* [Ed] (1982) Lange.
[3] Roitt's Essential Immunology; Ivan, M. Roitt & Peter J Delves (2001) Blackwell Science.
[4] Immunology: Roitt *et al.,* Mosby (2001),
[5] Kuby Immunology; Oven, Punt, Stranford, 7th Edn. W. H. Freeman (2013).
[6] Immune System; M. C. Connel et al., Eds. (1981) Blackwell Science.
[7] Immunology at a Glance: J.H.L. Playfare [ed.] Blackwell Science, (1987).
[8] Immunology; Jan Klein [Ed.], Blackwell Science (1990).
[9] Introduction to Immunology; Kim Bell [Ed.,] 3rd Edn. McMillan (1990).

Course Code	Title of the Course	Credits
BCB260	HUMAN PHYSIOLOGY AND NUTRITION	4

COURSE OUTCOME(S):

CO1 Specify the classification and characteristics of blood and respiratory systems

CO2 Identify in depth digestive and excretory systems

CO3 Learn in details with application, if applicable, concepts of nutrition

CO4 Specify the details of vitamins and minerals

		No. of Lectures
Unit I:		
1.1	**Blood and Respiratory System**	**12**
1.1.1	Blood–Composition, cells. Erythrocytes–structure and function, WBC–types and functions.	
1.1.2	Platelets and their function. Buffer systems; hemostasis–blood volume, blood pressure and its regulation. Blood clotting, Dissolution of clot; anticoagulants. CSF–composition and function.	
1.1.3	Respiratory System–Mechanism of gas exchange, oxygen binding by hemoglobin and factors affecting oxygenation. Acid–base balance and its regulation.	

Unit II:		
2.1	**Hepatobiliary, Digestive and Excretory System**	**12**
2.1.1	Hepatobiliary system–Anatomy of the liver, blood supply; cells–hepatocytes, endothelial cells, Kupffer cells and paranchymal cells.	
2.1.2	Secretory and excretory function; detoxification and formation of bile	
2.1.3	Digestive system–GI tract, digestion and absorption of carbohydrates, proteins and lipids. Mechanism of HCl production in the stomach. Gastrointestinal hormones.	
2.1.4	Excretory System–Ultra structure of the nephron, glomerular filtration, tubular reabsorption and tubular secretion, formation of urine.	

Unit III:		
3.1	**Nutrition, Carbohydrates, Proteins and Fats**	**16**
3.1.1	Nutrition–Concepts of macro and micro nutrients, essential nutrients and their classification. Food groups, proximate analysis of foods, chemical and biological analysis for nutrients.	
3.1.2	Food as source of energy, methods of determining energy value of foods, calorimetry, physiological fuel values and daily requirement of energy, high and low	

	calorie diets. Basal metabolic rate (BMR), factors affecting BMR, specific dynamic action of foods.	
3.1.3	Carbohydrates–dietary sources, dietary fiber essentiality of carbohydrates.	
3.1.4	Proteins–Evaluation of nutritive value of dietary protein PER, BV, essential amino acids, nutritional classification of proteins, supplementary value of proteins, protein calorie malnutrition–Kwashiorkor and Marasmus.	
3.1.4	Fats–Sources, invisible fat, essential fatty acids, PUFA.	

Unit IV:		**08**
4.1	**Vitamins and Minerals**	
4.1.1	Vitamins–Fat soluble and water soluble vitamins, provitamins, antivitamins, dietary sources, structure, daily requirements and functions.	
4.1.2	Deficiency symptoms of B complex members and fat soluble vitamins, hypervitaminosis, vitamin like compounds.	
4.1.3	Minerals–Macro and micronutrients, sources, requirements, functions and deficiency symptoms.	
4.1.4	Water metabolism–distribution in body, function and factors affecting water balance.	
4.1.5	Recommended daily allowances, special nutrition for infants, children, during pregnancy, lactation and old age.	

References

[1] The Cell, Copper, Geoffery, M., Oxford University Press, (2001)
[2] Text Book f Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (1997), Wiley –Liss.
[3] Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications (2012).
[4] Principles of Human Physiology; 4th Edn. Cindy L. Stanfield Pearson, (2010).
[5] Human Biochemistry, Orten and Neuhans , 10th Edn. Mosbey International, (1983).
[6] Human Physiology: The mechanisms of Body functions. A.J. Vander, et. Al.,(1985) McGraw-Hill.
[7] Molecular Cell Biology, Baltimore et. al. (1995) Scientific American Publication.
[8] Harper's Review of Biochemistry, Murray et. al., (1997) 24th Edn., Lange
[9] Molecular Biology of Cell; Albertis *et. al.* (2002) Garland Science.
[10] Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc. (2010).
[11] Mammalian Biochemistry; White, Handler and Smith, McGraw-Hill, (1986).
[12] Textbook of human Physiology by Guyton, 11th ed.Elesvier.
[13] Introduction to Human Nutrition, 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
[14] Nutrition: Everyday Choices, 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley (2006).
[15] Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease; Watson Elsevier (2012).
[16] Nutrition and Metabolism, 2nd Edn., Lanham S, Mac Donald I and Roche H. The Nutrition Society, London, UK, (2012).
[17] Introduction to Human Nutrition, 2nd Edn., Gibney M, Lanham S, Cassidy A and Vorster H. The Nutrition Society, London, UK, (2012).

Course Code	Title of the Course	Credits
BCB260	RESEARCH METHODOLOGY AND BIOSTATISTICS	4

COURSE OUTCOME(S):

CO1	Specify the classification and characteristics of research methodologies and the experimental designs
CO2	Identify in depth statistical analysis
CO3	Learn in details with application, if applicable, scientific write-up
CO4	Specify the details of Interpretation of data

		No. of Lectures
Unit I:		12
1.1	**Research Methodology and Design**	
1.1.1	Research Methodology: Meaning of research, Objectives of research, Motivation in Research, Types of Research, and Research approaches.	
1.1.2	Research methods vs. Research Methodology, Research process–scientific method, Criteria for good research, Defining the research problem.	
1.1.3	Research Design: Meaning and need for research design, features of good design. Preparation of Scientific report, presentation of a review.	

Unit II:		12
2.1	**Scientific Writing**	
2.1.1	Mechanical and stylistic aspects of scientific writing-Precision and clarity of language, writing style, writing process, presentation of numerical data and scientific figures.	
2.1.2	Constraints on scientific writing–audience, format and mechanics (grammar, word choice, punctuation, tenses).	
2.1.3	Objectives and design of experiment–experimental unit, identifying variables, replications & controls, power analysis in planning experiments, treatment structure and design structure.	
2.1.4	Graphical analysis of data and presentation of results.	

Unit III:		16
3.1	**Statistical Significance Analysis**	
3.1.1	Significance and limitations of statistical calculations, Sampling techniques.	
3.1.2	Probability theory, random variables and distribution functions, Point and interval estimation, linear regression. Statistical evaluation of results–Hypothesis testing, interpretation of statistic for analysis of error.	
3.1.3	Measures of central tendency and dispersion	

Unit IV:		
4.1	**Testing Methods**	**08**
4.1.1	ANOVA, F-test, t-test, z-test, chi-square, correlation coefficient.	

References

[1] Research Methodology: Methods & Techniques By CR Kothari. Publisher: New Age International

[2] From Research to Manuscript: A Guide to Scientific Writing (Paperback) By Michael Jay Katz. Publisher: Springer

[3] The Craft of Scientific Writing (3rd Edition) By Michael Alley. Publisher: Springer-Verlag.

[4] Writing Scientific Research Articles: Strategy and Steps (Hardcover) By Margaret Cargill and Patrick O.Connor. Publisher: WileyBlackewell.

[5] The Mayfield Handbook of Technical and Scientific Writing By Leslie Perelman and Edward Barrett. McGraw-Hill NY

[6] Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers(Hardcover) 6th Ed By Edward J. Huth. Publisher: Cambridge University Press.

[7] The Handbook of Technical Writing, Eighth Edition (Handbook of Technical Writing Practices) (Hardcover) By Gerald J. Alred, Charles T. Brusaw and Walter E. Oliu, St. Martin’s Press.

[8] Science and Technical Writing: A Manual of Style (2nd Ed.) By Philip Rubens. Publisher: Routledge, London.

[9] The Elements of Technical Writing (Elements of Series) (Paperback) By Gary Blake and Robert W. Bly. Publisher: Longman.

[10] Technical Writing: Principles, strategies and readings (7th Edition) By Diana C. Reep. Publisher: Longman.

[11] Biostatistics By PN Arora and PK Malhan, Himalaya Publishing House.

[12] Experimental Design and Data Analysis for Biologists By Gerry P. Quinn and Michael J. Keough. Publisher: Cambridge University Press.

[13] Principles of Biostatistics (with CD-ROM) (Hardcover) By Marcello Pagano and Kimberlee Gauvreau. Publishers: Duxbury Press

[14] Biostatistics: Experimental Design and Statistical Inference (Hardcover) By James F. Zolman. Oxford University Press.

[15] Intuitive Biostatistics By Harvey Motulsky. Publisher: Oxford University Press

Course Code	Title of the Course	Credits
BCB260	CLINICAL RESEARCH METHODS AND INDUSTRIAL BIOCHEMISTRY	4

COURSE OUTCOME(S):

CO1	Specify the classification and characteristics of clinical practice and clinical research
CO2	Identify in depth fermentation technology and downstream processing
CO3	Learn in details with application, if applicable, clinical research methods
CO4	Specify the details of steps involved in drug discovery

		No. of Lectures
Unit I:		10
1.1	**Introduction to Clinical Research**	
1.1.1	Introduction to Clinical Research, Terminologies and definition in Clinical Research, Origin and History of Clinical Research	
1.1.2	Difference between Clinical Research and Clinical Practice, Types of Clinical Research, Phases of clinical research	
1.1.3	Clinical Trials in India–The National Perspective, Post marketing surveillance	
1.1.4	Pharmaceutical Industry–Global and Indian Perspective Clinical Trial market, Career in Clinical Research	

Unit II:		14
2.1	**Clinical Research Methods**	
2.1.1	Design of experiments, factorial experiments, randomization, interaction among factors.	
2.1.2	Types of studies: Cohort studies, double blind, placebo control, cross over and double dummy.	
2.1.3	Introduction to Good Clinical Practices, Clinical Trial Development: Protocol Design and Development, Case Report Form Design and Development, Principals of Data Management, Clinical Trial Management: Maintaining and Managing Essential Documents, Recording and Reporting Non–Serious and Serious Adverse Events.	

Unit III:		12
3.1	**Drug Discovery Concepts and Biostatistics**	
3.1.1	Proof of concept, target identification and validation. Identifying the lead compound, optimization of lead compound, mechanism of action, drug target and validation of target.	
3.1.2	Safety pharmacology, pharmaco–kinetics and	

	pharmaco–dynamics, acute and chronic toxicity Development of new drug/molecules and elucidation of their mechanisms of actions, formulations, factors affecting drug efficacy, drug resistance, traditional medicines; biotransformation.	
3.1.3	Statistical concept: Data structure, sampling methods, collection, classification and tabulation of data, graphical and diagrammatic representation, histogram, frequency polygon, frequency curve, bar graph, pie chart.	
3.1.4	Measure of central tendency: Mean, median, mode, mean deviation, standard deviation, standard error	
3.1.4	Types of distribution of data: Normal, binomial, Poisson, Z-test, t-test and ANOVA. Correlation and regression.	
Unit IV:		**12**
4.1	**Bioprocess Methods**	
4.1.1	Basics of chemical engineering, mass transfer, heat generation and removal, fluid dynamics:	
4.1.2	Bernoulli's principle, viscosity, hydraulic conductivity, capillary flow, control and applications of industrial processes, process evaluation and development, over production of metabolites and methods;	
4.1.3	Fermentation–Submerged and solid state fermentation Fermentor design, Industrial use of microbes. Strain improvement, Inocula preparation, Downstream processing–Recovery and purification of intracellular and extra cellular products. Methods to maximize the yield.	

References

[1] Basic Test for Drugs, WHO-GENEVA 1998 edition
[2] Who Expert Committee on Specification for Pharmaceutical Preparation WHO-GENEVA, 2005 edition
[3] Who Expert Committee on Biological Standardization WHO-GENEVA 2003 edition
[4] Clinical Research Fundamental and Practice –Vishal Bansal Parar Medical Publisher, 2010 edition
[5] Introduction to Pharmacopoeia CBS Publishers and Distributors 1991 edition
[6] Essential of Clinical Research –Dr. Ravindra B. Ghooi and Sachin C. Itkar Nirali Prakashan 2010 edition
[7] Basic Principle of Clinical Research and Methodology, Jaypee Brothers Medical Publishers (P) Ltd. 2009 ed.
[8] A Comprehensive Clinical Research Manual-Samir Malhotra, Nusrat Shafiq, Promila Pandhi Jaypee Brothers Medical Publishers (P) Ltd, 2008 edition
[9] Industrial microbiology, A.H. Patel
[10] Principles of Fermentation technology, Stanburry. P. Whitaker and S.J. Hall, 1995
[11] Biotechnology–U. Sathyanarayana. YLL

Course Code	Title of the Course	Credits
BCC070	CELL BIOLOGY, ENDOCRINOLOGY AND CELL SIGNALING	4

COURSE OUTCOME(S):

CO1 Specify in details with examples cellular organization

CO2 Learn the characteristics of endocrinology

CO3 Learn in depth cell signaling

CO4 Write down the characteristics of membrane biology

		No. of Lectures
Unit I:		
1.1	**Cellular Organization, Division and Cytoskeletons**	
1.1.1	Cell types–organization of prokaryotic and eukaryotic cells.	12
1.1.2	Cell division–mitosis and meiosis, cell cycle–phases of cell cycle, cyclins and cdks. Regulation of cell growth and cell cycle.	
1.1.3	Cell motility–molecular motors, microtubules, structure and composition. Microtubular associated proteins–role in intracellular motility.	
1.1.4	Cellular organelles–Nucleus–internal organization, traffic between the nucleus the nucleolus, and cytoplasm. Endoplasmic reticulum–protein sorting and transport, golgi apparatus and lysosomes, morphology and function of mitochondria, chloroplasts and peroxisomes, glyoxysomes.	

Unit II:		
2.1	**Membrane Biology**	
2.1.1	Organization of lipid monolayer, bilayer, Physicochemical properties of biological membranes - compositions, supra molecular organization - Singer and Nicolson's model.	12
2.1.2	Membrane asymmetry-lipids proteins and carbohydrates, lateral diffusion, biogenesis of lipids and proteins. Polarized cells, membrane domains- caveolae, rafts, Membrane lipid and protein turnover, intracellular targeting of proteins. Factors influencing fluidity of membrane	
2.1.3	Membrane transport - Laws of diffusion across membranes, simple diffusion, facilitated diffusion and active transport - glucose transporter Na+ K+ ATPase (Structure and mechanism of action), bacterial phosphotransferase system. Endocytosis, receptor mediated endocytosis, exocytosis, ion channels, aquaporin channel, ionophores. Patch clamp technique.	

Unit III:		**12**
3.1	**ENDOCRINOLOGY**	
3.1.1 3.1.2 3.1.3 3.1.4	Endocrine System–Endocrine organs in man. Hierarchy and regulation of hormone release. Structure and control of hypothalamus, GRH, somatostatin, TRH, CRH, GnRH. Pituitary-anatomy and structure. Hormones of anterior, posterior and median lobes. Pro-opiomelanocortin. Thyroid, parathyroid, adrenals, gonads–Testes and ovaries. Menstrual cycle. Hypothalamus–pituitary target organ axis and regulation by feedback mechanism, Pineal gland, melatonin and circadian rhythm Classification of hormones based on solubility and structure, mechanism of action of water soluble and lipid soluble hormones.	
Unit IV:		**12**
4.1	**Cell Signaling**	
4.1.1 4.1.2 4.1.3 4.1.4	Nerve transmission–Central and peripheral nervous systems. Structure of neuron, axon, dendrites, synapse neuromuscular junction. Neurotransmitters- mechanisms of nerve conduction. α and β adrenergic neurons, nicotinic and muscarinic neurons. Muscle contraction–Skeletal muscle and smooth muscle contraction, muscle proteins–actin, myosin, tropomyosine, troponins, mechanisms of muscle contraction, role of calcium and calmodulin Biochemistry of vision Cellular signaling: Extra cellular signaling–G Protein linked receptors ,Role of cyclic AMP, IP3, DAG, Ca^{2+} as a second messenger, receptos tyrosine kinases , MAP kinase pathway, NFkB pathway, apoptosis, Cell survival pathway, Jak/Stat pathway, TGF β Signaling. Multiple signaling path ways–Insulin receptor (regulation of blood glucose) Steroid hormone receptors, structural organization of receptor protein, hormone binding domain, antigenic domain and DNA binding domain.	

References

[1] The World of the cell by Becker, Kleinsmith and Harden Academic Internet Publishers; 5th edition (2006)
[2] The Cell: A Molecular Approach, Fourth Edition by Geoffrey M. Cooper and Robert E. Hausman.
[3] Cell and Molecular Biology by concepts and experiments by Gerald Karp (2005) John Wiley sons & Inc.
[4] Molecular cell Biology by Harvey Lodish. W. H. Freeman; 6th edition (2007)
[5] The Cell–Biochemistry, physiology and morphology by J. Brachet and A. E. Mirsky, Academic Press (1963)

Course Code	Title of the Course	Credits
BCC050	CLINICAL BIOCHEMISTRY	4

COURSE OUTCOME(S):

CO1 Identify in details with application, if applicable, specimen collection and analysis

CO2 Specify in details with application, if applicable, metabolic disorders

CO3 Write down the characteristics of hormonal disorders

CO4 Write down in details with application, if applicable, hematology

		No. of Lectures
Unit I:		
1.1	**Specimen Collection and Analysis**	
1.1.1	Concepts of accuracy, precision, reproducibility, reliability, and other factors in quality control.	
1.1.2	Normal values. Specimen collection and Processing: Collection of blood–venipuncture, skin puncture, arterial puncture. Anticoagulants. Collection and analysis of normal and abnormal urine–timed urine specimens, preservatives.	**10**
1.1.3	Clinical significance of sugars, proteins, ketone bodies, bilirubin and porphyrins. CSF–collection, composition and analysis. Amniotic fluid–Origin, collection, composition.	

Unit II:		
2.1	**Disorders**	
2.1.1	Disorders of carbohydrate metabolism: Diabetes mellitus, glycohemoglobins, hypoglycemias, galactosemia and ketone bodies.	
2.1.2	Various types of glucose tolerance tests. Glycogen storage diseases.	
2.1.3	Lipid profile, lipidosis and multiple sclerosis. Causes and diagnosis of the disorders of HDL–cholesterol, LDL–cholesterol and triglycerides.	**14**
2.1.4	Cancer: Etiology, diagnosis, treatment and prognosis. Carcinogens, oncogens, mechanism.	
2.1.5	Biochemistry of ageing: Cellular senescence, Role of Telomerase in aging, Alzheimer’s disease, Parkinson’s disease.	

Unit III:		
3.1	**Enzymes and Hormonal Disorders**	
3.1.1	<u>Evaluation of organ function tests</u>: Clinical assessment of renal, hepatic, pancreatic, gastric, intestinal and thyroid functions. Clinical importance of bilirubin.	**12**
3.1.2	<u>Diagnostic enzymes</u>: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine	

	kinase, aldolase and lactate dehydrogenase.	
3.1.3	Enzyme tests in determination of myocardial infarction. Enzymes of pancreatic origin and biliary tract.	
3.1.4	Hormonal disorders: Protein hormones (anterior pituitary hormones, posterior pituitary hormones), steroid hormones, adrenocorticosteroids, and reproductive endocrinology. Disorders of thyroid hormones.	

Unit IV:		
4.1	**Hematology**	**12**
4.1.1	Biochemical aspects of hematology: Total cell count, differential count, hematocrit.	
4.1.2	Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemias, thrombosis, porphyrias and anemias. Laboratory tests to measure coagulation and thrombolysis.	
4.1.3	Doping	
4.1.4	Detoxification in the body: Enzymes of detoxification, polymorphism in drug metabolizing enzymes. Mechanism of drug action and channels of its excretion.	
4.1.5	Test for lung function: Chest X-ray, Spirometry. Test for Brain function: EEG, MRI, CT.	

References

[1] Textbook of Medical Biochemistry by MN Chatterjea and Rana Shinde, Jaypee Brothers.
[2] Lehninger Principles of Biochemistry 5th Ed by David L. Nelson and Michael M. Cox, WH Freeman and Company.
[3] Davidson's Principles and Practice of Medicine: A Textbook for Students and Doctors (Hardcover) 15th Ed by LSP Davidson, J MacLeod and CRW Edwards. Publisher: Churchill Livingstone.
[4] Medical Biochemistry (Paperback) by John W. Baynes and Marek Dominiczak. Publisher: Mosby.
[5] Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Ed By Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd. Publisher: Churchill Livingstone.
[6] Review of Medical Physiology (Lange Basic Science) (Paperback) By William F. Ganong. Publisher: McGraw-Hill Medical
[7] Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
[8] Clinical Biochemistry by Richard Luxton. Scion Publishing Ltd.
[9] Principles of Medical Biochemistry: With STUDENT CONSULT Online Access (Paperback) by Gerhard Meisenberg and William H. Simmons. Publisher: Mosby.

Course Code	Title of the Course	Credits
BCC060	**EXPERIMENTS IN CLINICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY**	**4**

COURSE OUTCOME(S):

CO1	Specify the details of urine and blood analysis
CO2	Specify the characteristics of determination of enzyme activity
CO3	Identify the classification and characteristics of DNA quantification and analysis
CO4	Deliberate the details of isolation of nucleic acids from plant, animal and microbial sources

Group I:	**Urine analysis** 1. Qualitative analysis of urine for normal organic and inorganic constituents 2. Qualitative analysis of urine for abnormal constituents- Glucose, albumin, Ketone bodies. 3. Quantitative estimation of Creatine and Creatinine, Urea Uric acid Sulphate Chloride 4. Titrable acidity **Blood analysis** 5. Quantitative estimation of Urea Uric acid Creatine Cholesterol HDL–C and LDL–C 6. Blood glucose and GTT	
Group II:	**Determination of Enzyme activity of** 7. Alkaline phosphatase 8. SGOT 9. SGPT 10. LDH 11. Electrophoresis of lipoproteins: Serum proteins. 12. Albumin/Globulin Ratio. 13. Fractionation of serum proteins-Ammonium sulphate precipitation. 14. Isolation of DNA and RNA from biological sources. 15. Quantitative determination of DNA and RNA.	
Group III:	16. Determination of melting temperature of DNA (Tm) 17. Sub-cellular fractionation of rat liver by differential centrifugation and marker analysis 18. Determination of activities of marker enzymes 19. Preparation of erythrocyte ghosts 20. Kinetics of uptake of glucose by erythrocytes 21. Viability of cells by trypan blue dye exclusion 22. Study of morphology of *Drosophila melanogaster*	

	23. Study of mutants of *Drosophila melanogaster* 24. Study of polytene chromosomes of *Drosophila melanogaster*	

Group Study	Isolation of plasmid DNA, Restriction digestion of plasmid DNA, ligation of DNA fragment into a plasmid vector, preparation of competent cells, *E.Coli* transformation and amplification of DNA by PCR.	

References

[1] Practical Clinical Biochemistry, ed. Harold Varley, 4th edn. CBS Publishers (1988).
[2] Practical Clinical Biochemistry: Methods and Interpretation, ed. Ranjna Chawla, Jaypee Brothers Medical Publishers (1996).
[3] Practical and Clinical Biochemistry for Medical Students, ed. T.N. Pattabhiraman, Gajana Publishers (1994).
[4] Hawk's Physiological Chemistry, ed. Oser, 14th Edn.(1976), Tata-McGrawHill.
[5] Biochemistry, ed. Plummer Tata-McGraw Hill, (1971).
[6] Molecular Biology Techniques; Sue Carson, Heather Miller and D. Scott Witherow, Academic Press (2011).
[7] Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn. Keith Wilson and John Walker (2012).
[8] Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
[9] Gene Cloning and DNA analysis- An Introduction; T. A. Brown, 5th Edition, Wiley-Blackwell (2006).
[10] Laboratory methods in Enzymology; Part-A; Jon Lorsch, Academic Press (2014).
[11] Gene Cloning Laboratory Manual 4th Edn. Michael R. Green and Joseph Sambrook, CSHL Press (2014).
[12] Current Protocols in Molecular Biology; S Gallaghar, Wiley Interscience (2008).

Course Code	Title of the Course	Credits
BCC220	GENOMICS, PROTEOMICS AND BIOINFORMATICS	4

COURSE OUTCOME(S):

CO1	Specify the details of DNA sequencing methods
CO2	Specify the characteristics of determination of Proteins
CO3	Identify the classification and characteristics of microarray data
CO4	Deliberate the details of bioinformatics in biological databases and sequencing analysis

		No. of Lectures
Unit I:		12
1.1	**Structural Organization of Genome and Sequencing**	
1.1.1	Structural organization of genome in Prokaryotes and Eukaryotes, Organelle DNA–mitochondrial, chloroplast,	
1.1.2	DNA sequencing–principles and translation to large scale projects, Recognition of coding and non–coding sequences and gene annotation. Tools for genome analysis–RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis–physical and genetic mapping.	
1.1.3	Microbes, plants and animals, Accessing and retrieving genome project information from web, Comparative genomics, ESTs and SNPs.	

Unit II:		12
2.1	**Proteomics**	
2.1.1	Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing),	
2.1.2	2–D electrophoresis of proteins, Microscale solution isoelectricfocusing, Peptide fingerprinting,	
2.1.3	LC/MS-MS for identification of proteins and modified proteins, MALDI-TOF	
2.1.4	SAGE and Differential display proteomics, Protein-protein interactions, Yeast two hybrid systems.	

Unit III:		08
3.1	**Functional Genomics, Proteomics and Metabolomics**	
3.1.1	Analysis of microarray data, Protein and peptide microarray–based technology; PCR–directed protein *in situ* arrays	
3.1.2	Structural proteomics	
3.1.3	Metabolomics	

Unit IV:		
4.1	**Biological Databases and Sequence Analysis**	**16**
4.1.1	<u>Introduction biological databases</u>: Types (relational & object–oriented). Primary, secondary & specialized databases.	
4.1.2	Types of databases–Nucleotide sequence database, EMBL, Genebank, Unigene, Genome biology, Protein dBase (Swiss–prot & Trembl and Motif) and 3D structure databases (PDB, SCOP, Cath, Genecards, SRS & Entrez).	
4.1.3	Computational approaches for gene identification, ORF and Human Genome Project.	
4.1.4	<u>Basics of sequence analysis</u>: Alignments using BLAST and FASTA, Multiple Sequence Alignment (CLUSTAL–X and CLUSTAL–W), Application of multiple sequence alignment	
4.1.5	Protein Structure Prediction in Bioinformatics–*Ab initio* based methods, Homology based methods, secondary structure prediction.	
4.1.6	Protein structure comparison–intermolecular and intramolecular methods. Phylogenetic construction by distance based methods	

References

[1] Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
[2] Brown TA, Genomes, 3rd Edition. Garland Science 2006
[3] Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007
[4] Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell, 2006.
[5] Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press, 1998.
[6] Essential Bioinformatics (Paperback) byJin Xiong. Cambridge University Press.
[7] Bioinformatics: Methods & Protocols by Stephen Misener and Stephen A. Krawetz,
[8] Humana Press.
[9] Essentials of Bioinformatics by Irfan Ali khan and Atiya Khanum. Publisher: Ukaaz Publications.
[10] Bioinformatics: Sequence and Genome Analysis (Hardcover) by David W. Mount. Cold Spring Harbor Laboratory Press
[11] Introduction to Bioinformatics (Paperback) by Arthur M. Lesk. Oxford Univ Press.
[12] Introduction to Bioinformatics: A Theoretical and Practical Approach (Paperback) by David Womble, Stephen A. Krawetz and David D. Womble. Humana Press Inc., U.S.
[13] Applied Bioinformatics: An Introduction (Paperback) y Paul M. Selzer, Richard
[14] Marhofer and Andreas Rohwer. Publisher: Springer-Verlag Berlin and Heidelberg GmbH & Co. K.

Course Code	Title of the Course	Credits
	BIOTECHNOLOGY AND RESEARCH METHODOLOGY	4

COURSE OUTCOME(S):

Upon completion of the course, the student is able to

CO1	Understand the concepts of biotechnology
CO2	Provide examples of current applications of biotechnology
CO3	Explain the concept and application of enzyme technology
CO4	Explain the general principles of generating transgenic plants, animals and microbes
CO5	Understand the concepts of research methods, tools and ethics

		No. of Lectures
Unit I:		12
1.1	**Tissue culture and transgenesis**	
1.1.1	Techniques of tissue culture–culturing explants and haploids, protoplasts fusion and embryoids.	
1.1.2	Methods of gene transfer to plants, animals and bacteria-Ca transfection, electroporation, shotgun and others.	
1.1.3	Transgenic plants, gene knockouts and transgenic animals.	

Unit II:		**16**
2.1	**Industrial Biotechnology**	
2.1.1	Fermentors: principle, types product recovery and purification of ethanol, citric acid, vitamin B12, streptomycin.	
2.1.2	Enzyme biotechnology–production and uses of industrially important enzymes such as protease, immobilization of enzymes and their applications	
2.1.3	Waste treatment, bioenergy, biogas production, biopesticides and bioleaching.	

Unit III:		
3.1	**Biosafety and Bioethics**	08
3.1.1	Biotechnology–potential hazards, biological weapons, biosafety of GM foods and GMOs–substantial equivalence and safety testing.	
3.1.2	Human genome research–the objectives and approaches, genomics and genome prospecting–the controversies, issues of biotechnology-social and scientific, technology protecting systems and the terminator.	
3.1.3	IPR, its concepts and conditions–patenting of genes, cells and life forms, evaluation of life patenting.	

Unit IV:		
4.1	**Research Methodology**	12
4.1.1	Types of Research: Academic, Industrial, Clinical, Basic and Applied research. Research objectives, review of literature and hypothesis formulation.	
4.1.2	Information, types and sources. PubMed as a resource. Research Design: Types of studies-cohort, double blind, placebo and cross-over.	
4.1.3	Statistical Methods: Error and significance, sample size and data collection, presentation of data, parametric and non-parametric tests	
4.1.4	Ethical issues: ICMR guidelines of ethical issues, IPR and Plagiarism	

References

[1] Fermentation Biotechnology O.P. Ward. 1989 Prentice Hall.
[2] Biotechnology J.E. Smith Cambridge University Press 1996.
[3] Introduction to Biotechnology Brown, Campbell and Priest Blackwell Science 1987.
[4] A Textbook on Biotechnology H.D. Kumar 2nd edition East West Press 1998.
[5] Molecular Biotechnology Glick and Pasternak, Panima Publ.
[6] From Genes to clones Winnaecker VCH Publication.
[7] Elements of Biotechnology P.K. Gupta, Rastogi Publication, 1998.
[8] Molecular Biology and Biotechnology. Walker and Gingold. 3rd ed. Panima Publ. 1999.
[9] Plant Biotechnology. Ignacimuthu, Oxford, IBH.
[10] Recombinant DNA Technology, Watson, Scientific American Publ.
[11] Principles of Genome analysis, Primrose, Oxford University Press, 1998.
[12] Handbook of Research Methodology: A compendium for scholars and researchers, Dr. Shanti Bhushan Mishra Dr. Shashi Alok, EDUCREATION PUBLISHING, 2019
[13] Research Methodology: A step-by-step Guide for Beginners, 3rd Edition, Ranjit Kumar, SAGE Publications, 2011

Course Code	Title of the Course	Credits
BCC220	**PHARMACEUTICAL BIOCHEMISTRY**	**4**

COURSE OUTCOME(S):

CO1	Identify the details of ADME mechanism of drugs
CO2	Learn in details with application, if applicable, Drug receptor interactions
CO3	Deliberate in details with application, if applicable, Mode of action of anti cancer drugs
CO4	Write down in depth Drug tolerance and abuse

		No. of Lectures
Unit I:		**10**
1.1	**Drugs**	
1.1.1	Drugs: History of Drugs Classification of drugs, routes of drug administration, absorption and distribution of drugs.	
1.1.2	Factors influencing drug absorption and elimination of drugs.	

Unit II:		**14**
2.1	**Drug Receptor and Metabolism**	
2.1.1	Drug-Receptor interactions involvements of binding forces in drug receptor interaction, drug action not mediated by receptors.	
2.1.2	Drug metabolism: Mechanism of phase I and II enzyme reactions, biochemical importance of xenobiotic metabolism.	

Unit III:		**12**
3.1	**Anticancer Drugs**	
3.1.1	Cancer: Cancer and principles of cancer chemotherapy, mode of action of anti cancer drugs.	
3.1.2	Antimetabolites, antibiotics, alkylating agents and other agents,	

Unit IV:		**12**
4.1	**Adverse Drug Reactions**	
4.1.1	Adverse drug reactions and drug induced side effects.	
4.1.2	Biological effects of drug abuse and drug dependence.	
4.1.3	Drug tolerance and intolerance.	

References

[1] The Pharmacology volume I and II –Goodman and Gillman
[2] Basic Pharmacology –Foxter Cox
[3] Oxford text book of Clinical Pharmacology and Drug Theraphy ,D.G Grahme Smith and J.K.Aronson
[4] Pharmacology and Pharmatherapeutics – R.S.Satoskar,S.D.Bhandhakarand
[5] Essentials of Pharmacotherapeutics ,Barav.F.S.K
[6] Lippincotts illustrated review Pharmacology, Mary.J.Mycek,Richards ,Pamela

Course Code	Title of the Course (Open Elective)	Credits
BCC630	**NUTRITION AND HEALTH**	**4**

COURSE OUTCOME(S):

CO1 Identify the details of basic concepts of nutrition

CO2 Learn in details with application, if applicable, nutrients

CO3 Deliberate in details with application, if applicable, nutrition associated problems

CO4 Write down in depth social health problems

		No. of Lectures
Unit I:		10
1.1	**Basic Concepts in Nutrition**	
1.1.1	Understanding relationship between food, nutrition, health and food pyramid.	
1.1.2	Functions of food: Physiological, psychological and social Basic food groups and concept of balanced diet	
1.1.3	Energy: Functions, sources and concept of energy balance.	
1.1.4	Nutritional requirements: Physiological considerations and nutritional concerns for the following life stages: Adult man / woman Preschool children Adolescent children Pregnant woman, Nursing woman and infant Geriatrics	

Unit II:		14
2.1	**Nutrients**	
2.1.1	Functions, Recommended Dietary Allowances, dietary sources, effects of deficiency and/ or excess consumption on health of the following nutrients: Carbohydrates and dietary fibre Lipids Proteins Fat soluble vitamins: A, D, E and K Water soluble vitamins: Thiamin, Riboflavin, Niacin, Pyridoxine, Folate, Vitamin B12 and Vitamin C Minerals: Calcium, Iron, Zinc and Iodine	
2.1.2	Gut Microbiome	

Unit III:		
3.1	**Nutritional problems, their implications and related nutrition programmes**	**14**
3.1.1 3.1.2	Etiology, prevalence, clinical features and preventive strategies of <u>Undernutrition:</u> Protein energy malnutrition, nutritional anemia's, vitamin A deficiency and iodine deficiency disorders <u>Overnutrition:</u> Obesity, Coronary Heart Disease and Diabetes <u>National Nutrition Policy and Programmes:</u> Integrated Child Development Services (ICDS) Scheme Mid day Meal Programme (MDMP) National programmes for prevention of Anemia Vitamin A deficiency and Iodine Deficiency Disorders	

Unit IV:		
4.1	**Social health problems**	**10**
4.1.1 4.1.2	Smoking Alcoholism AIDS including AIDS Control Programme <u>Nutrition for special conditions:</u> Nutrition for physical fitness and sport, BMI Feeding problems in children with special needs Considerations during natural and man-made disasters e.g. floods, war. Basic guidelines in disaster management	

References

[1] Text Book f Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (1997), Wiley –Liss.

[2] Harper's Review of Biochemistry, Murray et. al., (1997) 24th Edn., Lange

[3] Bryan Derrickson, Gerard J Tortora Principles of Anatomy and Physiology , twelfth Ed, 2011, Wiley & Sons Limited.

[4] Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

[5] Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; 2012; New Age International Publishers

[6] Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.

[7] Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.

[8] Suri S. and Malhotra A. Food Science, Nutrition & Food Safety Pearson India Ltd. 2014.

[9] Edelstein S, Sharlin J (ed). Life Cycle Nutrition- An Evidence Based Approach; 2009; Jones and Barlett Publishers.

[10] ICMR (1989) Nutritive Value of Indian Foods. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad.

[11] ICMR (2011) Dietary Guidelines for Indians – A Manual. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad

[12] World Health Organization (2006). WHO Child Growth Standards: Methods and development: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age (d).

[13] Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic 14 Excellence

Course Code	Title of the Course	Credits
BCD010	MOLECULAR BIOLOGY AND GENE REGULATION	4

COURSE OUTCOME(S):

CO1 Write down the characteristics of DNA characteristics and replication

CO2 Write down in depth Transcription and regulation

CO3 Learn in depth translation

CO4 Identify in depth translational regulation

		No. of Lectures
Unit I:		
1.1	**DNA Replication and Gene Expression**	
1.1.1	Introduction: Historical perspective, types of RNA, Central dogma of molecular biology.	
1.1.2	DNA Replication: Nearest neighbor base frequency analysis. Replication of DNA semiconservative model-Meselson and Stahl experiment. Direction of replication of *E.coli*, discontinuous replication–Okazaki fragments.	
1.1.3	Composition and properties of DNA polymerase I, II and III. of *E.coli* DNA ligase, fidelity of replication. DNA topoisomerases and gyrases.	
1.1.4	Replication in viruses single stranded DNA virus, ϕX174, rolling circle model. Replication of mitochondrial DNA.	**14**
1.1.5	Organization of prokaryotic and eukaryotic gene–promoters, introns, exons, other regulatory sequences, enhancers, silencers, function of introns.	
1.1.6	Regulation of Gene expression in prokaryotes: Operon model–Lac operon–structure and regulation; Galactose operon–role of two promoters; Arabinose operon–positive control; tryptophan operon–attenuation control.	
1.1.7	Regulation of gene expression at the level of DNA structure: Super coiling, DNA methylation, role of nucleosome structure of eukaryotic DNA in gene expression–eg. glucocorticoid gene, chromatin remodeling	

Unit II:		
2.1	**Transcription and Regulation**	
2.1.1	Transcription: RNA biosynthesis in prokaryotes and eukaryotes- initiation, elongation and termination. RNA polymerase I, II and III. RNA dependent RNA synthesis - RNA replicase of QB virus.	
2.1.2	Processing of eukaryotic mRNA–cap addition, poly A tail addition, intron splicing, RNA editing. Processing of t–RNA.	**10**
2.1.3	Regulation at the level of transcription: Transcription factors, TF II. Formation of initiation complex. Role of enhancers	
2.1.4	Regulation at the level of RNA processing: RNA export and RNA stability. Factors affecting RNA stability. RNA degradation.	
Unit III:		
3.1	**Translation**	
3.1.1	Translation: Genetic code, triplet codon, Universality features of the genetic code, assignment of codons studies of Khorana, Nirenberg, triplet binding techniques, degeneracy of codons, wobble hypothesis, evolution of genetic code and codon usage, variation in the codon usage.	
3.1.2	3D structure of prokaryotic and eukaryotic ribosomes, Translation: initiation, elongation and termination. Role of m–RNA and t–RNA; aminoacyl t–RNA synthetase and its role in translation accuracy, signal sequence, translational proof-reading, translational inhibitors.	
3.1.3	Post translational modification of proteins–signal peptide cleavage, disulphide bond formation, O–and N–Glycosylation, folding of nascent protein, role of chaperones, attachment of glycosyl anchor, and other modifications.	**12**

Unit IV:		
4.1	**Translational Regulation**	
4.1.1	Regulation at the level of translation: Secondary structure in the 5' and 3’ untranslated region–eg. Regulation of Ferritin and Transformation of m-RNA. Role of upstream AUG codons. (eg. GCN 4 gene regulation), transplicing and translational introns, protein splicing introns.	**12**
4.1.2	Role of ribosomes in the regulation of translation: Proof–reading mechanism. Ribosomal optimization of translation. Regulation at the level of ribosome assembly. Regulation at the level of post-translational modification, protein stability, N–end rule, PEST and other sequences	

References

[1] Molecular Biology of the Cell, Alberts et al., Garland Publications, (2012).
[2] Molecular Biology, David Freifelder, Narosa Publishers, (1997).
[3] Molecular Biology Robert F. Weaver, McGraw Hill (2012).
[4] Molecular Biology of Gene; Watson, J.D. et al., 5th Edn. Pearson Education; (2004).
[5] Principles of Virology; S.J. Flint et al., ASM Press (2000).
[6] Biochemistry and Molecular Biology; 5th Edn. D.Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott Oxford University Press (2014)
[7] Chromatin structure and Gene Expression; 2nd Edn. Sarah Elgin, Jerry Workman, Oxford University Press (2000)
[8] Molecular Cell Biology; Harvey Lodish 5th Edn. (2010)
[9] Biochemistry 5th Edn. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer (2011).
[10] Genome Stability: DNA Repair and Recombination; James Haber, Garland Science (2013)

Course Code	Title of the Course	Credits
BCD070	GENETICS AND GENETIC ENGINEERING	4

COURSE OUTCOME(S):

Upon completion of the course, the student is able to

CO1	Understand the importance of plasmids and viruses to genetic engineering.
CO2	Understand the principle of Mendelism and gene development
CO3	Describe how mutations occur and scope of population genetics
CO4	Explain the principle of genetic engineering
CO5	Understand the value of and the processes involved in the amplification of DNA

		No. of Lectures
Unit I:		12
1.1	**Mendelism and Gene Organization**	
1.1.1	Basic principles of Mendelism–Laws of inheritance, dominance, codominance, epistasis, (eg. Comb shape in chickens). Pleiotropism. Cytoplasmic inheritances (eg. Shell Coiling)	
1.1.2	Organisation of genes in chromosomes–Single copy gene, gene families, tandemly repeating genes, pseudo genes	
1.1.3	Chromosome number–Ploidy, karyotyping, sex chromosome and dosage compensation. Mobile genetic elements,	
1.1.4	Chromosomal basis of human diseases–Extra or missing chromosome, abnormality in chromosome structure–deletion duplication, inversion and translocation.	
1.1.5	Gene and development–Model systems for studying development in Drosophila, genetic control of development in Drosophila, anteroposterior axis, specification role of maternal genes, segmentation of larval body, gap genes, pair rule genes, homeotic genes, complex gene interaction in development, sequential gene action.	

Unit II:		
2.1	**Population Genetics and Mutations**	**16**
2.1.1	Population Genetics–Genetic variation, Hardy–Weinberg Law, genetic frequency, migration, genetic equilibrium	
2.1.2	Mutations- nature of mutations–spontaneous and induced mutation, conditional lethal (eg. Temperature sensitive) mutation. Biochemical basis of mutation. Point mutation, base substitution mutation, missense, nonsense and silent mutations. Mutation rates. Chemical mutagens, radiation induced mutation, reverse mutations and suppressor mutations–intergenic and intragenic suppression, reversion as a means of detecting mutagens - Ames test	
2.1.3	Repair Mechanism–DNA repair mechanisms. Reciprocal recombination, site specific recombination, *E. coli* rec system. Holliday model of recombination, SOS repair.	

Unit III:		
3.1	**Tools of Genetic Engineering**	**12**
3.1.1	Basic principles–mechanism of natural gene transfer by Agrobacterium, generation of foreign DNA molecules.	
3.1.2	Restriction enzymes, their types and target sites, cutting and joining DNA molecules, linkers, adapters, homopolymers, enzymes used in genetic engineering.	
3.1.3	Cloning vehicles and their properties, natural plasmids, in vitro vectors, cosmids and T-DNA based hybrid vectors.	
3.1.4	Cloning strategies–cloning with single strand DNA vectors, cDNA cloning and gene libraries, recombinant selection and screening methods, expression of cloned genes–problems and solutions, shuffle vectors.	
3.1.5	DNA sequencing strategies–Sanger's and Maxam–Gilbert's methods and NGS.	

Unit IV:		
4.1	**Amplification & Applications of Genetic Engineering**	**8**
4.1.1	Amplification of DNA by PCR technique and applications.	
4.1.2	*Insitu* hybridization, analysis of DNA, RNA and protein by blotting techniques.	
4.1.3	Marker and Reporter genes.	
4.1.4	Applications of genetic engineering: Transgenic plants and animals, DNA vaccines and Gene therapy	

References

[1] Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi

[2] Wilkinson, D.M. (2007). Fundamental Processes in Ecology. An Earth System Approach. Oxford.

[3] Daubenmier, R.F. (1970). Plants and Environment: A text book of Plant Autoecology, Wiley Eastern Private Limited

[4] Daubenmier, R.F. (1970), Plant Communities, Wiley Eastern Private Limited

[5] Odum, E. (2008) Ecology. Oxford and IBH Publisher.

[6] Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.

[7] Tom Strachan & Andrew P.Read 1999. Human Molecular Genetics (2nd Edition), John Wiley & Sons.

[8] Ricki Lewis, 1998. Human Genetics-Concepts & Applications (3rd Edition), McGraw-Hill.

[9] T. A. Brown, 1999. Genomes, John Wiley & Sons (Asia) PTE Ltd.

[10] Scott Freeman & Jon C. Herron, 2001. Evolutionary Analysis (2nd Edition), Prentice Hall.

[11] Garner E.J, Simmons, M.J. & Snustad, D.P.1991. Principles of Genetics, John Wiley & Sons Inc, N.Y

[12] Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., 1987. Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.

Course Code	Title of the Course	Credits
BCD060	PROJECT WORK OR DISSERTATION	8

COURSE OUTCOME(S):

CO1	Identify the classification and characteristics of literature survey
CO3	Learn in depth define of objective of project work
CO3	Write down the classification and characteristics of design of experimental methods
CO4	Understand the details of result analysis and interpretation

BLUE PRINT OF QUESTION PAPER FOR C1 & C2 COMPONENT

JSS Mahavidyapeetha

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous) B N Road, Mysuru - 25

M.Sc. Biochemistry

I/II/III/IV Semester First/Second Internal Assessment Test (Component 1/2)

Title of the Course & Code

Duration: 1hr | **Max Marks: 20**

A) Answer any FOUR of the following **4X2=08**

1.
2.
3.
4.
5

B) Answer any ONE of the following **1X4=04**

1.
2.

C) Answer any ONE of the following **1X8=08**

1.
2.

BLUE PRINT OF QUESTION PAPER FOR C3 COMPONENT

JSS Mahavidyapeetha

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

(Autonomous), Ooty Road, Mysuru – 570025

M.Sc Degree

I/II/III/IV Semester Examination, ____________

BIOCHEMISTRY

Course Title & QP Code

Time: 3 Hours | Max. Marks: 70

Instructions to Candidates: **Answer any Five questions from Part – A**
Any Four questions from Part – B
Any Three questions from Part – C

Part – A **5X2=10**

1.
2.
3.
4.
5.
6.
7.

Part – B **4X6=24**

8.
9.
10.
11.
12.
13.

Part – C **3X12=36**

14.
15.
16.
17.
18.

JSS Mahavidyapeetha

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE

OOTY ROAD, MYSURU – 570 025

POSTGRADUATE DEPARTMENT OF CHEMISTRY

SYLLABUS

PROGRAMME: M.Sc. in CHEMISTRY

PROGRAMME CODE: CHE

Under
Choice Based Credit System (CBCS) and
Continuous Assessment Grading Pattern (CAGP)
Effective from 2021-22

GUIDELINES AND REGULATIONS LEADING TO MASTER OF SCIENCE IN CHEMISTRY (TWO YEARS - SEMESTER SCHEME UNDER CBCS-CAGP)

Programme details

Name of the Department	: PG Department of Chemistry
Subject	: Chemistry
Faculty	: Science
Name of the Programme	: Master of Science (M.Sc.) in Chemistry
Duration of the Programme	: 2 years divided into 4 semesters

Programme Objectives

- To provide the latest subject matter both theory as well as practicals in such a way to foster their core competency and discovery learning. A chemistry postgraduate as envisioned in this framework would be sufficiently competent in the field to understand further discipline specific studies as well as to begin domine related employment.
- To mould a responsible citizen who is aware of most basic domain-independent knowledge including critical thinking and communication.
- Enable the graduate to prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC civil service examinations.

Programme Outcomes

- Students will have a strong foundation in the fundamentals and applications of current theoretical and practical chemistry in Analytical, Inorganic, Organic and Physical Chemistry.
- Students will be able to design and carry out scientific experiments and accurately record and analyze the results of the experiments.
- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
- Students will be able to explore new areas of research in both chemistry and allied fields such as Biochemistry, Material Chemistry, Pharmaceutical chemistry and Chemical biology and related technology.
- Students will understand the central role of chemistry to our society which includes understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

Programme Specific Outcomes

- Global level research opportunities to pursue Ph.D. programme, targeted approach of CSIR – NET and competitive civil service examinations.
- Enormous job opportunities at all levels of teaching, chemical, pharmaceutical, food products, life oriented material industries.
- Specific placements in R & D and many pharmaceutical & other industries.
- Facile development for the synthesis of biologically significant organic molecules using the green route for chemical reactions for sustainable properties.
- To inculcate the scientific temperament in the students and outside the scientific community.
- Learnt to handle sophisticated equipment for the determination and characterization of chemical compounds.
- Use of the latest chemistry software to avoid the laborious work in research.

Pedagogies used in the programme

- Conventional method such as black board and chalk, and modern methods like power point presentation and information and communications technology (ICT) are used in class room teaching.
- Molecular models are used to teach molecular symmetry, stereochemistry and solid state chemistry topics.
- Each student performs experiments as per the protocol in practical classes.
- For the preparation of new compounds, each student can adopt new experimental setup, and also exposed to different analytical instruments for qualitative and quantitative analyses. In addition to this, students will acquire skill to handle various instruments independently.
- Students will be presenting seminars in each semester.
- Each student will be subjected to viva-voce examinations in every semester.
- Every student will work for project on a small research problem.
- Rigorous training will be giving for every student to interpret spectral data in the respective course including their dissertation.
- Special lectures are delivered by eminent scholars from different intuitions.
- National/International conferences are organized to upgrade the subject knowledge.

GENERAL REQUIREMENTS

Scheme of instructions

1. A Masters Degree programme is of 4 semesters-two Years duration. A candidate can avail a maximum of 8 semesters – 4 years (in one stretch) to complete Masters Degree (including blank semesters, if any). Whenever a candidate opts for blank semesters, he/she has to study the prevailing courses offered by the department when he/she continues his/her studies.

2. A candidate has to earn a minimum of 76 credits, for successful completion of a Master Degree. The 76 credits shall be earned by the candidate by studying Hardcore, Soft Core and Open Elective. A candidate may earn another 04 credits by studying MOOCs/SWAYAM courses.

3. **Minimum for Pass:** In case a candidate secures less than 30% in C_1 and C_2 put together, the candidate is said to have DROPPED the course, and such a candidate is not allowed to appear for C_3.

4. In case a candidate secures less than 30% in C_3, or secures more than 30% in C_3 but less than 50% in C_1, C_2 and C_3 put together, the candidate is said to have not completed the course and he/she may either opt to DROP the course or to utilize PENDING option.

5. **Credits (Minimum) Matrix:** A candidate has to study 42 credits, but not exceeding 52 credits from hard Core, a minimum of 16 credits in Soft Core (sum total of 4 semesters) and 04 credits in Open Elective (III Semester) for the successful completion of the Masters Degree programme.

6. All other rules and regulations hold good which are governed by the University of Mysore from time to time.

Definitions

1. In the Choice Based Credit System – Continuous Assessment Grading Pattern (CBCS-CAGP), programme means a course and a course means a paper.
2. **HC:** Hard Core; **SC:** Soft Core; **OE:** Open Elective

GENERAL SCHEME WITH RESPECT TO ASSESSMENT OF CREDITS

Semester	Hard Core		Soft Core			Open Elective
	Theory			Theory	Practicals	
I	I	3 + 0 + 0 = 3	A	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	-
	O	3 + 0 + 0 = 3	I	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	
	P	3 + 0 + 0 = 3	O	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	
	A	3 + 0 + 0 = 3	P	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	
II	I	3 + 0 + 0 = 3	A	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	-
	O	3 + 0 + 0 = 3	I	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	
	P	3 + 0 + 0 = 3	O	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	
	G	3 + 0 + 0 = 3	P	2 + 0 + 0 = 2	0 + 0 + 4 = 4[a]	
III	I	3 + 0 + 0 = 3	A	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	4 + 0 + 0 = 4
	O	3 + 0 + 0 = 3	I	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	
	P	3 + 0 + 0 = 3	O	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	
	G	3 + 0 + 0 = 3	P	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	
IV	I	3 + 0 + 0 = 3	A	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	-
	O	3 + 0 + 0 = 3	I	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	
	P	3 + 0 + 0 = 3	O	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	
	A	3 + 0 + 0 = 3	P	2 + 0 + 0 = 2	0 + 0 + 2 = 2[ab]	
			D	--	0 + 0 + 4 = 4[c]	
Total Credits	**48**		**24**			**04**

NOTE

A–Analytical; I–Inorganic; O–Organic; P–Physical; G-Spectroscopy; D-Dissertation/Project Work; (L+T+P)-Theory + Tutorial + Practical

[a] Compulsory but 50% of the students will attend Analytical/Inorganic Practicals and remaining 50% students will attend Organic/Physical Practicals in I or III Semesters and vice-versa during II or IV Semesters.

[b] Practicals are only for Chemistry students which are compulsory papers.

[c] Dissertation/Project work, which is offered by the department during IV Semester.

SCHEME OF STUDY AND EXAMINATION

FIRST SEMESTER

HARD CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHA10	Concepts & Models of Inorganic Chemistry	3	3	100	15	15	3	70
21CHA11	Stereochemistry & Reaction Mechanism	3	3	100	15	15	3	70
21CHA12	Basic Physical Chemistry	3	3	100	15	15	3	70
21CHA13	Essentials of Analytical Chemistry	3	3	100	15	15	3	70

SOFT CORE PRACTICALS

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHA50	Analytical Chemistry Practicals	8	4	100	15	15	6	70
21CHA51	Inorganic Chemistry Practicals	8	4	100	15	15	6	70
21CHA52	Organic Chemistry Practicals	8	4	100	15	15	6	70
21CHA53	Physical Chemistry Practicals	8	4	100	15	15	6	70

NOTE: 50% of students will attend Analytical and Inorganic Practicals and the remaining 50% of students will attend Organic and Physical Practicals in I Semester and vice-versa in II Semester.

SOFT CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHA54	Titrimetric Analysis	2	2	100	15	15	3	70
21CHA55	Chemistry of Selected Elements	2	2	100	15	15	3	70
21CHA56	Chemistry of Natural Products-I	2	2	100	15	15	3	70
21CHA57	Biophysical Chemistry	2	2	100	15	15	3	70

SECOND SEMESTER

HARD CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHB10	Coordination Chemistry	3	3	100	15	15	3	70
21CHB11	Synthetic Organic Chemistry	3	3	100	15	15	3	70
21CHB12	Principles of Physical Chemistry	3	3	100	15	15	3	70
21CHB13	Molecular Symmetry and Spectroscopy	3	3	100	15	15	3	70

SOFT CORE PRACTICALS

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHB50	Analytical Chemistry Practicals	8	4	100	15	15	6	70
21CHB51	Inorganic Chemistry Practicals	8	4	100	15	15	6	70
21CHB52	Organic Chemistry Practicals	8	4	100	15	15	6	70
21CHB53	Physical Chemistry Practicals	8	4	100	15	15	6	70

NOTE: Practicals: Same as that of I Semester. Students who have conducted Analytical and Inorganic or Organic and Physical Practicals in the I Semester will get interchanged during II Semester.

SOFT CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHB54	Titrimetric Analysis	2	2	100	15	15	3	70
21CHB55	Chemistry of Selected Elements	2	2	100	15	15	3	70
21CHB56	Chemistry of Natural Products-I	2	2	100	15	15	3	70
21CHB57	Biophysical Chemistry	2	2	100	15	15	3	70

NOTE: Soft Core Theory: All courses are same as that described in first semester.

THIRD SEMESTER

HARD CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHC10	Advanced Inorganic Chemistry	3	3	100	15	15	3	70
21CHC11	Organometallic and Photochemistry	3	3	100	15	15	3	70
21CHC12	Advanced Physical Chemistry	3	3	100	15	15	3	70
21CHC13	Chemical Spectroscopy	3	3	100	15	15	3	70

SOFT CORE PRACTICALS

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHC50	Analytical Chemistry Practicals	4	2	100	15	15	6	70
21CHC51	Inorganic Chemistry Practicals	4	2	100	15	15	6	70
21CHC52	Organic Chemistry Practicals	4	2	100	15	15	6	70
21CHC53	Physical Chemistry Practicals	4	2	100	15	15	6	70

NOTE: 50% of students will attend Analytical and Inorganic Practicals and the remaining 50% of students will attend Organic and Physical Practicals in I Semester and vice-versa in II Semester.

SOFT CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHC54	Kinetic and Radiochemical Methods of Analysis	2	2	100	15	15	3	70
21CHC55	Frontiers in Inorganic Chemistry	2	2	100	15	15	3	70
21CHC56	Chemistry of Natural Products-II	2	2	100	15	15	3	70
21CHC57	Material Chemistry	2	2	100	15	15	3	70

OPEN ELECTIVE FOR NON-CHEMISTRY STUDENTS

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHC80	General Chemistry	4	4	100	15	15	3	70

FOURTH SEMESTER

HARD CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHD10	Bioinorganic Chemistry	3	3	100	15	15	3	70
21CHD11	Heterocyclic and Bioorganic Chemistry	3	3	100	15	15	3	70
21CHD12	Nuclear, Radiation and Photochemistry	3	3	100	15	15	3	70
21CHD13	Instrumental Methods of Analysis	3	3	100	15	15	3	70

SOFT CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHD50	Analytical Chemistry Practicals	4	2	100	15	15	6	70
21CHD51	Inorganic Chemistry Practicals	4	2	100	15	15	6	70
21CHD52	Organic Chemistry Practicals	4	2	100	15	15	6	70
21CHD53	Physical Chemistry Practicals	4	2	100	15	15	6	70
21CHD54	Dissertation/Project Work	8	4	100	15	15	-	70

NOTE: Practicals: Same as that of III Semester. Students who have conducted Analytical and Inorganic or Organic and Physical Practicals in the III Semester will get interchanged during IV Semester.

SOFT CORE COURSES

Course Code	Title	Contact Hours/ week	Credits	Max. Marks	Internal Assessment Marks		Semester End Exams (C_3)	
					C_1	C_2	Duration (hrs)	Marks
21CHD55	Automated Methods and Real Sample Analysis	2	2	100	15	15	3	70
21CHD56	Bioinorganic Photochemistry	2	2	100	15	15	3	70
21CHD57	Medicinal Chemistry	2	2	100	15	15	3	70
21CHD58	Quantum Chemistry	2	2	100	15	15	3	70

SCHEME OF EXAMINATION FOR C1, C2 AND C3 COMPONENTS

Preamble

In view of the CBCS syllabus, following is the model distribution of marks for C_1, C_2 and C_3 Components. At a glance, the model includes HC, SC and OE courses for the assessment of marks.

The following is the scheme which will be followed for the assessment of marks for HC, SC and OE courses irrespective of the credits associated with each course. 30% of the marks will be assessed for internals (C_1 and C_2) and remaining 70% will be for the Semester end Examinations (C_3). Each course carries 100 marks and hence 30 marks will be allotted to internals and remaining 70 marks will be for Semester end Examinations. Out of 30 marks for internals, 15 marks will be allotted to each C_1 and C_2 components.

Each course (HC/SC/OE) consists of three components namely C_1, C_2 and C_3. C_1 and C_2 are designated as Internal Assessment (IA) and C_3 as Semester end Examination. Each course (HC/SC/OE) carries **100 Marks** and hence the allotment of marks to C_1, C_2 and C_3 Components will be 15, 15 and 70 marks, respectively. i.e.,

C_1 Component	15 Marks	Assessment Marks
C_2 Component	15 Marks	
C_3 Component	70 Marks	Semester end Examination
Total	**100 Marks**	

The above Scheme will be followed for all the HC, SC and OE courses in all the four semesters.

1. HARD CORE (03 CREDIT COURSES)

Distribution of Marks for C_1 and C_2 Components

Assessment Marks (C_1 + C_2) consists of 30 marks. It will be divided into three parts *viz.*, ***Internal Test, Home Assignment and Seminar***. Internal tests will be conducted during the 8th week of the semester for C_1 and 16th week of the semester for C_2. Home Assignment will be considered for C_1 Component and Seminar for C_2 Component only. Hence, a teacher from each unit of a course may be given one assignment (or in their personal interest one more may be given). Since each course has three units, the marks shall be divided equally. Allotment of marks for C_1 and C_2 is as follows: Out of 15 Marks for C_1, Internal test will be conducted for 30 Marks (10 Marks from each unit and reduced to 10 Marks) and Home Assignment will be given for 05 Marks (Each Home Assignment from every unit will be assessed for 05 Marks and finally reduced to 05 Marks). Assessment Marks for C_2 will be distributed as follows: Internal test will be conducted for 30 Marks (10 Marks from each unit and reduced to 10 Marks) and Seminar will be assessed for 20 Marks and finally its Marks will be distributed to each theory HC course. i.e.,

C_1		C_2	
Internal Test	30 Marks (10+10+10) **Reduced to 10 Marks**	Internal Test	30 Marks (10+10+10) **Reduced to 10 Marks**
Home Assignment	15 Marks (05+05+05) **Reduced to 5 Marks**	Seminar	20 Marks (05+05+05+05) **5 Marks will be distributed to each HC course**
Total	**15 Marks**	**Total**	**15 Marks**

Distribution of Marks for C_3 Component (Semester end Examination)

The question paper is of 3 hrs duration with the Maximum of 70 Marks. The following question paper pattern will be followed for all the theory courses (HC/SC/OE). Question paper will have FIVE main questions. All the questions will cover all the units of the course with equal marks distribution. Q. No. 1 is of Medium/ Short Answer Type questions which will have nine questions and each question carries two marks. A student has to answer any seven questions. Q. No. 2 to 5 carries 14 marks each and a student has to answer all the four questions (*No Choice*). Each main question will have three sub-sections a, b, c. An examiner may set the questions like (4+4+6) or (4+5+5) or as his/her wish. However, sub-section 'c' will have an internal choice. i.e.,

Model Question Paper Pattern

Max. Duration: 3 Hr **Max. Marks: 70**

Note: *Answer all the questions. Each question carries 14 marks.*
Q. No. 1: Nine Medium/ Short Answer Type Questions and any seven should be answered. Each question carries <u>TWO marks.</u> **(7 × 2 = 14)**

Q. No. 2 to 5: All the four questions have to be answered (*No Choice*). Each question carries **FOURTEEN** marks. An examiner may set the questions like (4+4+6) or (4+5+5) or as his/her wish. However, sub-section c will have an internal choice. (*Two marks questions shall be avoided for 2 to 5*). **(4 × 14 = 56)**

a)
b)
c) **OR** c)

2. SOFT CORE (02 CREDIT COURSES)

Distribution of Marks for C_1 and C_2 Components

Assessment Marks ($C_1 + C_2$) consists of 30 marks. It will be divided into two parts viz., ***Internal Test and Home Assignment***. Internal tests will be conducted during the 8th week of the semester for C_1 and 16th week of the semester for C_2. As far as Home Assignment is concerned, the concerned teacher will assign one or two Home Assignments to each student. Since each course has two units, the marks will be divided equally. Allotment of marks for C_1 and C_2 is as follows: Out of 15 Marks for IA, Internal tests will be conducted for 20 marks and reduced to 10 marks, whereas Home Assignment is for 05 Marks. i.e.,

C_1		**C_2**	
Internal Test	20 Marks (10+10) **Reduced to 10**	Internal Test	20 Marks (10+10) **Reduced to 10**
Home Assignment	10 Marks (05+05) **Reduced to 05**	Home Assignment	10 Marks (05+05) **Reduced to 05**
Total	**15 Marks**	**Total**	**15 Marks**

Distribution of Marks for C_3 Component (Semester End Examination)

The above described pattern (1.2) holds good in this case also.

3. PRACTICALS

The following Scheme will be applicable for all the four semesters (SC for chemistry students only)

Each practical consists of three components namely C_1, C_2 and C_3. C_1 and C_2 are designated as Internal Assessment (IA) and C_3 as Semester End Examination. Each practical carries **100 Marks** and hence the allotment of marks to C_1, C_2 and C_3 Components will be 15, 15 and 70 marks respectively. i.e.,

C_1 Component	15 Marks	Internal Assessment Marks
C_2 Component	15 Marks	
C_3 Component	70 Marks	Semester End Examination
Total	**100 Marks**	

Distribution of Marks for C_1 and C_2 Components

IA consists of **15 Marks**. It will be divided into three parts *viz*., ***Internal Test, Continuous Assessment and Record***. Continuous assessment refers to the daily assessment of each student based on his/her attendance, skill, results obtained etc. Thus, 05 marks are allotted for Continuous Assessment. Internal tests will be conducted for 05 Marks during the 8^{th} week of the semester for C_1 and 16^{th} week of the semester for C_2. Finally, remaining 05 Marks will be for the record. i.e.,

C_1		**C_2**	
Internal Test	05 Marks	Internal Test	05 Marks
Continuous Assessment	05 Marks	Continuous Assessment	05 Marks
Record	05 Marks	Record	05 Marks
Total	**15 Marks**	**Total**	**15 Marks**

Distribution of Marks for C_3 Component (Semester End Examination)

The end examination will be conducted for **70 Marks/course** with a maximum duration of 6 hours. Two experiments will be given to each student which carries 30 Marks each. Each student will be subjected to Viva-Voce Examination for which 10 Marks is allotted. i.e.,

Two Experiments	30+30 Marks
Viva-Voce	10 Marks
Total	**70 Marks**

Note: Examiners have to set at least one experiment from each part in the semester end Examination (C_3).

4. Evaluation of Dissertation/Project Work:

Each student can take up Project Work/ Dissertation under the guidance of the faculty of the department during the IV Semester as a Soft Core course.

4.1. Distribution of Marks for C_1 and C_2 Components:

IA consists of **fifteen Marks** for each components; it will be divided into three parts viz.,

Attendance, Continuous Assessment and Work Progress. Continuous assessment refers to the daily assessment of each student based on his or her skill, results obtained, literature survey etc. C_1 will be assessed during the 8^{th} Week of the semester and C_2 during the 16^{th} Week of the semester. Hence, the concerned guide will prepare the marks list based on the above said parameters for both C_1 and C_2 Components.

4.2. Distribution of Marks for C_3 Component (Semester End Examination):

The semester end examination will be conducted for **seventy Marks**. Every student is suppose to prepare a hard copy of the findings of the work in the form of report and submitted for evaluation. This part will be assessed for fourth Marks. Each student will be subjected to Viva-Voce Examination for which thirty Marks is allotted. i.e.,

Evaluation of Report	: 40 Marks
Viva-Voce	: 30 Marks
Total	**: 70 Marks**

FIRST SEMESTER
HARD CORE

CONCEPTS AND MODELS OF INORGANIC CHEMISTRY

COURSE CODE: 21CHA10

Objectives

- To study the structures of ionic crystals and simple molecules through VSEPR model.
- To learn acid-base concepts and chemical reactions in non-aqueous, ionic liquids and supercritical fluids as media.
- To study the chemistry of f-block elements.

Course Outcome

- The periodic properties of the elements, structures of ionic solids and their lattice energy calculations. Further, the use of VSEPR concepts in analyzing the structures of simple molecules.
- Various acid-base concepts and their applications in different fields. Also, understand the utility of various non-aqueous solvents in inorganic synthesis.
- Complete understanding of the chemistry of lanthanides, actinides and their applications.

Pedagogy

- Familiarize the students with the periodic properties of the elements using modern periodic table.
- Teaching through conventional method such as black board and chalk, and modern methods like power point presentation.
- For teaching structures of solids, crystal models (MX and MX2 types) are used.

Course content

UNIT-I [16 HOURS]

Chemical Periodicity: Review of periodic properties

Structures and energetics of ionic crystals: Introduction, MX (NaCl, CsCl, ZnS) and MX_2 (fluorite, rutile, β-crystobalite, cadmium chloride and cadmium iodide) types. The perovskite and spinel structures. Thermodynamics of ionic crystal formation. Hydration energy and solubility of ionic compounds, Lattice energy, Born-Haber cycle, Born-Lande equation. The Kapustinskii's equation, Consequences of lattice enthalpies. Applications of lattice energetics. Ionic radii, factors affecting the ionic radii, radius ratio rules.

Structures and energetics of inorganic molecules: Introduction, Bent's rule, Energetics of hybridization. VSEPR model for explaining structure of molecules including fluxional molecule. M.O. treatment of homo-nuclear and heteronuclear diatomic molecules. M.O. treatment involving delocalized π-bonding (CO_3^{2-}, NO_3^-, NO_2^-, CO_2 and N_3^-), M.O. correlation diagrams (Walsh) for triatomic molecules.

UNIT-II [16 HOURS]

Modern concepts of acids and bases: Lux-Flood and Usanovich concepts, solvent system and leveling effect. Hard-Soft Acids and Bases, Classification and Theoretical backgrounds.

Non-aqueous solvents: Classification of solvents, Properties of solvents (dielectric constant, donor and acceptor properties) protic solvents (anhydrous H_2SO_4, HF and glacial acetic acid)

aprotic solvents (liquid SO_2, BrF_3 and N_2O_4). Solutions of metals in liquid ammonia, hydrated electron. Super acids and super bases. Heterogeneous acid-base reactions.
Ionic liquids: Molten salt solvent systems, Ionic liquids at ambient temperature, Reactions in and applications of molten salt/ionic liquid media.
Supercritical fluids: Properties of supercritical fluids and their uses as solvents. Supercritical fluids as media for inorganic chemistry

UNIT-III

[16 HOURS]

Lanthanoid Chemistry: General trends, Electronic, optical and magnetic properties. Abundance and extraction, **General principles**: conventional, solvent extraction and ion-exchange methods. Separation from monazite. Chemistry of principal oxidation states (II, III and IV). Stability of tetrahalides, dihalides and aqua ions of simple lanthanide compounds. Redox potentials. **Uses:** lanthanides as shift reagents, lanthanides as probes in biological systems. High temperature super conductors.
Actinoid Chemistry: General trends and electronic spectra**.** Occurrence and preparation of elements, **Isolation of the elements**: thorium and uranium, enrichment of uranium for nuclear fuel, uranium hydrides, oxides and chlorides. Chemical reactivity and trend. Chemistry of trans-uranium elements.
Supramolecular Chemistry: Introduction, selectivity and Supramolecular Interactions.

References

1. Basic Inorganic Chemistry – 3rd edition. F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons (2002).
2. Inorganic Chemistry, 3rd edition. James E. Huheey, Harper and Row Publishers (1983).
3. Inorganic Chemistry, 5th edition. G.L. Miessler, P. J. Fischer and D.A. Tarr, Pearson (2014).
4. Inorganic Chemistry, 6th edition. D.F. Shriver, M. Weller. T. Overton, J. Rourke and F. Armastrong, Oxford University Press (2014).
5. Inorganic Chemistry, 4th edition. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2012).
6. Introduction to Modern Inorganic Chemistry, K.M. Mackay and R.A. Mackay, Blackie Publication (1989).
7. Concepts and Models of Inorganic Chemistry 3rd edition. B.E. Douglas, D.H. McDaniel and Alexander, Wiley (2001).
8. Ionic liquids-Classes and Properties (Ed) by Scott T. Handy, Intech Publisher (2011).
9. Lanthanide and Actinide Chemistry, Simon Cotton, John Wiley and Sons Ltd., (2006).
10. Supramolecular Chemistry, Peter J. Cragg, Springer (2010).

STEREOCHEMISTRY AND REACTION MECHANISM
COURSE CODE: 21CHA11

Objectives

- To understand detailed molecular structures of organic compounds.
- To learn bonding and chemical reactions of organic compounds.
- To study different chemical reactions involved in organic synthesis.

Course Outcome

- Optical and geometrical isomerism of Organic compounds. Application of stereochemistry in the study of regioselective and regiospecific reactions.
- The study of HMOT and its applications to simple organic molecules, and also understand the concept of aromaticity and methods of determining reaction mechanism.
- Nucleophilic, electrophilic and elimination reactions.

Pedagogy

- Molecular models are used to teach stereochemistry.
- Teaching through conventional method such as black board and chalk, and modern methods like power point presentation.

Course content

UNIT-I

[16 HOURS]

Stereoisomerism: Projection formulae [flywedge, Fischer, Newman and sawhorse], enantiomers, diastereoisomers, mesomers, configurational notations of simple molecules, DL and RS configurational notations.

Conformational analysis: Conformational analysis of ethane, butane, cyclohexane, decalins, 1,2-, 1,3- and 1,4-disubstituted cyclohexane derivatives, Effect of conformation on the course and rate of reactions.

Optical isomerism: Conditions for optical isomerism; Elements of symmetry-plane of symmetry, centre of symmetry, alternating axis of symmetry (rotation-reflection symmetry). Optical isomerism due to chiral centers and molecular dissymmetry, allenes and biphenyls,

Geometrical isomerism: In C=C, C=N and N=N bonds, *E*, *Z* conventions, determination of configuration by physical and chemical methods. Geometrical isomerism in cyclic systems.

Stereoselectivity: Meaning and examples of stereospecific reactions, stereoselective reactions, diastereoselective reactions, regioselective, regiospecific reactions, enantioselective reactions and enantiospecific reactions.

UNIT-II

[16 HOURS]

Basics of organic reactions: Meaning and importance of reaction mechanism, classification and examples for each class.

Bonding in organic systems: Theories of bonding-molecular orbital approaches. Huckel molecular orbital theory and its application to simple π-systems: ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, cyclohexatrienyl, heptatrienyl, cycloheptatrienyl systems. Calculation of the total π-energy, and M.O. coefficients of the systems.

Aromaticity: Concept of aromaticity, Huckel's rule, Polygon rule, annulenes, heteroannulenes and polycyclic systems.

Structure and reactivity: Brief discussion on effects of hydrogen bonding, resonance, inductive and hyperconjugation on strengths of acids and bases.

Methods of determining organic reaction mechanism: Thermodynamic and kinetic requirements for reactions, kinetic and thermodynamic control; Identification of products; Determination of reaction intermediates, isotope labeling and effects of cross over experiments, kinetic and stereochemical evidence, solvent effect. Formation, structure, stability, detection and reactions of carbocations (classical and non-classical), carbanions, free radicals, carbenes, nitrenes, arynes and ylides (Sulphur, nitrogen and phosphorous).

UNIT-III

[16 HOURS]

Aliphatic Nuleophilic Substitution reactions: Kinetics, mechanism and stereochemical factor affecting the rate of S_N1, S_N2, $S_{RN}i$, S_Ni, S_N1', S_N2', S_N1i and $S_{RN}1$ reactions; Neighboring group participation.

Electrophilic substitution reactions: Kinetics, mechanism and stereochemical factor affecting the rate of S_E1 & S_E2

Aromatic electrophilic substitution reactions: Mechanism of nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction, chloromethylation, Vilsmeier Haack reaction, Diazonium coupling, Gattermann–Koch reaction, Mercuration reaction.

Aromatic nucleophilic substitution reactions: S_N1, S_N2 and benzyne mechanism, Bucherer reaction, von Richter reaction.

Mechanism of Addition reactions: Addition to C=C multiple bonds involving electrophiles, nucleophiles. Markownikoff's rule and anti-Markownikoff's rule.

Additions to carbonyl compounds: Addition of water, alcohol, bisulphate, HCN and amino compounds. Hydrolysis of esters.

Elimination reactions: Mechanism and stereochemistry of eliminations - E_1, E_2, E_{1cB}. *cis* elimination, Hofmann and Saytzeff eliminations, competition between elimination and substitution reactions, decarboxylation reactions. Chugaev reaction.

References

1. Stereochemistry of carbon compounds, Ernest L. Eliel.
2. Stereochemistry: P. S. Kalsi.
3. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
4. Organic Chemistry, Vol-I by I. L. Finar.
5. Advance Organic Chemistry, IV edition, Jerry March.
6. Advance Organic Chemistry, III edition, Part-A and Part-B, Francis A. Carey and Rechard J. Sundberg.
7. Organic Chemistry, III edition, V. K. Ahluwalia and Rakesh Kumar Parashar.
8. Reactive intermediates in Organic Chemistry, N. S. Isaacs.

BASIC PHYSICAL CHEMISTRY
COURSE CODE: 21CHA12

Objectives

- To understand thermal properties of chemical compounds.
- To study the rate of chemical reactions including fast reactions and factors influencing the reaction rate.
- To understand the theory of electrochemistry in solution.

Course Outcome

- The completion of this course will enable the students to gain the knowledge on fundamentals and theoretical background on the concepts of chemical thermodynamics, chemical kinetics and electrochemistry of solutions.
- This helps in understanding the stability and energetics of reaction.

Pedagogy

- Teaching through conventional method such as black board and chalk, and modern methods like power point presentation.
- To teach electrochemical aspects through animations.

Course content

UNIT-I

[16 HOURS]

Chemical Thermodynamics: Entropy: Physical significance, entropy changes in an ideal gas. Variation of entropy with temperature, pressure and volume. Entropy changes in reversible and irreversible processes.

Free energy: Helmholtz and Gibbs free energies, Gibbs-Helmholtz equation and its applications, Maxwell‘s relations and its applications. Nernst heat theorem: its consequences and applications. Third law of thermodynamics: statements, applications and comparison with Nernst heat theorem.

Partial molar properties: Physical significance, determination of partial molar volumes by intercept method and from density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Formulation of the Gibbs – Duhem equation. Derivation of Duhem-Margules equation.

Fugacity: Relation between fugacity and pressure, variation of fugacity with temperature and pressure. Determination of fugacity of gases.

Activity and activity coefficient: Variation of activity with temperature and pressure. Determination of activity co-efficient by vapour pressure, depression in freezing point, solubility measurements and by electrical methods.

Thermodynamics of dilute solutions: Raoult‘s law, Henry‘s law. Ideal and non-ideal solutions.

UNIT-II

[16 HOURS]

Chemical Kinetics: Complex reactions: Kinetics of parallel, consecutive and reversible reactions. Chain reactions: Branched chain reactions, general rate expression, Auto catalytic reactions (Hydrogen-Oxygen reaction), oscillatory reactions and explosion limits.

Theories of reaction rates: Collision theory and its limitations, Activated complex theory (postulates -derivation) and its applications to reactions in solution. Energy of activation, other activation parameters - determinations and their significance. Lindemann theory, Hinshelwood‘s theory of unimolecular reactions.

Potential energy surfaces: Features and construction, theoretical calculations of E_a.

Reactions in solution: Ionic reactions - salt effects, effect of dielectric constant (single and double sphere models). Effect of pressure, volume and entropy change on the rates of reactions. Cage effect with an example.

Fast reactions- Introduction, study of fast reactions by continuous and stopped flow techniques, relaxation methods (T-jump and P-jump methods), flash photolysis, pulse and shock tube methods.

UNIT-III

[16 HOURS]

Electrochemistry of solutions: Factor effecting electrolytic conductance. Debye-Huckel theory - Concept of ionic atmosphere. Debye-Huckel-Onsager equation of conductivity and its validity. Debye-Huckel limiting law (DHL), its modification for appreciable concentrations. A brief survey of Helmholtz-Perrin, Guoy-Chapman and Stern electrical double layer (no derivation). Transference number: True and apparent transference numbers, Abnormal transference numbers, effect of temperature on transference numbers. Liquid junction potential-determination and minimization.

Energetics of cell reactions: Effect of temperature, pressure and concentration on energetics of cell reactions (calculation of ΔG, ΔH and ΔS).

Irreversible electrode process: Introduction, reversible and irreversible electrodes, reversible and irreversible cells. Polarization, over voltage - concentration over voltage, activation over voltage and ohmic over voltage. Experimental determination of over voltage. Equations for concentration over potential, stationary and non-stationary surface. Butler-Volmer equation, Tafel equation. Hydrogen oxygen over voltage. Effect of temperature, current density and *p*H on over voltage. Polarography- Half wave potential, application in qualitative and quantitative analysis.

References

1. Thermodynamics for Chemists by S. Glasstone, Affiliated East-West Press, New Delhi, (1965).
2. Physical Chemistry by P.W. Atkins, ELBS, 5th edition, Oxford University Press (1995).
3. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
4. Elements of Physical Chemistry by Lewis and Glasstone, 2nd Edn. Macmillan & Co Ltd., New York.
5. Chemical Kinetics by K.J. Laidler, Tata McGraw-Hill Pub, Co Ltd, New Delhi.
6. Chemical Kinetics by Frost and Pearson.
7. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose, Macmillan, New Delhi.
8. Chemical Kinetics by L.K. Jain.
9. Introduction to Electrochemistry by S. Glasstone, Affiliated East-West Press, New Delhi,
10. Electrochemistry –Principles and Applications by E.G. Potter, Cleaver-Hume press Ltd, London.
11. Modern Electrochemistry Vol. I and II by J.O.M. Bockris and A.K.N. Reddy, Pentium Press, New York (1970).

ESSENTIALS OF ANALYTICAL CHEMISTRY
COURSE CODE: 21CHA13

Objectives

- To familiarize statistical methods to validate analytical methods.
- To learn sampling techniques and conventional volumetric methods.
- To learn extraction and chromatographic methods for the separation and identification of different compounds.

Course Outcome

- To enhance the knowledge on usage of analytical terminologies
- To build the skills on statistical analysis and comparison of results
- To aquire the skills on sampling, purification, separation and data analysis using instrumental techniques.
- To excel the knowledge on various separation techniques
- Explore topics such as experimental design, sampling, calibration strategies, standardization, optimization, statistics and the validation of experimental results

Pedagogy

- Teaching through conventional method such as black board and chalk, and modern methods like power point presentation.
- To evaluate validation parameters, MS-Office tools *viz.,* MS-Excel sheets can be used.

Course Content

Unit-I

Analytical Chemistry – Objectives. Meaning and role of analytical chemists. Quantitative and qualitative analysis. Analytical process and steps in quantitative analysis. Meanings of the terms: analysis, determination and measurement, techniques, methods, procedures and protocols. Calculating and reporting the data. Measurement of central tendency and variability: Mean median, range, standard deviation and variance.

Meaning of error. Determinate and indeterminate errors and minimization of errors. Accuracy and precision, distribution of random errors, the normal error curve. Propagation of determinate and indeterminate errors

Statistical treatment of finite samples- Student's t-test, confidence interval of mean. Comparison of two means and two standard deviations. Comparison of an experimental mean and a true mean. Criteria for the rejection of an observation- Q-test.

Standardization and calibration: Comparison with standards-direct comparison and titrations. External standard calibration-the least squares methods, regression equation and regression coefficient. Internal standard methods and standard-addition methods.

Validation of analytical method: Linearity, accuracy, precision, sensitivity, selectivity, robustness and ruggedness.

Figures of merit of analytical methods – sensitivity, detection and quantitation limit, linear dynamic range.

Obtaining and preparing samples for analysis: Importance of sampling, designing a sample plan-random, judgement, systematic-judgement, stratified and convenience sampling. Type of sample to collect - grab and composite samples. *Insitu* sampling. Size of sample and number of samples. Implementing the sampling plan - solutions, gases and solids. Bringing solid samples into solution - digestion and decomposing.

[16 HOURS]

UNIT – II

Solvent extraction: Theory-Nernst partition law, efficiency and selectivity of extraction.

Extraction systems: Extraction of covalent neutral molecules, extraction of uncharged metal chelates and synergic extraction, extraction of ion-association complexes-non chelated complexes, chelated complexes and oxonium systems. Use of salting out agents. Methods of extraction-batch and continuous extractions. applications.

Solid Phase Extraction (SPE): Principles, apparatus and instrumentation. Solid phase sorbents, extraction formats - Automated solid phase extraction. Solid phase micro extraction (SPME). Applications of SPE and SPME.

Chromatography: Definition, principles and mechanism of separation, classification of chromatographic techniques. General descriptions of column chromatography-frontal analysis, displacement analysis and elution analysis. General theory of column chromatography: characterizing a chromatogram-retention time, retention volume and baseline width. Chromatographic resolution, capacity factor, column selectivity. Column efficiency-band broadening-rate theory and plate theory. Peak capacity, non ideal behavior. Optimizing chromatographic separations using capacity factor, column selectivity and column efficiency- van Deemter equation, and its modern versions, Golay equation and Huber-Knox equations.

Thin layer chromatography (TLC) - Principles and procedures, stationary and mobile phases, solute- detection, alternative TLC procedures and applications of TLC.

[16 HOURS]

Unit-III

Gas chromatography (GC) - Principles and types. Mobile phases, Sample injections, columns and stationary phases. Temperature control and solute detection; thermal conductivity detector (TCD), flame ionization detector (FID), nitrogen-phosphorus detector (NPD) and electron capture detector (ECD). Instrument control and data processing. GC-procedures- temperature programming and special procedures used in GC. Quantitative and qualitative analyses.

High performance liquid chromatography (HPLC): Principles, mobile phases, solvent delivery systems, sample injection system, column and stationary phases. Solute detection-UV- visible, fluorescence, refractive index and electrochemical detectors. Instrument control and data processing. Modes of HPLC. Optimisation of separations, qualitative and quantitative analyses.

Ion-exchange chromatography (IEC): Principles, apparatus and instrumentation, and applications.

Size-exclusion chromatography (SEC): Principles, apparatus and instrumentation, and applications.

Affinity chromatography (AFC): Principles, methodology and applications.

Supercritical fluid chromatography (SFC): Properties of supercritical fluids, instrumentation and operating variables, comparison of SFC with other chromatographic techniques, applications.

Supercritical fluid extraction (SFE): Advantages, instrumentation, choice of supercritical fluids, off-line and on-line extraction, applications.

Electrophoresis (EP) and electrochromatography (EC): Principles- high performance capillary electrophoresis and capillary electrochromatography, running buffers, supporting medium, sample injection, solutes- detection, instrument control and data processing. Modes of EP and EC- capillary zone electrophoresis (CZE), micellar electrokinetic chromatography (MEKC), capillary gel electrophoresis (CZE), capillary isoelectric focusing (CIEF). Capillary electrochromatography (CEC), features, basis of separations. Qualitative analysis by CE and CEC and applications.

[16 Hours]

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001, John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993,Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders CollegePublishing, California, 1990.
6. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
7. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.

SOFT CORE

ANALYTICAL CHEMISTRY PRACTICALS

COURSE CODE: 21CHA50 **[128 HOURS]**

Safety measures in the laboratory; MSDS; reporting of values.

Course Objective

- To understand basic concepts by carrying out analytical experiments.
- The experimental results are subjected to validation of analytical parameters

Course Outcomes

- After studying this course the student to:
- Analyze various samples with different classical and simple instrumental skills.
- Obtain knowledge for selection of analytical methods with suitable technique being adopted for the analysis different samples like, water, laboratory chemicals and reagents, body fluids such as urine etc.
- Distinguish classical and instrumental methods.
- Propose and conduct experiment for quantification of individual analytes

Pedagogy

- Computer aided applications for the evaluation of experimental results.
- Each student performs experiments as per the protocol in practical classes.

PART – I

1. Determination of total acidity of vinegar and wines by acid-base titration.
2. Determination of purity of a commercial boric acid sample, and Na_2CO_3 content of washing soda.
3. Determination of relative equivalent weight of a weak organic acid by titration with NaOH.
4. Determination of ephedrine and aspirin in their tablet preparations by residual acid-base titrimetry.
5. Determination of carbonate and bicarbonate in a mixture by *p*H-metric titration and comparison with visual acid-base titration.
6. Determination of carbonate and hydroxide-analysis of a commercial washing soda by visual and *p*H-titrimetry.
7. Determination of purity of a commercial sample of mercuric oxide by acid-base titration.
8. Determination of benzoic acid in food products by titration with methanolic KOH in chloroform medium using thymol blue as indicator.
9. Determination of the *p*H of hair shampoos and *p*H determination of an unknown soda ash.
10. Analysis of water/ waste water for acidity by visual, *p*H metric and conductometric titrations.
11. Analysis of water/ waste water for alkalinity by visual, *p*H metric and conductometric titrations.
12. Determination of ammonia in house-hold cleaners by visual and conductometric titration.
13. Determination of chromate and dichromate in mixture by acid-base titration: visual and pH metric methods.

14. Potentiometric determination of the equivalent weight and Ka for a pure unknown weak acid.
15. Determination of purity of aniline by non-aqueous acid-base titration by visual and potentiometric methods.
16. Determination of purity of ethylene glycol and glycerol by oxidimetric method using periodate (Malprade reaction).
17. Spectrophotometric determination of creatinine and phosphorus in urine.
18. Flame emission spectrometric determination of sodium, potassium and calcium in river/ lake water.

PART – II

1. Determination of percentage of chloride in a sample by precipitation titration- Mohr, Volhard and Fajan's methods.
2. Determination of silver in an alloy and Na_2CO_3 in soda ash by Volhard method.
3. Mercurimetric determination of chloride in blood or urine.
4. Determination of total hardness, calcium and magnesium hardness and carbonate and bicarbonate hardness of water by complexation titration using EDTA.
5. Determination of calcium in calcium gluconate/ calcium carbonate tablets/ injections and of calcium in milk powder by EDTA titration.
6. Determination of zinc in a sample of foot powder and thallium in a sample of rodenticide by EDTA titration.
7. Analysis of commercial hypochlorite and peroxide solution by iodometric titration.
8. Determination of copper in an ore/ an alloy by iodometry and tin in stibnite by iodimetry.
9. Determination of ascorbic acid in vitamin C tablets by titrations with $KBrO_3$ and of vitamin C in citrus fruit juice by iodimetric titration.
10. Determination of iron in razor blade by visual and potentiometric titration using sodium metavanadate.
11. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate.
12. Determination of nickel in steel by synergic extraction and boron in river water/ sewage using ferroin.
13. Determination of total cation concentration of tap water by ion-exchange chromatography.
14. Determination of magnesium in milk of magnesium tablets by ion-exchange chromatography.
15. Cation exchange chromatographic separation of cadmium and zinc and their estimation by EDTA titration.
16. Gas chromatographic determination of ethanol in beverages.
17. Solvent extraction of zinc and its spectrophotometric determination.
18. Anion exchange chromatographic separation of zinc and magnesium followed by EDTA titration of the metals.
19. Separation and determination of chloride and bromide on an anion exchanger.
20. Separation of *o*- and *p*-nitroaniline and analysis by thin layer chromatography.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Practical Clinical biochemistry methods and interpretations, R. Chawla, J.P. Bothers Medical Publishers (P) Ltd., 1995.
7. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
8. Practical Clinical Biochemistry by Harold Varley and Arnold.Heinmann, 4th edition.

INORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHA51 **[128 HOURS]**

Objectives

- To understand basic concepts by carrying out different experiments.
- To develop the skill for the qualitative and quantitative analysis of various samples.

Course Outcome

- Determination of various analytes presents in different ore samples by volumetric, gravimetric and spectrophotometric methods.
- The chemistry of redox, complexometric and indirect methods
- The principle in the semi-micro analysis of an inorganic salt mixture

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Handling the instrument and pyrolysis for quantitative determination of analyte.

Course experiments

PART – A

1. Determination of iron in haematite using cerium (IV) solution (0.02M) as the titrant, and gravimetric estimation of insoluble residue.
2. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.
3. Determination of manganese dioxide in pyrolusite using permanganate titration.
4. Quantitative analysis of copper-nickel in alloy/mixture:
   i. Copper volumetrically using KIO_3.
   ii. Nickel gravimetrically using DMG

5. Determination of lead and tin in a mixture: Analysis of solder using EDTA titration.
6. Quantitative analysis of chloride and iodide in a mixture:
    i. Iodide volumetrically using KIO_3
    ii. Total halide gravimetrically
7. Gravimetric analysis of molybdenum with 8-hydroxyquinoline.
8. Quantitative analysis of copper(II) and iron(II) in a mixture:
    i. Copper gravimetrically as CuSCN and
    ii. Iron volumetrically using cerium(IV) solution
9. Spectrophotometric determinations of:
    a. Titanium using hydrogen peroxide
    b. Chromium using diphenyl carbazide in industrial effluents
    c. Iron using thiocyanate/1,10-phenanthroline method in commercial samples
    d. Nickel using dimethylglyoxime in steel solution
10. Micro-titrimetric estimation of :
    a) Iron using cerium(IV)
    b) Calcium and magnesium using EDTA
11. Quantitative estimation of copper (II), calcium (II) and chloride in a mixture.
12. Circular paper chromatographic separation of: (Demonstration)
    a. Iron and nickel
    b. Copper and nickel

PART – B

Semimicro qualitative analysis of inorganic mixtures containing **TWO** anions and **TWO** cations (excluding sodium, potassium and ammonium cations) and **ONE** of the following less common cations: W, Mo, Ce, Ti, Zr, V and Li.

References

1. Vogel‘s Text Book of Quantitative Chemical Analysis – 5th edition, J. Basset, R.C. Denney, G.H. Jeffery and J. Mendhom.
2. A Text Book of Quantitative Inorganic Analysis by A.I. Vogel, 3rd edition.
3. Spectrophotometric Determination of Elements by Z. Marczenko.
4. Vogel‘s Qualitative Inorganic Analysis – Svelha.
5. Macro and SemimicroInorganicQualitative Analysis by A.I. Vogel.
6. Semimicro Qualitative Analysis by F.J. Welcher and R.B. Halin.
7. Quantitative Chemical Analysis by Daniel C. Harris, 7th edition, (2006).

ORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHA52 [128 HOURS]

Objectives

- To understand synthetic methods by carrying out different experiments.
- To develop the skill for the separation and qualitative analysis of binary mixtures of organic compounds.

Course Outcome

- Students are involved in the multi-step synthesis of different organic compounds.
- Understand the qualitative analysis of binary mixture of organic compounds through separation, identification of functional groups and preparation of solid derivatives.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Experimental setup for the synthesis of organic compounds by every individual.

Course experiments

PART-A

Safety measures in the laboratory; MSDS; reporting of values and demonstration of KingDraw/ ChemDraw

Multistep synthesis

1. Preparation *p*-bromoaniline from acetanilide**.**
2. Preparation of *n*-butyl bromide from *n*-butyl alcohol.
3. Oxidation of cyclohexanol to adipic acid.
4. Esterification: Preparation of benzoccaine from *p*-nitrotoluene.
5. Diazotization (Sandmeyer‘s reaction): Preparation of *p*-chlorobenzoic acid from *p*-toluidine.
6. Preparation benzilic acid from benzoin**.**
7. Preparation of *o*-hydroxy benzophenone from phenyl benzoate *via* Fries rearrangement.
8. Preparation of benzanilide from benzophenone oxime *via* Beckmann rearrangement.
9. Preparation of benzoic acid from benzaldehyde (Cannizzaro Reaction).
10. Preparation of 2,4-dinitrophenylhydrazine from 2,4-dinitrochlorobenzene.
11. Preparation of *m*-nitrobenzoic acid from methylbenzoate.
12. Preparation of chalcone.

PART-B

Qualitative analysis: Separation of binary mixtures, identification of functional groups and preparation of suitable solid derivatives.

References

1. Vogel' text book of practical organic chemistry, V edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatehell.
2. Elementary practical organic chemistry, Part-I: Small scale preparations, Part-II: Qualitative organic analysis, By Arthur I, Vogel.
3. Hand book of organic analysis, H. T. Clarke and Norman Collie.
4. Experiments in Organic Chemistry, Louis F. Fieser.
5. Laboratory manual of Organic Chemistry by B. B. Dey and M. V. Sitaraman.
6. Practical Organic Chemistry by Mann F. G. and Saunders.

PHYSICAL CHEMISTRY PRACTICALS

COURSE CODE: 21CHA53 [128 HOURS]

Objectives

- To understand the rate of chemical reactions and factors influencing the reaction rate by carrying out kinetic experiments.
- To understand basic concepts of electrochemistry by carrying out experiments.

Course Outcome

- After the completion of this course, the students can able to develop the experimental skill and theoretical interpretation of experimental results of many physical chemistry experiments of chemical kinetics in solution phase, thermodynamics, electrochemistry and spectrophotometry.
- This helps in academics, research and industries.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- To optimize the reaction conditions for understanding the rate of chemical reactions.

Course experiments

PART - A

1. Study of kinetics of hydrolysis of methyl acetate in presence of two different concentrations of HCl/H_2SO_4 and report the relative catalytic strength.
2. Study of kinetics of reaction between $K_2S_2O_8$ and KI, first order, determination of rate constants at two different temperatures and E_a.
3. To study the kinetics of saponification of ethyl acetate by conductivity method at two different concentrations of NaOH and report the relative catalytic strength.
4. Determination of partial molar volume of salt-water system ($NaCl-H_2O/KCl-H_2O/KNO_3-H_2O$) systems.
5. To study the kinetics of reaction between acetone and iodine - determination of order of reaction with respect to iodine and acetone.
6. Study the kinetics of decomposition of diacetone alcohol by NaOH, determine the catalytic coefficient of the reaction and comparison of strength of alkali.
7. Determination of energy of activation for the bromide-bromate reaction.
8. Kinetics of reaction between sodium formate and iodine and determination of energy of activation.
9. Determination of heat of solution of organic acid (benzoic acid/salicylic acid) by variable temperature method (graphical method).
10. Determination of degree of association of benzoic acid in benzene by distribution method.
11. To determine the eutectic point of a two component system (Naphthalene-*m*-dinitrobenzene system).
12. Analysis of a binary mixture (Gylcerol & Water) by measurement of refractive index.
13. Determination of the molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).

PART – B

1. Conductometric titration of a mixture of HCl and CH_3COOH against NaOH.
2. Conductometric titration of sodium sulphate against barium chloride.
3. pH titration of (a) HCl against NaOH (b) Copper sulphate against NaOH and (c) $CH_3COOH/HCOOH$ against NaOH - determination of K_a.
4. Determination of equivalent conductance of weak electrolyte (CH_3COOH) at infinite

dilution following Kohlrausch law.

5. Determination of dissociation constant and mean ionic activity coefficient of weak acids ($CH_3COOH/HCOOH/ClCH_2COOH$) by conductivity method.
6. Potentiometric titration of KI *vs* $KMnO_4$ solution.
7. Determination of dissociation constant of a weak acid ($CH_3COOH/HCOOH/ClCH_2COOH$) by potentiometric method.
8. Potentiometric titration of a mixture of halides (KCl+KI/KCl+KBr/KBr+KI) against $AgNO_3$.
9. To obtain the absorption spectra of coloured complexes, verification of Beer's law and estimation of metal ions in solution using a spectrophotometer.
10. Potentiometric titration of $K_2Cr_2O_7$ against FAS determination of redox potential and concentration of Fe^{2+} ions.
11. Conductometric titration of oxalic acid against NaOH and NH_4OH.
12. Coulometric titration I_2 vs $Na_2S_2O_3$.
13. Determination of acidic and basic dissociation constant and isoelectric point of an amino acid by pH metric method.
14. Kinetics of photodegradation of indigocarmine (IC) using ZnO/TiO_2 as photocatalyst and study the effect of [ZnO/TiO_2] and [IC] on the rate of photodegradation.

References

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels *et al*.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments – J. Rose.
7. Practical Physical Chemistry – S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
11. Experimental Physical Chemistry – R.C. Das and B. Behera, Tata Mc Graw Hill.

SOFT CORE PAPERS

TITRIMETRIC ANALYSIS

COURSE CODE: 21CHA54

Objective

- To familiarize statistical methods to validate analytical methods.
- To learn sampling techniques and conventional volumetric methods.

Course Outcome

After studying this course the student able to:

- Understand on quantitative and qualitative methods of analysis with relevant equilibrium chemistry.
- Develop the ideas with the fundamental aspects in analytical chemistry.
- Build the interest in students in developing good experimental protocols, and in interpreting

experimental results.

- Gain analytical knowledge for the quantitative analysis of various samples of different origin under titrimetric aspects.
- Learn statistical aspects from which the spirit of assessing the results will be enhanced.
- Learn method development and validation features so that they will become outstanding basement for their career in various industries.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Unit-I

Titrimetric analysis: An overview of titrimetry. Principles of titrimetric analysis. Titration curves. Titrations based on acid-base reactions-titration curves for strong acid and strong base, weak acid and strong base and weak base and strong acid titrations. Selecting and evaluating the end point. Finding the end point by visual indicators, monitoring *p*H and temperature. Quantitative applications – selecting and standardizing a titrant, inorganic analysis-alkalinity, acidity and free CO_2 in water and waste waters, nitrogen, sulphur ammonium salts, nitrates and nitrites, carbonates and bicarbonates. Organic analysis-functional groups like carboxylic acid, sulphonic acid, amine, ester, hydroxyl, carbonyl. Air pollutants like SO_2. Quantitative calculations. Characterization applications-equivalent weights and equilibrium constants.

Acid-base titrations in non-aqueous media: Role of solvent in acid-base titrations, solvent systems, differentiating ability of a solvent, some selected solvents, titrants and standards, titration curves, effect of water, determining the equivalence point, typical applications-determination of carboxylic acids, phenols and amines.

Precipitation titrations: Titration curves, feasibility of precipitation titrations, factors affecting shape - titrant and analyte concentration, completeness of the reaction, titrants and standards, indicators for precipitation titrations involving silver nitrate, the Volhard, the Mohr and the Fajan's methods, typical applications.

[16 HOURS]

UNIT – II

Complexometric titrations: Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA - acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves - completeness of reaction, indicators for EDTA titrations - theory of common indicators, titration methods employing EDTA - direct, back and displacement titrations, indirect determinations, titration of mixtures.

Redox titrations: Balancing redox equations, calculation of the equilibrium constant of redox reactions, calculating titration curves, detection of end point, visual indicators and potentiometric end point detection. Quantitative applications - adjusting the analyte's oxidation state, selecting and standardizing a titrant. Inorganic analysis - chlorine residuals, dissolved oxygen in water, water in non-aqueous solvents. Organic analysis - chemical oxygen demand (COD) in natural and waste waters, titrations of mercaptans and ascorbic acid with I_3^- and titration of organic compounds using periodate.

Automatic titrators: Principles and theory of CO_2, sulphate, chloride and Karl Fisher titrators.

[16 HOURS]

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001, John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993,Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders CollegePublishing, California, 1990.
6. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
7. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.

CHEMISTRY OF SELECTED ELEMENTS
COURSE CODE: 21CHA55

Objectives

- To learn basic chemistry of some selected group elements from periodic table.
- To understand properties of metal-metal bonding and cluster compounds.

Course Outcome

- Understand the chemistry of hydrogen and group 2 elements.
- The chemistry of pseudohalogens, interhalogens and their halogen compounds.
- The chemistry of xenon and other noble gas compounds.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.Course content

UNIT-I

Compounds of hydrogen: The hydrogen and hydride ions, Dihydrogen and hydrogen bonding. Classes of binary hydrides: Molecular hydrides, saline hydrides and metallic hydrides.

The Group 1 elements: Occurrence, extraction and uses. Simple compounds: Hydrides, halides, oxides, hydroxides, oxoacids, nitrides, solubility and hydration and solutions in liquid ammonia. Coordination and organometallic compounds. Applications.

The Group 2 elements: Occurrence, extraction and uses. General properties. Halides, hydrides

and salts of oxo acids. Complex ion in aqueous solution and complexes with amido and alkoxy ligands.
The Group 15 elements: Introduction, oxides and oxoacids of nitrogen and phosphorus.

[16 HOURS]

UNIT-II

The Group 17 elements: Occurrence, recovery and uses. Trends in properties and pseudohalogens. **Interhalogens**: Physical properties and structures, chemical properties, cationic interhalogens. **Compounds with oxygen**: Halogen oxides, oxoacids and oxoanions**.** Trends in rates of redox reactions and redox properties of individual oxidation states**.**
Chemistry of astatine.
The Group 18 elements: Occurrence, recovery and uses. Synthesis and structure of xenon fluorides, Reaction of xenon fluorides, xenon-oxygen compounds, Organoxenon compounds, other compounds of noble gases.
M-M bonds: Multiple metal-metal bonds.
Cluster compounds: carbonyl and carbide clusters.

References

1. Basic Inorganic Chemistry – 3rd edition. F.A. Cotton, G. Wilkinson and P.L. Gaus, John
2. Wiley and Sons (2002).
3. Inorganic Chemistry, 3rd edition. James E. Huheey, Harper and Row Publishers (1983).
4. Inorganic Chemistry, 3rd edition. G.L. Miessler and D.A. Tarr, Pearson Education (2004).
5. Inorganic Chemistry, 4th edition. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2012).
6. Chemistry of the Elements – N.N. Greenwood and A. Earnshaw, Pergamon Press (1985).
7. Inorganic Chemistry, 6th edition. D.F. Shriver, M. Weller. T. Overton, J. Rourke and F.

CHEMISTRY OF NATURAL PRODUCTS-I
COURSE CODE: 21CHA56

Objectives

- To learn the nomenclature, classification, purification, structure and synthesis of some natural products.
- To understand the biological functions of biomolecules.

Course Outcome

- Acquire the knowledge of chemistry of lipids, prostaglandins and terpenoids.
- Understand the biological importance of chlorophyll and porphyrins.
- Chemistry of flavonoids and isoflavonoids.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern method like power point presentation is used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Lipids: Nomenclature, classification, purification, structure and synthesis of fatty acids, phospholipids, sphingolipids. Biological importance of lipids (Lecithin, sphingolipids, oils and fats).

Prostaglandins: Introduction, classification and biological importance of PG's. Constitution of PGE1. Synthesis of PGE & F series.

Terpenoids: Introduction, classification and general methods of structural elucidation. Chemistry of pinene, camphor, caryophyllene, santonin. Biosynthesis of terpenoids.

UNIT-II

[16 HOURS]

Porphyrins: Introduction, structure and biological functions of haemin. Vitamin B12: structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.

Flavonoids and Isoflavonoids: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercetin, wedelolactone, Butein, Daidzein. Biosynthesis of flavonoids and isoflavonoids: Acetate Pathway and Shikimic acid Pathway. Biological importance of flavonoids and isoflavonoids

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Organic Chemistry, Vol-II by I. L. Finar.
3. Schaum's outline of theory and problems of Organic Chemistry, Harbert Meislich, Howard Nechamkin and Jocob Sharefkin.
4. Natural products: Their chemistry and biological significance, J. Mann, R. S. Davidson, J. B. Banthorpe and J. B. Harborne.
5. Synthetic drugs, Gurdeep R. Chatwal.
6. Heterocyclic chemistry by Achison.
7. Heterocyclic chemistry by Smith and Joule.
8. Heterocyclic chemistry by Pacquete.

BIOPHYSICAL CHEMISTRY

COURSE CODE: 21CHA57

Objectives

- To understand the physico-chemical principles of biological fluids.
- To learn the pharmacokinetics, pharmacodynamics, toxicokinetics of biological systems.

Course Outcome

- After the completion of this course, the students gain the knowledge on theory and principles of biophysical chemistry and pharmacokinetics.
- This course helps to understanding the bio-availability and different pharmacokinetic parameters of drugs in the living system.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Biophysical Chemistry: Electrophoresis - Principles of free electrophoresis, zone electrophoresis, gel electrophoresis and its applications in qualitative and quantitative study of proteins. Determination of isoelectric point of a protein. Electro-osmosis and streaming potential and its biological significance. Biological significance of Donnan membrane phenomenon. Micelles and its involvement during digestion and absorption of dietary lipids. Diffusion of solutes across bio-membranes and its application in the mechanism of respiratory exchange. –Salting In‖ and –Salting Out‖ of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Effect of temperature and *p*H on the viscosity of bio-molecules (albumin solution). Significance of viscosity in biological systems - mechanism of muscle contraction, polymerization of DNA and nature of blood flow through different vessels. Effect of temperature, solute concentration (amino acids) on surface tension. Biological significance of surface tension - stability of Alveoli in lungs, interfacial tension in living cells (Danielli and Davson model). Application of sedimentation velocity and sedimentation equilibrium method for molecular weight determination of proteins.

UNIT-II

[16 HOURS]

Pharmacokinetics: Introduction, biopharmaceutics, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, toxicokinetics and clinical toxicology. Measurement of drug concentration in blood, plasma or serum. Plasma level-time curve, significance of measuring plasma drug concentrations.

One compartment open model: Intravenous route of administration of drug, elimination rate constant, apparent volume of distribution and significance. Calculation of elimination rate constant from urinary excretion data, clinical application.

Two compartment model: Plasma level-time curve, relationship between tissue and plasma drug concentrations, Apparent volumes of distribution. Drug clearance, clinical example. Plasma level-time curve for a three compartment open model.

Drug absorption: Factors affecting the rate of drug absorption - nature of the cell membrane, Route of drug administration - Oral drug absorption, Intravenous infusion and intravenous solutions, Effect of food on gastrointestinal drug absorption rate.

References

1. Introduction to Physical Organic Chemistry, R.D. Gilliom, Madison – Wesley, USA (1970).
2. Physical Organic Chemistry- Reaction Rate and Equilibrium Mechanism – L.P. Hammett, McGraw HillBook, Co., (1970).
3. Biophysical Chemistry- Principle and Technique – A. Upadhyay, K. Upadhyay and N. Nath, Himalaya Publishing House, Bombay, (1998).
4. Essentials of Physical Chemistry and Pharmacy – H. J. Arnikar, S. S. Kadam, K.N. Gujan, Orient Longman, Bombay, (1992).
5. Applied Biopharmacokinetics and Pharmacokinetics - Leon Shargel, Andrew YuPrentice-Hall International, Inc (4^{th} edition).
6. Essentials of Physical Chemistry and Pharmacy – H.J. Arnikar, S.S. Kadam, K.N. Gujan, Orient Longman, Bombay, (1992).

SECOND SEMESTER

COORDINATION CHEMISTRY

COURSE CODE: 21CHB10

Objectives

- To understand the preparation, properties, electronic configuration and structural elucidation of coordination compounds.
- To learn the reaction mechanism, stereochemistry and photochemistry of coordination compounds.

Course Outcome

- Gain the knowledge of preparative methods of coordination compounds and geometries of different coordination numbers.
- Understand the CFT and MOT bonding theories of metal complexes.
- Electronic spectra, magnetic properties and infrared spectroscopy of coordination compounds. In addition, understand the reaction mechanism and photochemistry of coordination compounds.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Preparation of coordination compounds: Introduction, Preparative methods- simple addition reactions, substitution reactions, oxidation-reduction reactions, thermal dissociation reactions. Geometries of metal complexes of higher coordination numbers (2-12).

Stability of coordination compounds: Introduction, trends in stepwise stability constants, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligands, the Irving-William series, chelate effect.

Determination of stability constants: Theoretical aspects of determination of stability constants of metal complexes by spectrophotometric and polarographic methods.

Crystal field theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, Jahn-Teller distortions, measurement of 10 Dq and factors affecting it. Evidences for metal-ligand covalency.

Molecular Orbital Theory: MOT to octahedral, tetrahedral and square planar complexes without and with pi-bonding.

UNIT-II

[16 HOURS]

Electronic spectra: Introduction, selection rules and intensities, electronic spectra of octahedral and tetrahedral complexes, Term symbols for d^n ions, Orgel and Tanabe-Sugano diagrams, charge-transfer spectra. Ligand-field transition. Charge transfer and energy applications. Optical rotatory dispersion and Circular dichroism. Magnetic circular dichroism.

Magnetic properties: Introduction, magnetic susceptibility and its measurements, spin and orbital contributions to the magnetic moment, the effects of temperature on μeff, spin-cross over, ferromagnetism, anti-ferromagnetism and ferrimagnetism.

Applications of infrared spectroscopy of coordination compounds: Metal complexes of ammine, nitro, nitrito, hydroxo, carbonato, sulphato, cyano, cyanato and thiocyanato complexes.

UNIT-III

[16 HOURS]

Reactions and Mechanisms: Introduction. Substitution reactions- Inert and labile compounds, mechanisms of substitution. Kinetic consequences of Reaction pathways- Dissociation, interchange and association. Experimental evidence in octahedral substitution- Dissociation, associative mechanisms, the conjugate base mechanism, the kinetic chelate effect.

Stereochemistry of reactions- Substitution in *trans* and its complexes, isomerization of chelate rings. Substitution reactions of square-planar complexes-kinetics and stereochemistry of square-planar substitutions, evidence for associative reactions, explanations of the *trans* effect.

Electron-transfer processes: Inner-sphere mechanism and outer-sphere mechanism, conditions for high and low oxidation numbers.

Photochemistry of coordination compounds: Photochemistry of chromium(III) ammine compounds, Light-induced excited state spin trapping in iron(II) compounds and MLCT photochemistry in pentammineruthenium(II) compounds.

References

1. Physical Inorganic Chemistry- A Coordination Chemistry Approach- S.F.A. Kettle, Spektrum, Oxford, (1996).
2. Inorganic Chemistry-4th edition. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2012).
3. Inorganic Chemistry-5th edition. G.L. Miessler, P. J. Fischer and D.A. Tarr, Pearson (2014).
4. Inorganic Chemistry-6th edition. D.F. Shriver, M. Weller. T. Overton, J. Rourke and F. Armastrong, Oxford University Press (2014).
5. Inorganic Chemistry- 3rd edition, James E. Huheey, Harper and Row Publishers, (1983).
6. Basic Inorganic Chemistry- 3rd edition, F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons, (2002).
7. Infrared and Raman Spectra of Coordination Compounds, Part-B- 6th edition, K. Nakamoto, John Wiley and Sons (2009).

SYNTHETIC ORGANIC CHEMISTRY
COURSE CODE: 21CHB11

Objectives

- To understand the reactions of organic compounds involving various reagents.
- To learn the synthesis and retro-synthesis of different organic compounds.

Course outcome

- Students are familiar about chemistry of oxidants, reductants and their applications in the organic synthesis.
- Understand the various catalysts in organic synthesis by known naming reactions.
- Retro-synthesis and molecular rearrangement.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern method like power point presentation is used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Oxidation: Oxidation with chromium and manganese reagents (CrO_3, $K_2Cr_2O_7$, PCC, PDC, Sarret reagent, MnO_2, $KMnO_4$), peroxides and peracids, periodic acid, OsO_4, SeO_2, NBS, Oppenauer oxidation, Sharpless epoxidation.
Reduction: Catalytic hydrogenation (homogeneous and heterogeneous) – catalysts (Pt, Pd, Ra-C, Ni, Ru, Rh), solvents and reduction of functional groups, catalytic hydrogen transfer reactions. Wilkinson catalyst, $LiAlH_4$, $NaBH_4$, DIBAL-H, Sodium cyanoborohydride, Birch reduction, Leukart reaction (reductive amination), diborane as reducing agent, Meerwein-Ponndorf-Verley reduction, Wolff-Kishner reduction, Clemensen reduction, stannous chloride, Organoboron compounds: Introduction and preparations; Hydroboration and its applications; Reactions of organoboranes: isomerization reactions, oxidation, protonolysis, carbonylation, cyanidation. Reactions with aldehydes or ketones (*E* and *Z*-alkenes).

UNIT-II

[16 HOURS]

Reagents and reactions in organic synthesis: Use of following reagents in organic synthesis and functional group transformations: Lithium diisopropylamide (LDA), Gilmann reagent, dicyclohexyl carbodimide (DCC), dichlorodicyanoquinone (DDQ), Silane reagents-trialkylsilyl halides, trimethylsilyl cyanide, trimethyl silane; phase transfer catalyst, crown ethers, cyclodextrins, Ziegler-Natta catalyst, diazomethane, Woodward and Prevost hydroxylation, Stark enamine reaction, phosphorous ylides - Wittig and related reactions, Sulphur ylides – reactions with aldehydes and ketones, 1,3-dithiane anions - Umpolung reaction, Peterson reaction. Palladium reagents: Suzuki coupling, Heck reaction, Negishi reaction. Green Chemistry: Definition and principles, planning green synthesis in the laboratory, green preparations- aqueous reactions, solid state (solvent free) reactions, photochemical reactions, enzymatic transformations and reactions in ionic liquids.

UNIT-III

[16 HOURS]

Molecular rearrangements: Introduction Carbon to carbon migration: Pinacol-pinacolone, Wagner-Meerwein, Benzidine, benzylic acid, Favorskii, Fries rearrangement, dienophile rearrangement. Carbon to nitrogen migration: Hofmann, Curtius, Lossen, Schmidt and Beckmann rearrangements. Miscellaneous rearrangements: Wittig, Smiles, Bayer-Villeger rearrangement and Barton reaction.

Retrosynthesis: Introduction to disconnection approach: Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X disconnections. Synthons and synthetic equivalents. Retrosynthesis and synthesis of benzofurans, *p*-methoxy acetophenone, saccharine, α-bisabolene, nuciferal, tetralone, ibuprofen; Functional group transformations in organic synthesis: nitro to keto, nitro to amine, acid to alcohol etc.

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Organic Chemistry, Vol-I & II by I. L. Finar.
3. Advance Organic Chemistry, IV edition, Jerry March.
4. Advance Organic Chemistry, III edition, Part-A and Part-B, Francis A. Carey and Rechard J. Sundberg.
5. Organic Chemistry, III edition, V. K. Ahluwalia and Rakesh Kumar Parashar.
6. Organic named reactions and molecular rearrangements, Gudeep Raj.
7. Modern synthetic reactions, II edition, H. O. House.
8. Organic synthesis, Jagadamba Singh and L. D. S. Yadav.
9. Green Chemistry, K. R. Desai.
10. Principles of Organic synthesis, R. O. C. Norman and J. M. Coxon.
11. Organic synthesis II edition, V. K. Aluwalia and Renu Agarwal.
12. Organic synthesis, Robert E. Ireland.
13. Schaum's outline of theory and problems of Organic Chemistry, Harbert Meislich, Howard Nechamkin and Jocob Sharefkin.
14. Organic chemistry by Clayden, Greeves, Warren and Wothers.

PRINCIPLES OF PHYSICAL CHEMISTRY
COURSE CODE: 21CHB12

Objectives

- To understand the theoretical calculations of energies of simple molecules.
- To learn the calculation of different energies by statistical thermodynamics.
- To understand the basics of polymers, their kinetics and applications.

Course Outcome

- Principles of Quantum chemistry and theoretical calculations of energies of molecules and chemical reactions.
- Apply solutions of the Schrödinger equation for simple systems (particle in a box, rigid rotor, harmonic oscillator) to real systems (vibrational, rotational, and electronic energy states) in determining the energy of stationary states.
- Explain angular momentum as possessed by atomic or molecular systems, various descriptions of how angular momentum can be coupled, and how conservation of angular momentum is important to spectroscopy.
- Concepts and applicability of statistical thermodynamics in the calculations of different energies in the reacting system. Applications of phase rule for separation of the metals from ore.
- Fundamentals of polymers and their applications in controlling the quality and waste management of polymer product.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern method like power point presentation is used in class room teaching.
- Assigning the students to solve the problems to understand the concepts.

Course content

UNIT-I

[16 HOURS]

Quantum Chemistry: Introduction to quantum mechanics: Schrödinger wave equation, time-independent and time dependent Schrödinger wave equation and the relation between their solutions. Eigen functions and Eigen values. Physical interpretation of wave function. Concept of operators – Laplacian, Hamiltonian, Linear and Hermitian operators. Angular momentum operators and their properties. Commutative and non-commutative operators. Normalization, orthogonality and orthonormality of wave functions. Postulates of quantum mechanics. Solutions of Schrödinger wave equation for free particles, particle in a ring, particle in three dimensional box. Quantum mechanical degeneracy, tunnelling (no derivation). Wave equation for H-atom, separation and solution of R, ϕ and θ equations. Application of Schrodinger equation to rigid rotator and harmonic oscillator. Eigen functions and Eigen values of angular momentum. Ladder operator method for angular momentum.

UNIT-II

[16 HOURS]

Statistical thermodynamics: Objectives of statistical thermodynamics, concept of distribution, types of ensembles. Thermodynamic probability and most probable distribution law. Partition functions – definition, evaluation of translational, rotational and vibrational and electronic partition functions for monoatomic, diatomic and polyatomic gaseous molecules. Sackur-Tetrode equation for entropy of translation function. Calculation of thermodynamic functions and equilibrium constants in terms of partition functions. Different distribution laws (Types of statistics): Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Statistics (derivation of the three distribution laws). Comparison of Bose-Einstein and Fermi-Dirac Statistics with Maxwell-Boltzmann statistics. Problems and their solutions.
Phase rule studies: Thermodynamic derivation of phase rule. Application of phase rule to the two component systems - compound formation with congruent melting point and incongruent melting points, Roozeboom‘s classification. Application of phase rule to three component systems- systems of three liquids and systems of two salts and water.

UNIT-III

[16 HOURS]

Polymers: Fundamentals of polymers - monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers, Polymerization - condensation, addition, free radical, ionic, co-ordination polymerization and ring opening polymerization. Molecular weight and size, polydispersion. Average molecular weight concepts – number, weight and viscosity average molecular weight. Determination of molecular weights - viscosity method, osmotic pressure method, sedimentation and light scattering methods.
Kinetics of Polymerization - Condensation, addition, free radical, ionic, co-ordination polymerization.
Phase transitions in polymers and thermal characterization: Glass transition, crystallinity and melting- correlation with the polymer structure.
Polymers in solution: Criteria of polymer solubility, thermodynamics of polymer solutions.
Colloids: Types and classification, Micelles: Surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, micellar catalysis.

References

1. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
2. Quantum Chemistry – A.K. Chandra. 2nd edition, Tata McGraw Hill Publishing Co. Ltd., (1983).
3. Quantum Chemistry – Eyring, Walter and Kimball. John Wiley and Sons, Inc., New York.
4. Quantum Chemistry – I.N. Levine. Pearson Education, New Delhi, (2000).
5. Theoretical Chemistry – S. Glasstone. East West Press, New Delhi, (1973).
6. Quantum Chemistry – R.K. Prasad, New Age International Publishers, (1996).
7. Text Book of Polymer Science, F.W. Billmeyer, Jr., John Wiley, London (1994).
8. Polymer Science. V. R. Gowrikar, N.V. Vishwanathan and J. Sreedhar, Wiley Eastern, New Delhi (1990).
9. Fundamentals of Polymer Science and Engineering. A. Kumar and S.K. Gupta, Tata – McGraw Hill New Delhi (1978).
10. Polymer Characterization, D. Campbell and J.R. White, Chapman and Hall, New York.
11. Fundamental Principles of Polymer Materials, R.L. Rosen, John Wiley and Sons, New York.

MOLECULAR SYMMETRY AND SPECTROSCOPY
COURSE CODE: 21CHB13

Objectives

- To understand the concepts of symmetry and symmetry operations and their application to CFT, hybridization, MOT and vibrational spectroscopy.
- To learn the theory and applications of microwave, vibration and Raman spectroscopy.
- To understand the principles and applications of UV-Visible and resonance Raman spectroscopy.

Course outcome

- Molecular symmetry and applications of group theory to CFT, hybridization, MOT and vibrational spectroscopy.
- Theory and principles of Rotation, Vibration and Raman Spectroscopy.
- Theory and principles Electronic and Resonance Raman spectroscopy.

Pedagogy

- Conventional method such as black board and chalk is used.
- Molecular models are used to teach symmetry aspects of molecules
- Modern methods like power point presentation and animations are used in class room teaching.
- Students will be assigned to solve the numerical problems.

Course content

UNIT-I

[16 HOURS]

Molecular symmetry and group theory: Symmetry elements and symmetry operations.

The Point Groups Used with Molecules: Concept of a group, definition of a point group. Classification of molecules into point groups. Subgroups.

Hermann-Maugin symbols for point groups. Multiplication tables ($C_{2}v$, C_{2h} and $C_{3}v$). Matrix notation for the symmetry elements. Classess and similarity transformation.

Representation of groups: The Great Orthogonality theorem and its consequences.

Character tables (C_s, C_i, C_2, C_{2v}, C_{2h} and C_{3v}). Symmetry and dipole moment.

Applications of group theory: Group theory and hybrid orbitals.

Symmetry in Chemical bonding: Group theory to Crystal field theory and Molecular orbital theory (octahedral and tetrahedral complexes).

Symmetry in Vibrational Spectroscopy: Determining the symmetry groups of normal modes for non-linear molecules (H_2O, NH_3, CH_4, trans-N_2F_2) and linear molecules (CO, HCl, HCN and CO_2) (Integration method).

UNIT-II

[16 HOURS]

Microwave spectroscopy: Rotation spectra of diatomic Molecules - rigid and non rigid rotator model. Rotational quantum number and the selection rule. Effect of isotopic substitution on rotation spectra. Classification of polyatomic molecules based on moment of inertia. Rotation spectra of polyatomic molecules (OCS CH_3F and BCl_3). Moment of inertia expression for linear tri-atomic molecules. Applications - Principles of determination of Bond length and moment of inertia from rotational spectra. Stark effect in rotation spectra and determination of dipole moments.

Vibration spectroscopy*:* Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator. Effects of anharmonic oscillation, expressions for fundamental and overtone frequencies. Vibration - rotation spectra of carbon monoxide. Vibration of polyatomic molecules – The number of degrees of freedom of vibration. Parallel and perpendicular vibrations (CO_2 and H_2O). Combination, difference and hot bands. Fermi resonance. Force constant and its significance. Theory of infrared absorption and theoretical group frequency. Intensity of absorption band and types of absorptions. Applications: Structures of small molecules: XY_2 – linear or bent, XY_3 – planar or pyramidal.

Raman spectroscopy: Introduction, Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid. Theories of Raman spectra - classical and quantum theory. Rotation-Raman and vibration-Raman spectra. Raman activity of vibrations, rule of mutual exclusion principle. Vibration modes of some simple molecules and their activity.

UNIT-III

[16 HOURS]

UV Visible spectroscopy: Quantitative aspects of absorption – Beer's law, Technology associated with absorption measurements. Limitations – real, chemical, instrumental and personal. Theory of molecular absorption. Vibration-rotation fine structure of electronic spectra. Types of absorption bands: n to π^*, π to π^*, n to σ^* and σ to σ^*, C-T and ligand field. Instrumentation.

Applications: Qualitative and quantitative analysis of binary mixtures, measurements of dissociation constants of acids and bases, determination of molecular weight. Woodwards empirical rules for predicting the wavelength of maximum absorption for olefins, conjugated dienes, cyclic trienes and polyenes, α,ß-unsaturated aldehydes and ketones, benzene and substituted benzene rings.

Resonance Raman Spectroscopy: Resonance Raman Effect and its applications. Non-linear Raman effects: Hyper, stimulated and inverse Raman effects. Coherent Anti-Stokes Raman Scattering and its applications.

References

1. Chemical Applications of Group Theory, 3rd edition, F.A. Cotton, John Wiley and
2. Sons (2006).
3. Molecular Symmetry and Group Theory – Robert L Carter, John Wiley and Sons (2005).
4. Symmetry in Chemistry - H. Jaffe and M. Orchin, John Wiley, New York (1965).
5. Molecular Symmetry – David J. Willock, John Wiley and Sons Ltd., (2009).
6. Group Theoryand its Chemical Applications - P.K. Bhattacharya, Himalaya Publications, New Delhi (1998).
7. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M. McCash. 4th edition, Tata McGraw Hill, New Delhi.
8. Fundamentals of molecular spectroscopy, G. M. Barrow, MgGraw Hill, New York (International students Edition), 1974.
9. Theoretical chemistry, S. Glasstone, affiliated East-West Press Pvt. Ltd, New Delhi,

1973.
10. Spectroscopy, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 1 and 2, 1976.
11. Vibration Spectroscopy Theory and Applications, D.N. Satyanarayana, New Age International, New Delhi (2004).
12. Spectroscopy, B.P. Straughan and S. Salker, John Wiley and Sons Inc., New York, Vol.2, 1976.
13. Organic Spectroscopy, William Kemp, English Language Book society, Macmillan, 1987.
14. Instrumental methods of analysis, H. H. Willard, L. L. Merritt and J. A. Dean, 7th Edition, 1988.
15. Physical methods in inorganic chemistry, R. S. Drago, affiliated East-West press Pvt. Ltd., (Student Edition) 1978.

SOFT CORE

ANALYTICAL CHEMISTRY PRACTICALS

COURSE CODE: 21CHB50 **[128 HOURS]**

Safety measures in the laboratory; MSDS; reporting of values.

Course Objective

- To understand basic concepts by carrying out analytical experiments.
- The experimental results are subjected to validation of analytical parameters

Course Outcomes

- After studying this course the student to:
- Analyze various samples with different classical and simple instrumental skills.
- Obtain knowledge for selection of analytical methods with suitable technique being adopted for the analysis different samples like, water, laboratory chemicals and reagents, body fluids such as urine etc.
- Distinguish classical and instrumental methods.
- Propose and conduct experiment for quantification of individual analytes

Pedagogy

- Computer aided applications for the evaluation of experimental results.
- Each student performs experiments as per the protocol in practical classes.

PART – I

1. Determination of total acidity of vinegar and wines by acid-base titration.
2. Determination of purity of a commercial boric acid sample, and Na_2CO_3 content of washing soda.
3. Determination of relative equivalent weight of a weak organic acid by titration with NaOH.
4. Determination of ephedrine and aspirin in their tablet preparations by residual acid-base titrimetry.
5. Determination of carbonate and bicarbonate in a mixture by *p*H-metric titration and comparison with visual acid-base titration.

6. Determination of carbonate and hydroxide-analysis of a commercial washing soda by visual and *p*H-titrimetry.
7. Determination of purity of a commercial sample of mercuric oxide by acid-base titration.
8. Determination of benzoic acid in food products by titration with methanolic KOH in chloroform medium using thymol blue as indicator.
9. Determination of the *p*H of hair shampoos and *p*H determination of an unknown soda ash.
10. Analysis of water/ waste water for acidity by visual, *p*H metric and conductometric titrations.
11. Analysis of water/ waste water for alkalinity by visual, *p*H metric and conductometric titrations.
12. Determination of ammonia in house-hold cleaners by visual and conductometric titration.
13. Determination of chromate and dichromate in mixture by acid-base titration: visual and pH metric methods.
14. Potentiometric determination of the equivalent weight and Ka for a pure unknown weak acid.
15. Determination of purity of aniline by non-aqueous acid-base titration by visual and potentiometric methods.
16. Determination of purity of ethylene glycol and glycerol by oxidimetric method using periodate (Malprade reaction).
17. Spectrophotometric determination of creatinine and phosphorus in urine.
18. Flame emission spectrometric determination of sodium, potassium and calcium in river/ lake water.

PART – II

1. Determination of percentage of chloride in a sample by precipitation titration- Mohr, Volhard and Fajan's methods.
2. Determination of silver in an alloy and Na_2CO_3 in soda ash by Volhard method.
3. Mercurimetric determination of chloride in blood or urine.
4. Determination of total hardness, calcium and magnesium hardness and carbonate and bicarbonate hardness of water by complexation titration using EDTA.
5. Determination of calcium in calcium gluconate/ calcium carbonate tablets/ injections and of calcium in milk powder by EDTA titration.
6. Determination of zinc in a sample of foot powder and thallium in a sample of rodenticide by EDTA titration.
7. Analysis of commercial hypochlorite and peroxide solution by iodometric titration.
8. Determination of copper in an ore/ an alloy by iodometry and tin in stibnite by iodimetry.
9. Determination of ascorbic acid in vitamin C tablets by titrations with $KBrO_3$ and of vitamin C in citrus fruit juice by iodimetric titration.
10. Determination of iron in razor blade by visual and potentiometric titration using sodium metavanadate.
11. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate.

12. Determination of nickel in steel by synergic extraction and boron in river water/ sewage using ferroin.
13. Determination of total cation concentration of tap water by ion-exchange chromatography.
14. Determination of magnesium in milk of magnesium tablets by ion-exchange chromatography.
15. Cation exchange chromatographic separation of cadmium and zinc and their estimation by EDTA titration.
16. Gas chromatographic determination of ethanol in beverages.
17. Solvent extraction of zinc and its spectrophotometric determination.
18. Anion exchange chromatographic separation of zinc and magnesium followed by EDTA titration of the metals.
19. Separation and determination of chloride and bromide on an anion exchanger.
20. Separation of *o*- and *p*-nitroaniline and analysis by thin layer chromatography.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Practical Clinical biochemistry methods and interpretations, R. Chawla, J.P. Bothers Medical Publishers (P) Ltd., 1995.
7. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
8. Practical Clinical Biochemistry by Harold Varley and Arnold.Heinmann, 4th edition.

INORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHB51 **[128 HOURS]**

Objectives

- To understand basic concepts by carrying out different experiments.
- To develop the skill for the qualitative and quantitative analysis of various samples.

Course Outcome

- Determination of various analytes presents in different ore samples by volumetric, gravimetric and spectrophotometric methods.
- The chemistry of redox, complexometric and indirect methods
- The principle in the semi-micro analysis of an inorganic salt mixture

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Handling the instrument and pyrolysis for quantitative determination of analyte.

Course experiments

PART – A

1. Determination of iron in haematite using cerium (IV) solution (0.02M) as the titrant, and gravimetric estimation of insoluble residue.
2. Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.
3. Determination of manganese dioxide in pyrolusite using permanganate titration.
4. Quantitative analysis of copper-nickel in alloy/mixture:
   a. Copper volumetrically using KIO_3.
   b. Nickel gravimetrically using DMG
5. Determination of lead and tin in a mixture: Analysis of solder using EDTA titration.
6. Quantitative analysis of chloride and iodide in a mixture:
   a. Iodide volumetrically using KIO_3
   b. Total halide gravimetrically
7. Gravimetric analysis of molybdenum with 8-hydroxyquinoline.
8. Quantitative analysis of copper(II) and iron(II) in a mixture:
   a. Copper gravimetrically as CuSCN and
   b. Iron volumetrically using cerium(IV) solution
9. Spectrophotometric determinations of:
   e. Titanium using hydrogen peroxide
   f. Chromium using diphenyl carbazide in industrial effluents
   g. Iron using thiocyanate/1,10-phenanthroline method in commercial samples
   h. Nickel using dimethylglyoxime in steel solution
10. Micro-titrimetric estimation of :
    c) Iron using cerium(IV)
    d) Calcium and magnesium using EDTA
11. Quantitative estimation of copper (II), calcium (II) and chloride in a mixture.
12. Circular paper chromatographic separation of: (Demonstration)
    c. Iron and nickel
    d. Copper and nickel

PART – B

Semimicro qualitative analysis of inorganic mixtures containing **TWO** anions and **TWO** cations (excluding sodium, potassium and ammonium cations) and **ONE** of the following less common cations: W, Mo, Ce, Ti, Zr, V and Li.

References

1. Vogel's Text Book of Quantitative Chemical Analysis – 5th edition, J. Basset, R.C. Denney, G.H. Jeffery and J. Mendhom.
2. A Text Book of Quantitative Inorganic Analysis by A.I. Vogel, 3rd edition.
3. Spectrophotometric Determination of Elements by Z. Marczenko.
4. Vogel's Qualitative Inorganic Analysis – Svelha.
5. Macro and SemimicroInorganicQualitative Analysis by A.I. Vogel.
6. Semimicro Qualitative Analysis by F.J. Welcher and R.B. Halin.
7. Quantitative Chemical Analysis by Daniel C. Harris, 7th edition, (2006).

ORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHB52 **[128 HOURS]**

Objectives

- To understand synthetic methods by carrying out different experiments.
- To develop the skill for the separation and qualitative analysis of binary mixtures of organic compounds.

Course Outcome

- Students are involved in the multi-step synthesis of different organic compounds.
- Understand the qualitative analysis of binary mixture of organic compounds through separation, identification of functional groups and preparation of solid derivatives.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Experimental setup for the synthesis of organic compounds by every individual.

Course experiments

PART-A

Safety measures in the laboratory; MSDS; reporting of values and demonstration of KingDraw/ ChemDraw

Multistep synthesis

1. Preparation *p*-bromoaniline from acetanilide**.**
2. Preparation of *n*-butyl bromide from *n*-butyl alcohol.
3. Oxidation of cyclohexanol to adipic acid.
4. Esterification: Preparation of benzoccaine from *p*-nitrotoluene.
5. Diazotization (Sandmeyer‘s reaction): Preparation of *p*-chlorobenzoic acid from *p*-toluidine.
6. Preparation benzilic acid from benzoin**.**
7. Preparation of *o*-hydroxy benzophenone from phenyl benzoate *via* Fries rearrangement.
8. Preparation of benzanilide from benzophenone oxime *via* Beckmann rearrangement.
9. Preparation of benzoic acid from benzaldehyde (Cannizzaro Reaction).
10. Preparation of 2,4-dinitrophenylhydrazine from 2,4-dinitrochlorobenzene.
11. Preparation of *m*-nitrobenzoic acid from methylbenzoate.
12. Preparation of chalcone.

PART-B

Qualitative analysis: Separation of binary mixtures, identification of functional groups and preparation of suitable solid derivatives.

References

1. Vogel' text book of practical organic chemistry, V edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatehell.
2. Elementary practical organic chemistry, Part-I: Small scale preparations, Part-II: Qualitative organic analysis, By Arthur I, Vogel.
3. Hand book of organic analysis, H. T. Clarke and Norman Collie.
4. Experiments in Organic Chemistry, Louis F. Fieser.
5. Laboratory manual of Organic Chemistry by B. B. Dey and M. V. Sitaraman.
6. Practical Organic Chemistry by Mann F. G. and Saunders.

PHYSICAL CHEMISTRY PRACTICALS

COURSE CODE: 21CHB53 **[128 HOURS]**

Objectives

- To understand the rate of chemical reactions and factors influencing the reaction rate by carrying out kinetic experiments.
- To understand basic concepts of electrochemistry by carrying out experiments.

Course Outcome

- After the completion of this course, the students can able to develop the experimental skill and theoretical interpretation of experimental results of many physical chemistry experiments of chemical kinetics in solution phase, thermodynamics, electrochemistry and spectrophotometry.
- This helps in academics, research and industries.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- To optimize the reaction conditions for understanding the rate of chemical reactions.

Course experiments

PART - A

1. Study of kinetics of hydrolysis of methyl acetate in presence of two different concentrations of HCl/H_2SO_4 and report the relative catalytic strength.
2. Study of kinetics of reaction between $K_2S_2O_8$ and KI, first order, determination of rate constants at two different temperatures and E_a.
3. To study the kinetics of saponification of ethyl acetate by conductivity method at two different concentrations of NaOH and report the relative catalytic strength.
4. Determination of partial molar volume of salt-water system ($NaCl-H_2O/KCl-H_2O/KNO_3-H_2O$) systems.
5. To study the kinetics of reaction between acetone and iodine - determination of order of reaction with respect to iodine and acetone.
6. Study the kinetics of decomposition of diacetone alcohol by NaOH, determine the catalytic coefficient of the reaction and comparison of strength of alkali.
7. Determination of energy of activation for the bromide-bromate reaction.
8. Kinetics of reaction between sodium formate and iodine and determination of energy of activation.
9. Determination of heat of solution of organic acid (benzoic acid/salicylic acid) by variable temperature method (graphical method).
10. Determination of degree of association of benzoic acid in benzene by distribution method.
11. To determine the eutectic point of a two component system (Naphthalene-*m*-dinitrobenzene system).
12. Analysis of a binary mixture (Gylcerol & Water) by measurement of refractive index.
13. Determination of the molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).

PART – B

1. Conductometric titration of a mixture of HCl and CH_3COOH against NaOH.
2. Conductometric titration of sodium sulphate against barium chloride.
3. pH titration of (a) HCl against NaOH (b) Copper sulphate against NaOH and (c) $CH_3COOH/HCOOH$ against NaOH - determination of K_a.
4. Determination of equivalent conductance of weak electrolyte (CH_3COOH) at infinite

dilution following Kohlrausch law.

5. Determination of dissociation constant and mean ionic activity coefficient of weak acids ($CH_3COOH/HCOOH/ClCH_2COOH$) by conductivity method.
6. Potentiometric titration of KI *vs* $KMnO_4$ solution.
7. Determination of dissociation constant of a weak acid ($CH_3COOH/HCOOH/ClCH_2COOH$) by potentiometric method.
8. Potentiometric titration of a mixture of halides (KCl+KI/KCl+KBr/KBr+KI) against $AgNO_3$.
9. To obtain the absorption spectra of coloured complexes, verification of Beer's law and estimation of metal ions in solution using a spectrophotometer.
10. Potentiometric titration of $K_2Cr_2O_7$ against FAS determination of redox potential and concentration of Fe^{2+} ions.
11. Conductometric titration of oxalic acid against NaOH and NH_4OH.
12. Coulometric titration I_2 vs $Na_2S_2O_3$.
13. Determination of acidic and basic dissociation constant and isoelectric point of an amino acid by pH metric method.
14. Kinetics of photodegradation of indigocarmine (IC) using ZnO/TiO_2 as photocatalyst and study the effect of [ZnO/TiO_2] and [IC] on the rate of photodegradation.

References

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels *et al*.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments – J. Rose.
7. Practical Physical Chemistry – S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
11. Experimental Physical Chemistry – R.C. Das and B. Behera, Tata Mc Graw Hill.

SOFT CORE PAPERS

TITRIMETRIC ANALYSIS

COURSE CODE: 21CHB54

Objective

- To familiarize statistical methods to validate analytical methods.
- To learn sampling techniques and conventional volumetric methods.

Course Outcome

After studying this course the student able to:

- Understand on quantitative and qualitative methods of analysis with relevant equilibrium chemistry.
- Develop the ideas with the fundamental aspects in analytical chemistry.
- Build the interest in students in developing good experimental protocols, and in interpreting

experimental results.

- Gain analytical knowledge for the quantitative analysis of various samples of different origin under titrimetric aspects.
- Learn statistical aspects from which the spirit of assessing the results will be enhanced.
- Learn method development and validation features so that they will become outstanding basement for their career in various industries.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Unit-I

Titrimetric analysis: An overview of titrimetry. Principles of titrimetric analysis. Titration curves. Titrations based on acid-base reactions-titration curves for strong acid and strong base, weak acid and strong base and weak base and strong acid titrations. Selecting and evaluating the end point. Finding the end point by visual indicators, monitoring *p*H and temperature. Quantitative applications – selecting and standardizing a titrant, inorganic analysis-alkalinity, acidity and free CO_2 in water and waste waters, nitrogen, sulphur ammonium salts, nitrates and nitrites, carbonates and bicarbonates. Organic analysis-functional groups like carboxylic acid, sulphonic acid, amine, ester, hydroxyl, carbonyl. Air pollutants like SO_2. Quantitative calculations. Characterization applications-equivalent weights and equilibrium constants.

Acid-base titrations in non-aqueous media: Role of solvent in acid-base titrations, solvent systems, differentiating ability of a solvent, some selected solvents, titrants and standards, titration curves, effect of water, determining the equivalence point, typical applications-determination of carboxylic acids, phenols and amines.

Precipitation titrations: Titration curves, feasibility of precipitation titrations, factors affecting shape - titrant and analyte concentration, completeness of the reaction, titrants and standards, indicators for precipitation titrations involving silver nitrate, the Volhard, the Mohr and the Fajan's methods, typical applications.

[16 HOURS]

UNIT – II

Complexometric titrations: Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA - acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves - completeness of reaction, indicators for EDTA titrations - theory of common indicators, titration methods employing EDTA - direct, back and displacement titrations, indirect determinations, titration of mixtures.

Redox titrations: Balancing redox equations, calculation of the equilibrium constant of redox reactions, calculating titration curves, detection of end point, visual indicators and potentiometric end point detection. Quantitative applications - adjusting the analyte's oxidation state, selecting and standardizing a titrant. Inorganic analysis - chlorine residuals, dissolved oxygen in water, water in non-aqueous solvents. Organic analysis - chemical oxygen demand (COD) in natural and waste waters, titrations of mercaptans and ascorbic acid with $I_3^-$and titration of organic compounds using periodate.

Automatic titrators: Principles and theory of CO_2, sulphate, chloride and Karl Fisher titrators.

[16 HOURS]

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001, John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993,Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders CollegePublishing, California, 1990.
6. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
7. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.

CHEMISTRY OF SELECTED ELEMENTS
COURSE CODE: 21CHB55

Objectives

- To learn basic chemistry of some selected group elements from periodic table.
- To understand properties of metal-metal bonding and cluster compounds.

Course outcome

- Understand the chemistry of hydrogen and group 2 elements.
- The chemistry of pseudohalogens, interhalogens and their halogen compounds.
- The chemistry of xenon and other noble gas compounds.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.Course content

UNIT-I

Compounds of hydrogen: The hydrogen and hydride ions, Dihydrogen and hydrogen bonding. Classes of binary hydrides: Molecular hydrides, saline hydrides and metallic hydrides.

The Group 1 elements: Occurrence, extraction and uses. Simple compounds: Hydrides, halides, oxides, hydroxides, oxoacids, nitrides, solubility and hydration and solutions in liquid ammonia. Coordination and organometallic compounds. Applications.

The Group 2 elements: Occurrence, extraction and uses. General properties. Halides, hydrides and salts of oxo acids. Complex ion in aqueous solution and complexes with amido and alkoxy ligands.

The Group 15 elements: Introduction, oxides and oxoacids of nitrogen and phosphorus.

[16 HOURS]

UNIT-II

The Group 17 elements: Occurrence, recovery and uses. Trends in properties and pseudohalogens. **Interhalogens**: Physical properties and structures, chemical properties, cationic interhalogens. **Compounds with oxygen**: Halogen oxides, oxoacids and oxoanions**.** Trends in rates of redox reactions and redox properties of individual oxidation states**.**

Chemistry of astatine.

The Group 18 elements: Occurrence, recovery and uses. Synthesis and structure of xenon fluorides, Reaction of xenon fluorides, xenon-oxygen compounds, Organoxenon compounds, other compounds of noble gases.

M-M bonds: Multiple metal-metal bonds.

Cluster compounds: carbonyl and carbide clusters.

References

1. Basic Inorganic Chemistry – 3rd edition. F.A. Cotton, G. Wilkinson and P.L. Gaus, John
2. Wiley and Sons (2002).
3. Inorganic Chemistry, 3rd edition. James E. Huheey, Harper and Row Publishers (1983).
4. Inorganic Chemistry, 3rd edition. G.L. Miessler and D.A. Tarr, Pearson Education (2004).
5. Inorganic Chemistry, 4th edition. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2012).
6. Chemistry of the Elements – N.N. Greenwood and A. Earnshaw, Pergamon Press (1985).
7. Inorganic Chemistry, 6th edition. D.F. Shriver, M. Weller. T. Overton, J. Rourke and F.

CHEMISTRY OF NATURAL PRODUCTS-I
COURSE CODE: 21CHB56

Objectives

- To learn the nomenclature, classification, purification, structure and synthesis of some natural products.
- To understand the biological functions of biomolecules.

Course Outcome

- Acquire the knowledge of chemistry of lipids, prostaglandins and terpenoids.
- Understand the biological importance of chlorophyll and porphyrins.
- Chemistry of flavonoids and isoflavonoids.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern method like power point presentation is used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Lipids: Nomenclature, classification, purification, structure and synthesis of fatty acids, phospholipids, sphingolipids. Biological importance of lipids (Lecithin, sphingolipids, oils and fats).

Prostaglandins: Introduction, classification and biological importance of PG‘s. Constitution of PGE1. Synthesis of PGE & F series.

Terpenoids: Introduction, classification and general methods of structural elucidation. Chemistry of pinene, camphor, caryophyllene, santonin. Biosynthesis of terpenoids.

UNIT-II

[16 HOURS]

Porphyrins: Introduction, structure and biological functions of haemin. Vitamin B12: structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.

Flavonoids and Isoflavonoids: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercetin, wedelolactone, Butein, Daidzein. Biosynthesis of flavonoids and isoflavonoids: Acetate Pathway and Shikimic acid Pathway. Biological importance of flavonoids and isoflavonoids

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Organic Chemistry, Vol-II by I. L. Finar.
3. Schaum's outline of theory and problems of Organic Chemistry, Harbert Meislich, Howard Nechamkin and Jocob Sharefkin.
4. Natural products: Their chemistry and biological significance, J. Mann, R. S. Davidson, J. B. Banthorpe and J. B. Harborne.
5. Synthetic drugs, Gurdeep R. Chatwal.
6. Heterocyclic chemistry by Achison.
7. Heterocyclic chemistry by Smith and Joule.
8. Heterocyclic chemistry by Pacquete.

BIOPHYSICAL CHEMISTRY

COURSE CODE: 21CHB57

Objectives

- To understand the physico-chemical principles of biological fluids.
- To learn the pharmacokinetics, pharmacodynamics, toxicokinetics of biological systems.

Course Outcome

- After the completion of this course, the students gain the knowledge on theory and principles of biophysical chemistry and pharmacokinetics.
- This course helps to understanding the bio-availability and different pharmacokinetic parameters of drugs in the living system.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Biophysical Chemistry: Electrophoresis - Principles of free electrophoresis, zone electrophoresis, gel electrophoresis and its applications in qualitative and quantitative study of proteins. Determination of isoelectric point of a protein. Electro-osmosis and streaming potential and its biological significance. Biological significance of Donnan membrane phenomenon. Micelles and its involvement during digestion and absorption of dietary lipids. Diffusion of solutes across bio-membranes and its application in the mechanism of respiratory exchange. –Salting In‖ and –Salting Out‖ of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Effect of temperature and *p*H on the viscosity of bio-molecules (albumin solution). Significance of viscosity in biological systems - mechanism of muscle contraction, polymerization of DNA and nature of blood flow through different vessels. Effect of temperature, solute concentration (amino acids) on surface tension. Biological significance of surface tension - stability of Alveoli in lungs, interfacial tension in living cells (Danielli and Davson model). Application of sedimentation velocity and sedimentation equilibrium method for molecular weight determination of proteins.

UNIT-II

[16 HOURS]

Pharmacokinetics: Introduction, biopharmaceutics, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, toxicokinetics and clinical toxicology. Measurement of drug concentration in blood, plasma or serum. Plasma level-time curve, significance of measuring plasma drug concentrations.

One compartment open model: Intravenous route of administration of drug, elimination rate constant, apparent volume of distribution and significance. Calculation of elimination rate constant from urinary excretion data, clinical application.

Two compartment model: Plasma level-time curve, relationship between tissue and plasma drug concentrations, Apparent volumes of distribution. Drug clearance, clinical example. Plasma level-time curve for a three compartment open model.

Drug absorption: Factors affecting the rate of drug absorption - nature of the cell membrane, Route of drug administration - Oral drug absorption, Intravenous infusion and intravenous solutions, Effect of food on gastrointestinal drug absorption rate.

References

1. Introduction to Physical Organic Chemistry, R.D. Gilliom, Madison – Wesley, USA (1970).
2. Physical Organic Chemistry- Reaction Rate and Equilibrium Mechanism – L.P. Hammett, McGraw HillBook, Co., (1970).
3. Biophysical Chemistry- Principle and Technique – A. Upadhyay, K. Upadhyay and N. Nath, Himalaya Publishing House, Bombay, (1998).
4. Essentials of Physical Chemistry and Pharmacy – H. J. Arnikar, S. S. Kadam, K.N. Gujan, Orient Longman, Bombay, (1992).
5. Applied Biopharmacokinetics and Pharmacokinetics - Leon Shargel, Andrew YuPrentice-Hall International, Inc (4th edition).
6. Essentials of Physical Chemistry and Pharmacy – H.J. Arnikar, S.S. Kadam, K.N. Gujan, Orient Longman, Bombay, (1992).

THIRD SEMESTER

ADVANCED INORGANIC CHEMISTRY
COURSE CODE: 21CHC10

Objectives

- To understand the fundamental concepts of organometallic chemistry and general principles of homogeneous and heterogeneous catalysis.
- To learn the concepts of metal clusters, silicates and silicones.

Course Outcome

- Fundamental concepts of organometallic chemistry and synthesis, structure and bonding in different organometallics and their applications.
- Homogeneous and heterogeneous catalysts and their applications in the synthesis of organic compounds in industries.
- Chemistry of main group elements, metal clusters, silicates and silicones and their applications in day to day life.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Fundamental concepts: Introduction, Classification of organometallic compounds by bond type, nomenclature, the effective atomic number rule, complexes that disobey the EAN rule, common reactions used in complex formation.

Organometallics of transition metals: Preparation, bonding and structures of nickel, cobalt, iron and manganese carbonyls. Preparation and structures of metal nitrosyls.

Ferrocene: Preparation, structure and bonding**. Metal-carbene and metal-carbyne complexes**.

Complexes containing alkene, alkyne, arene and allyl ligands: Preparation, structure and bonding.

UNIT-II

[16 HOURS]

General principles of Catalysis: Language of catalysis. Homogeneous and heterogeneous catalysts.

Homogeneous catalysis - Industrial Applications: Alkene hydrogenation and hydroformylation, The Wacker's process, Monsanto acetic acid process and L-DOPA synthesis, alkene oligomerizations, water-gas shift reactions. The Reppe reaction.

Heterogeneous catalysis –The nature of heterogeneous catalysts. Alkene polymerization: Ziegler-Natta catalysis, Fischer-Tropsch carbon chain growth. New directions in heterogeneous catalysis.

Zeolites as catalysts for organic transformation: Uses of ZSM – 5.

Alkene metathesis, hydroboration, arylation or vinylation of olefins (Heck reaction).

Biological and Medicinal Applications: Organomercury, organoboron, organosilicon and organoarsenic compounds.

UNIT-III

[16 HOURS]

Chemistry of main group elements: Diborane and its reactions, polyhedral boranes(preparation, properties, structure and bonding). Wade's rules, carboranes andmetallocarboranes. Borazines. Phosphazenes, S-N compounds.

Metal clusters: Evidences and factors favoring of M-M bonding, Wade's-Mingo's-Lauherrules, bi, tri, tetra, penta and hexa nuclear metal carbonyl clusters.

Low and high nuclearity carbonyl clusters. Electron counting schemes in carbonyl clusters. The isolobal analogy.

Silicates: Structure, classification - silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional net-work and applications.

Silicones: General methods of preparation, properties. Silicone polymers - silicone fluids, silicone greases, silicone resins, silicone rubbers and their applications.

References

1. Organometallic Chemistry, 2nd edition, R.C. Mehrothra and A. Singh, New Age International Publications (2006).
2. Fundamental Transition Metal Organometallic Chemistry - Charles M. Lukehart, Brooks, Cole Publishing Company (1985).
3. The Organometallic Chemistry of the Transition Metals, 4th edition, Robert H. Crabtree, Wiley Interscience, (2005).
4. Organometallics - A Concise Introdution, 2nd edition, ChistophElschenbroich and Albert Salzer VCH, (1992).
5. Inorganic Chemistry, 2nd edition, C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd., (2005).
6. Inorganic Chemistry- 3rd edition, G.L. Miessler and D.A. Tarr, Pearson Education,(2004).
7. Basic Organometallic Chemistry - B.D. Gupta and A.J. Elias, Universities Press (2010).
8. Inorganic Chemistry Principles of Structure and Reactivity: James E. Huheey, Ellen A.
9. Keiter, Richard L. Keiter, Okhil K. Medhi, Delhi University, New Delhi (2006)
10. Chemistry of the Elements – N.N. Greenwood and A. Earnshaw, Pergamon Press (1985).
11. Inorganic Chemistry, 6th edition. D.F. Shriver, M. Weller. T. Overton, J. Rourke and F. Armastrong, Oxford University Press (2014).
12. Organometallic Chemistry and Catalysis, Didier Astruc, Springer (2007).
13. Transition Metal Organometallic Chemistry, Francois Mathey, Springer (2013).

ORGANOMETALLIC AND PHOTOCHEMISTRY
COURSE CODE: 21CHC11

Objectives

- To understand the fundamental concepts of photochemistry and pericyclic reactions.
- To learn the synthesis and reactions of organometallic compounds.
- To learn the asymmetric synthesis of organic compounds.

Course Outcome

- Basic concepts of photochemistry and pericyclic reactions and their usefulness in the synthesis of many organic compounds.
- Synthesis of organic compounds using different organometallic compounds as catalysts.
- Asymmetric synthesis of organic compounds using chiral compounds.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation is used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Photochemistry: Light absorption and electronic transitions, Jablonski diagram, intersystem crossing, energy transfer, sensitizers, quenchers. Photochemistry of olefins, conjugated dienes, aromatic compounds, ketones-Norrish type-I and Norrish type-II reactions, enones, Paterno-Buchi reaction, di-pi methane rearrangement, photooxidation, photoreduction.

Pericyclic reactions: Electrocyclic reactions: Stereochemistry, symmetry and Woodward-Hofmann rules for electrocyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for butadiene to cyclobutene and hexatriene to cyclohexadiene systems. Cycloaddition reactions: Classification, analysis by FMO and correlation diagram method. Cycloaddition reactions: [2+2] and [4+2] cycloadditions-FMO and correlation diagram method, Deil's-Alder reaction, hetero Diels-Alder reaction and their applications. Intra and intermolecular 1,3-dipolar cycloadditions: involving nitrile oxide, nitrile imine, nitrile ylide and their application in organic synthesis. Sigmatropic reactions: Classification, stereochemistry and mechanisms. suprafacial and antarafacial shifts of H and carbon moieties. [3,3] and [5,5]-sigmatropic rearrangement, Claisen, Cope and aza-Cope rearrangement.

UNIT-II

[16 HOURS]

Chemistry of organometallic compounds: Synthesis and reactions of organolithium (n-BuLi, PhLi), organocadmium, organomagnesium (Grignard reagent), organoselenium and organotellurium. Organoaluminium reagents: Preparation, site selective and stereoselective additions of nucleophiles mediated by organoaluminum reagents, reaction with acid chlorides, allyl vinyl ethers, 1,2-addition to imines and application in the synthesis of natural products. Organocopper reagents: Gilmann reagent, preparation, reactions with aldehydes, ketones and imines. Application in the synthesis of brevicomin, Organozinc reagents: Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic and propargylic zinc reagents, diastereoselective and enantioselective addition reaction with aldehydes, Reformatsky reaction. Organotin reagents: tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction, Stille coupling, Stille-Kelley coupling reactions, Barton McCombie reaction, Keck stereoselective allylation and other applications.

UNIT-III

[16 HOURS]

Asymmetric synthesis: Definition, importance, mechanism, energy consideration, advantages and limitations, methods of determination of enantiomeric excess. Methods of asymmetric induction:

Topocity-Prochirality: Substrate selectivity - Diastereoselectivity and enantioselectivity-Substrate controlled methods-use of chiral substrates - examples

Auxiliary controlled methods: Use of chiral auxiliaries - Chiral enolates-alkylation of chiral imines - Asymmetric Diels - Alder reaction

Reagent controlled methods: Use of chiral reagents - Asymmetric oxidation – Sharpless epoxidation - Asymmetric reduction - Use of lithium aluminium hydride and borate reagents. Synthesis and applications of oxazaborolidines, IPC-BBN, IPC2BH, (*S*)-BINAP-DIAMINE and (*R*)-BINAL-H. Use of (*R,R*)-DIPAMP, (*S,S*)-CHIRAPHOS, (*R,R*)-DIOP, SAMP, RAMP, *S*-Proline, *S*-PBMgCl, (-)-BOAlCl2, (+) and (-)-DET.

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Advance Organic Chemistry, IV edition, Jerry March.
3. Advance Organic Chemistry, III edition, Part-A and Part-B, Francis A. Carey and Rechard J. Sundberg.
4. Organic Chemistry, III edition, V. K. Ahluwalia and Rakesh Kumar Parashar.
5. Schaum's outline of theory and problems of Organic Chemistry, Harbert Meislich, Howard Nechamkin and Jocob Sharefkin.
6. Asymmetric synthesis, Garry Procter.
7. Mechanism in Organic Chemistry, VI edition, Peter Sykes.
8. Molecular reactions and photochemistry, Charles H. Depuy, Orville L. Chopman.
9. Modern methods of Organic synthesis, III edition, W. Carruthers.
10. Organometallics in Organic synthesis, J. M. Swan and D. Stc Black.
11. Organic chemistry by Clayden, Greeves, Warren and Wothers.

ADVANCED PHYSICAL CHEMISTRY
COURSE CODE: 21CHC12

Objectives

- To understand the concepts of enzyme kinetics, industrial catalysis and linear free energy relationship.
- To learn the electrochemical aspects of batteries and electroplating.
- To understand the mechanism of corrosion prevention of metals by different methods.
- To understand the fundamentals of X-ray crystallography.

Course Outcome

- Applications of reaction kinetics help in correlating the rates of biological and chemical reactions.
- Theory and applications of electrochemical systems helps in the field of e-waste management and protection of metals.
- Fundamentals of X-ray crystallography and structural interpretation by various X-ray diffraction techniques.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animation are used in class room teaching.
- Students will be assigned to solve the numerical problems to understand the concepts.

Course content

UNIT-I

[16 HOURS]

Homogeneous Catalysis: Electronic and structural effects on acidity and basicity. Hard and soft acids and bases. Acidity functions: Hammet acidity function, Zucker-Hammet hypothesis, Bonnett hypothesis. Industrial catalysis: Catalyst carrier, promoter, inhibitor and catalyst poison.
Enzyme kinetics: Effect of substrate concentration (Michaelis - Menton equation), Effect of pH, effect of catalysts and inhibitors (substrate, zeolite, Cr^{3+}, Fe^{2+} ZnO, U.V light), effect of temperature. A brief kinetic and mechanistic applications of glucose oxidase in the oxidation of glucose.
Linear Free Energy Relationship: Hammett equation, Taft equation, Okemoto Brown equation and its application to oxidation of amino acids and aromatic amines. Swain-Scott and Edward equation. Winstein - Grunwald relationship. Isokinetic relationship and significance of isokinetic temperature, Exner criterion.
Kinetic Isotope Effect: Theory of kinetic isotope effect - normal and inverse isotope effect, primary isotope effect, secondary isotope effect, solvent isotope effect.

UNIT-II

[16 HOURS]

Electrochemical cells and batteries: Introduction, galvanic and electrolytic cells, schematic representation of cells. Faradays's law, mass transfer in cells. Batteries: Classification, characteristics, primary, secondary and lithium batteries, fuel cells.
Electroplating: Definition, theory and mechanism of electroplating, effect of plating variables on the properties of electro deposits, comparative account of complexing and non-complexing baths (general treatment), additives on plating baths and their significance.
Metallic coating: Preparation of substrate surface, electroplating of Cu and Cr. Application of

Au and Ag plating.
Corrosion: Types of corrosion, basis of electrochemical corrosion, theories and mechanism of wet corrosion. Thermodynamic aspects of corrosion. Current – potential relations (Evan diagram) in corrosion cells. Factors influencing the rate of corrosion: Metal and environmental factors. Kinetic aspects corrosion: Corrosion rate measurement by different methods – chemical and electrochemical methods. General aspects of corrosion prevention and control – designing aspects, effect of allying and surface modification. Corrosion prevention by painting, phosphating and anodic (passivation) and cathodic protection. Corrosion inhibitors: Introduction, classification, Characteristics and requirements of efficient corrosion inhibitors, Green inhibitors and their significance, Corrosion inhibition mechanism.

UNIT-III

[16 HOURS]

Fundamentals of X-ray crystallography: Law of interfacial angles, laws of symmetry, Miller indices, Bragg equation (No derivation), Experimental methods – powder and rotating crystal methods, indexing of powder and rotating crystal photographs. Atomic scattering factor, structure factor, Fourier synthesis and electron density diagrams. Electron diffraction of gases, experimental technique, Scattering-Intensity curves, Wierl equation (no derivation), Radial distribution method determination of bond lengths and bond angles.
Imperfections in atomic packing: Types of imperfections, classification of imperfections, point defects, Schottky defects, Frenkel defects, disordered crystals, line defects, dislocation types, plane defects, small-angle and large-angle boundaries, stacking faults, crystal growth and twinning, non-stoichiometry.

Imperfections and physical properties: electrical, optical, magnetic, thermal and mechanical properties.

References

1. Chemical Kinetics by K.J. Laidler, Tata McGraw-Hill Pub, Co Ltd, New Delhi.
2. Fundamentals of Chemical Kinetics, M. R. Wright, Harwood publishing, Chichesrer, 1999.
3. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose, Macmillan, New Delhi.
4. Electrochemistry –Principles and Applications by E.G. Potter, Cleaver-Hume press Ltd, London.
5. Chemical and Electrochemical energy systems, R. Narayan and B. Viswanathan (University Press), 1998.
6. Industrial Electrochemistry, D. Pletcher and F. C. Walsh, Chapman and Hall, 2^{nd} Edn, 1984.
7. An Introduction to Metallic Corrosion and its Prevention, Raj Narayan (Oxford –IBH, New Delhi), 1983.
8. Fundamentals of metallic corrosion, Philips A. Schweitzer, CRC press Taylor and Francis group, New York.
9. Corrosion prevention and control, Baldev Raj, U Kamachi Mudali & S. Rangarajan, Narora Publishing House, India.
10. Solid State Chemistry and its applications – A.R. West, John Wiley & Sons.
11. New Directions in Solid State Chemistry – CNR Rao and J. Gopalakrishna, Cambridge University Press.
12. Solid state chemistry, N. B. Hannay, PHI, New Delhi.
13. Principles of the Solid State – H.V. Keer, Wiley Eastern.

CHEMICAL SPECTROSCOPY
COURSE CODE: 21CHC13

Objectives

- To understand the basic concepts of spectroscopic techniques such as NMR, ESR, NQR, Mossbauer and photoelectron spectroscopy.
- To familiarize with the IR and mass spectroscopy.

Course Outcome

- Understand the spectroscopic techniques such as NMR, IR, UV, and MS for recording and interpretation of spectra.
- Understand the characterization of chemical compounds.
- To learn electric and magnetic properties of radiation, molecules and bulk matter and solve the problems related to these properties.
- Understanding various fragmentation reactions of organic molecules.
- Predict the NMR, IR, UV, and MS spectra from a given molecular structure, including fragment-ions in MS.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animation are used in class room teaching.
- Students will be assigned to solve the spectroscopic problems to understand the interpretation of spectra.

Course content

UNIT-I

[16 HOURS]

NMR Spectroscopy: Magnetic properties of nuclei (magnetic moment, g factor, nuclear spin), effect of external magnetic field on spinning nuclei, Larmor precession frequency, resonance conditions, population of nuclear magnetic energy levels, relaxation processes, relaxation time, line width and other factors affecting line width. Chemical Shift: Standards employed in NMR, factors influencing chemical shift: electronegativity, shielding and deshielding, van der Walls deshielding magnetic anisotropy, H-bonding, diamagnetic and paramagnetic anisotropies, spin-spin coupling, chemical shift values and correlation for protons bonded to carbon and other nuclei, Instrumentation. Chemical shift equivalence and magnetic equivalence, effects of chiral centre, Karplus curve-variation of coupling constants with dihedral angle. Complex NMR Spectra: Simplification of complex spectra-isotopic substitution, increased magnetic field strength, double resonance and lanthanide shift reagents, Nuclear Overhauser Effect (NOE), FT-NMR Spectroscopy and advantages. ^{13}C-NMR Spectroscopy: multiplicity-Proton decoupling-Off resonance decoupling; Chemical shift, application of ^{13}C, ^{19}F, ^{31}P, ^{11}B and ^{15}N. Applications of NMR: Structural diagnosis, conformational analysis, keto-enol tautomerism, H-bonding. Solid state NMR and its applications.

Multiple resonance spectroscopy: Introduction to 2D-techniques: DEPT, COSY and NOESY.

UNIT-II

[16 HOURS]

Electron Spin Resonance Spectroscopy: Basic principles, hyperfine couplings, the g values, factors affecting g values, isotropic and anisotropic hyperfine coupling constants, Zero

Field splitting and Kramer's degeneracy. Measurement techniques and applications to simple inorganic and organic free radicals and to inorganic complexes.

NQR Spectroscopy: Introduction, Principles, Quadrupolar nuclei, electric field gradient, nuclear quadrupole coupling constants, energies of quadrupolar transitions, effect of magnetic field. Applications.

Mössbauer spectroscopy: The Mössbauer effect, chemical isomer shifts, quadrupole interactions, magnetic splitting, measurement techniques and spectrum display, application to the study of $Fe^{2+}$and Fe $^{3+}$compounds; iron in very high oxidation states-Fe(V) and Fe(VI) nitride complexes; $Sn^{2+}$and Sn^{4+}compounds, nature of M-L bond, coordination number and structure, detection of oxidation states and an inter halogen compound $I_2Br_2Cl_4$.

Photoelectron Spectroscopy: Introduction, principles, chemical shifts, photoelectron spectra of simple molecules. X-ray photoelectron and Auger electron spectroscopy- Principles and applications.

UNIT-III

[16 HOURS]

IR spectroscopy: Introduction, instrumentation, sample handling, Characteristic group frequencies and skeletal frequencies. Finger print region, Correlation chart. Identification of functional groups-alkanes, alkenes, alkynes, aromatics, carbonyl compounds (aldehydes, ketones, esters and lactones), halogen compounds, sulphur and phosphorous compounds, alcohols, amides, lactums, amino acids and amines, Factors affecting group frequencies and band shapes: conjugation, resonance and inductance, hydrogen bonding and ring strain. tautomerism, *Cis-trans* isomerism. Applications of IR spectroscopy.

Mass Spectrometry: Basic principles, Instrumentation-Mass spectrometer, interpretation of mass spectra, resolution, molecular ions, meta-stable ions, Nitrogen rule and isotope ions. Different methods of ionization (chemical ionization, electron impact, field ionization-FAB and MALDI). Fragmentation processes-representation of fragmentation, basic fragmentation types and rules. Factors influencing fragmentations and reaction pathways. McLafferty rearrangement. Fragmentations (fragmentation of organic compounds with respect to their structure determination) associated with functional groups-alkanes, alkenes, cycloalkanes, aromatic hydrocarbons, halides, alcohols, phenols, ethers, acetals, ketals, aldehydes, ketones, quinines, carboxylic acids, esters, amides, acid chlorides, nitro compounds, amines & nitrogen heterocycles. Fragmentation patterns of glucose, myrcene, nicotine, retro Diels-Alder fragmentation. Composite problems involving the applications of UV, IR, ^{1}H and ^{13}C-NMR and mass spectroscopic techniques for the structural elucidation of organic compounds.

References

1. Organic Spectroscopy-3rd Ed.-W. Kemp (Pagrave Publishers, New York), 1991.
2. Spectrometric Identification of Organic Compounds - Silverstein, Bassler & Monnill (Wiley) 1981.
3. Spectroscopy of Organic Compounds-3rd Ed.-P.S. Kalsi (New Age, New Delhi) 2000.
4. E.A.V. Ebsworth, D.W.H. Ranklin and S. Cradock: Structural Methods in Inorganic Chemistry, Blackwell Scientific, 1991.
5. J. A. Iggo: NMR Spectroscopy in Inorganic Chemistry, Oxford University Press, 1999.
6. C. N. R. Rao and J. R. Ferraro: Spectroscopy in Inorganic Chemistry, Vol I & II (Academic) 1970.
7. Spectroscopy, B. P. Straughan and S. Salker, John Wiley and Sons Inc., New York, Vol.2, 1976.
8. Application of Absorption Spectroscopy of Organic Compounds, John R. Dyer, Prentice/Hall of India Private Limited, New Delhi, 1974.
9. Organic Spectroscopy, V. R. Dani, Tata McGraw-Hall Publishing Company Limited, New Delhi. 1995.

10. Interpretation of Carbon-13 NMR Spectra, F.W. Wehrli and T. Wirthin, Heyden, London, 1976.
11. NMR spectroscopy-Powai

SOFT CORE

ANALYTICAL CHEMISTRY PRACTICALS

COURSE CODE: 21CHC50 **[64 HOURS]**

Objectives

- To familiarize with the handling of instruments in the quantitative analysis of various samples.
- To understand the analysis of real samples like waste water, soil samples and biological samples and mixtures

Course Outcomes

After studying this course, the student to:

- Get experience on analysis of various complex mixtures by following multistep reactions.
- Acquire the knowledge on handling instruments and to overcome the general problems arises during the analysis.
- Acquire industrial skills required for sampling, analytical and interpretation and presentation of results.
- Possess adequate knowledge on literature search for developed analytical methods.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Computer aided applications are used for the evaluation of experimental results.

[128 HOURS]

PART – III

1. Determination of calcium in limestone by redox, acid-base and complexation titrations.
2. Determination of vitamin C in orange juice by titration with cerium(IV) and with 2,6-dichlorophenol indophenol.
3. Determination of mercury in an algaecide by EDTA titration; and arsenic in ant control preparation by redox titration.
4. Determination of aluminium and magnesium in antacids by EDTA titration.
5. Analysis of a copper-nickel alloy sample for copper and nickel by EDTA titration using masking and selective demasking reactions.
6. Determination of saccharin in tablets by precipitation titration.
7. Determination of iodine value and saponification value of edible oils.
8. Determination of ascorbic acid in goose berry/bitter gourd by titrimetry and spectrophotometry using *N*-bromosuccinimide (NBS).
9. Analysis of a mixture of iron(II) and iron(III) by EDTA titration using *p*H control.

10. Determination of sulpha drugs by potentiometry using $NaNO_2$ and iodometric assay of penicillin.
11. Solvent extraction method for determination of silver as ion-associate with 1,10-phenanthroline and bromopyragallol red.
12. Electrolytic determination of copper and lead in brass.
13. Polarographic determination of copper and zinc in brass.
14. Determination of sodium, potassium and calcium in mineral waters by atomic emission spectrometry.
15. Determination of iron in mustard seeds and phosphorus in peas by spectrophotometry.
16. Analysis of waste water for anionic detergents and phenol by spectrophotometry.
17. Fluorimetric determination of riboflavin (vit.B_2) in tablets.
18. Colorimetric analysis of procaine by diazotization and coupling reaction.
19. Determination of manganese in steel by extraction-free spectrophotometry and molybdenum in steel by extractive spectrophotometry.
20. Determination of ethanol in wine by titrimetric and spectrophotometric dichromate methods

PART – IV

1. Analysis of waste waters for DO and COD by titrimetry.
2. Analysis of a ground water sample for sulphate by titrimetry (EDTA) and turbidimetry.
3. Potentiometric determination of formula and stability constant of a silver-ammonia complex ion.
4. Determination of aspirin, phenacetin and caffeine in mixture and APC tablets by solvent extraction and UV spectrophotometry.
5. Kinetic determination of urinary creatinine and purity of a commercial H_2O_2 sample.
6. Determination of chromium(III) and iron(III) in a mixture by kinetic masking methods.
7. Catalytic determination of traces of selenium in biological materials and iodide in blood serum.
8. Photometric and potentiometric titration of iron(III) with EDTA.
9. Photometric and potentiometric titration of copper with EDTA.
10. Determination of copper(II) and iron(III) in mixture by photometric titration with EDTA.
11. Analysis of brackish water for chloride content by a) spectrophotometry (mercuric thiocyanate method), b) conductometry (silver nitrate) and c) potentiometry (silver nitrate).
12. Conductometric titration of sodium acetate with HCl and NH_4Cl with NaOH.
13. Ascorbic acid determination in natural orange juice by coulometry.
14. Spectrophotometric determination of iron in natural waters using thiocyanate and 1,10-phenanthroline as reagents.
15. Determination of fluoride in drinking water/ground water by spectrophotometry(alizarin red lake method).
16. Analysis of waste water for
    a) Phosphate by molybdenum blue method

b) ammonia-nitrogen by Nessler's method

c) nitrite-nitrogen by NEDA method

15. Analysis of a soil sample for

    a) Calcium carbonate and organic carbon by titrimetry.

    b) Calcium and magnesium by EDTA titration.

16. Analysis of a soil sample for

    a) Nitrogen content by Kjeldahl method

    b) Available phosphorus by spectrophotometry.

    c) Nitrate-nitrogen/nitrite nitrogen/ammonia nitrogen by spectrophotometry.

    d) Sodium and potassium by flame photometry.

17. Analysis of urine for

    a) Urea and uric acid by titrimetrysnd spectrophotometry.

    b) Sulphate by precipitation titration after ion-exchange separation.

    c) Sugar by Benedict's reagent.

18. Analysis of blood for

    a) cholesterol by spectrophotometry

    b) Bicarbonate by acid-base titration.

19. Fluorimetric determination of quinine in an antimalarial tablet.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8thedition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001 John Wiley & Sons, Inc. India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003 Pearson EducationPvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders CollegePublishing, California, 1990.
6. Quantitative Analysis of Drugs in Pharmaceutical Formulations, P. D. Sethi, 3rdedition, CBS Publishers & Distributors, New Delhi, 1997.
7. Practical Clinical biochemistry methods and interpretations, R. Chawla, J.P. BothersMedical Publishers (P) Ltd., 1995.
8. Laboratory Manual in Biochemistry, J. Jayaraman, New Age International Publishers,New Delhi, 1981.
9. Experiments on Water Pollution, D.I.Williams and D. Anglesia, Wayland Publishers Ltd., England, 1978.
10. Experiments on Land Pollution, D.I. Williams and D. Anglesia, Wayland PublishersLtd., England, 1978.

15. Experiments in Environmental Chemistry, P.D. Vowler and D.W. Counel, PergamonPress,Oxford 1980.

16. Manual Soil Laboratory Testing, vol.I, K.H. Head, Pentech Press, London 1980.

INORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHC51 **[64 HOURS]**

Objectives

- To familiarize with the instrumental methods of analysis for determining metals present in the different samples.
- To familiarize with the preparation and characterization of different inorganic complexes.

Course Outcome

- Determination of alloy samples and understanding the electrochemical deposition of metals.
- Preparation and characterization of coordination compounds.
- Determination of composition, stability constant and magnetic susceptibility of metal complexes.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Spectroscopic tools are applied for the characterization of the synthesized complexes.

Course experiments

PART-A

1. Determination of bismuth, cadmium and lead in a mixture: Analysis of a low melting alloy (Wood's alloy).
2. Simultaneous spectrophotometric determination of chromium and manganese in a steel solution.
3. Determination of chromium(III) and iron(III) in a mixture: Kinetic masking method.
4. Electrogravimetric determination of:
   a) Copper in copper sulphate
   b) Nickel in nickel suphate
   c) Copper and nickel in alloy solution
   d) Lead in lead nitrate.
5. Flame photometric determination of the following metal ions from different samples:
   a) sodium b) potassium and c) sodium and potassium in a mixture.
6. Polarographic estimation of cadmium and zinc.
7. Determination of iron as the 8-hydroxyquinolate by solvent extraction method.
8. Quantitative determination of nickel using dithizone and 1,10-phenanthroline by synergistic extraction.
9. Spectrophotometric determination of the *p*Ka value of methyl red.
10. Semimicro gravimetric determination of aluminium.

PART-B

1. Preparation and characterization of:
   a) Chloropentammine cobalt(III) chloride
   b) Estimation of chloride in a complex by potentiometric or ion-exchange method

c) Record the electronic absorption spectrum of a complex and verify TanabeSugano diagram.

2. Preparation of *cis*- and *trans*- dichlorobis(ethylenediammine) cobalt(III)chloride. Record the UV-Vis spectra and compare it with *cis*-form. Measure the molar conductance.
3. Preparation of hexammine cobalt(III) chloride and estimate cobalt ion.
4. Determination of magnetic susceptibility of any two compounds/complexes by Gouy method.
5. Determination of the composition of iron-phenanthroline complex by:
   (a) Job's method
   (b) mole-ratio method and
   (c) Slope-ratio method.
6. Determine the stability constant of iron-tiron/iron-phenanthroline by Turner-Anderson method.
7. Preparation of potassium tris(oxalato)ferrate(III) and estimate the metal ion.
8. Preparation of acetyl acetonatomanganese(III) complex.
9. Preparation of tris(en)nickel(II) chloride and hexamine nickel(II) chloride complexes. Record electronic spectra and evaluate spectrochemical series.
10. Using chloropentammine cobalt(III) chloride, prepare nitro and nitritopentammine cobalt(III) chloride. Record the IR spectra of the isomers and interpret.
11. Estimate the chloride ion in a given complex by silver nitrate titration after ion-exchange separation.
12. Demonstration Experiments:
    (a) Recording and interpretation of IR and NMR spectra of complexes.
    (b) Spectrochemical series- Evaluation of Dq value.
    (c) DNA interaction with metal complexes by UV-visible absorption and viscosity methods.

References

1. Advanced Physico-Chemical Experiments – J. Rose.
2. Instrumental Analysis Manual - Modern Experiments for Laboratory – G.G. Guilbault and L.G. Hargis.
3. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, 5th edition.
4. Experimental Inorganic Chemistry – G. Palmer.
5. Inorganic Synthesis – O. Glemser.
6. Experimental Inorganic/Physical Chemistry- Mounir A. Malati.
7. Quantitative Chemical Analysis – Daniel C. Harris, (2006) 7th edition.
8. Spectrophotometric Determination of Elements – Z. Marczenko

ORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHC52 [64 HOURS]

Objectives

- To understand the concepts of isolation and purification of natural products.
- To familiarize with the estimation of different functional groups in organic compounds.

Course Outcome

- The isolation of caffeine, carotene, lycopene, cincole, azelaic acid and piperine from respective natural sources.
- Estimation of ketones, sugars, nitro and amino groups in natural products.
- Interpret UV, IR, NMR and MS data of different organic compounds.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Spectroscopic tools are applied for the characterization of isolated natural products.

Course experiments

PART-A

1. Fractional crystallization: separation of mixture of naphthalene and biphenyl.
2. Thin layer chromatography: Separation of plant pigments.
3. Column chromatography: Separation of *o*- and *p*-nitro aniline
4. Isolation of piperine from pepper.
5. Isolation of caffeine from tea.
6. Isolation of azelaic acid from castor oil.
7. Isolation of carotene from carrot.
8. Isolation of lycopene from tomato.
9. Isolation of cincole from eucalyptus leaves.

PART-B

Isolation of natural products & estimations:

1. Estimation of ketones by haloform reaction.
2. Estimation of sugars by Bertrand's method.
3. Estimation of nitro groups.
4. Estimation of amino group.
5. Determination of enol content by Meyer's method.
6. Determination of iodine value of an oil or fat.
7. Determination of saponification value of oil.
8. Determination of equivalent weight of carboxylic acid by silver salt method

Interpretation of Spectra: Structural elucidation of some simple organic compounds by UV, IR, NMR and mass. Spectra have to be provided by the Teachers/ Examiners.

References

1. Vogel' text book of practical organic chemistry, V edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatehell.
2. Elementary practical organic chemistry, Part-III: Quantitative organic analysis, By Arthur I, Vogel.
3. Laboratory manual of Organic Chemistry by B. B. Dey and M. V. Sitaraman.
4. Practical Organic Chemistry by Mann F. G. and Saunders.
5. Natural products: A laboratory guide by Raphael Ikhan.

PHYSICAL CHEMISTRY PRACTICALS

Objectives **COURSE CODE: 21CHC53** **[64 HOURS]**

- To understand the significance of various factors influencing the reaction rate in proposing the reaction mechanism.
- To understand electrochemical and spectrophotometric methods of quantification of samples, and also determination of physico-chemical parameters of some important samples.

Course Outcome

- Students can able to develop experimental skill and interpretation of plausible mechanisms of reactions.
- Gain practical knowledge on the theoretical basis of electrochemistry, thermodynamics, and spectrophotometry experiments.
- This helps in academics, research and industries.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Electrochemical and spectrophotometric tools are used to conduct the experiments.

Course experiments

PART-A

1. Determination of order of reaction for the acid hydrolysis of methyl acetate and evaluation of activation parameters.
2. Evaluation of Arrhenius parameters for the reaction between $K_2S_2O_8$ and KI (First order reaction).
3. Study of kinetics of autocatalytic reaction between oxalic acid and $KMnO_4$ and determine the order of reaction with respect to $KMnO_4$.
4. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (using CH_3OH).
5. Study of effect of salt (ionic strength) on the kinetics of reaction between potassium persulphate and potassium iodide (second order reaction).
6. Spectrophotometric kinetics of oxidation of indigocarmine (IC) by chloramine-T (CAT) – Determination of order of reaction with respect to [CAT] and [IC].
7. To study the acid catalysed kinetics of oxidation of glycine by chloramine-T (CAT) - determination of order of reaction with respect to [CAT] and [glycine].
8. Study the phase diagram of three component system (Glacial acetic acid-Chloroform-water system / Glacial acetic acid-Acetone-Water system).
9. Study the rate of corrosion and inhibition efficiency of an inhibitor (thiourea) on mild steel/Al/Cu by weight loss method.

PART-B

1. Conductometric titration of orthophosphoric acid against NaOH.
2. Conductometric titration of a mixture of HCl, CH_3COOH and $CuSO_4$ against NaOH.
3. Conductometric titration of thorium nitrate with potassium tartarate.
4. Potentiometric titration of mixture of weak acids (acetic acid and monochloroacetic acid) against NaOH.
5. Dwtermination of pK_a values of phosphoric acid by potentiometric / pH metric method.

6. Potentiometric titration of mixture of KCl+KBr+KI against $AgNO_3$.
7. Potentiometric titration of FAS against ceric sulphate and sodium metavenadate, determine the concentration of FAS and redox potential.
8. Potentiometric titration of lead nitrate against EDTA and determine the concentration of lead nitrate solution.
9. Determination of *p*K value of an indicator (methyl orange/methyl red).
10. Spectrophotometric analysis of a mixture of (a) $KMnO_4$ and $K_2Cr_2O_7$.
11. Study of complex formation between ferric salt and salicylic acid.

References

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels *et al*.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments – J. Rose.
7. Practical Physical Chemistry – S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
11. Experimental Physical Chemistry – R.C. Das and B. Behera, Tata Mc Graw Hill.

SOFT CORE
KINETIC AND RADIOCHEMICAL METHODS OF ANALYSIS

COURSE CODE: 21CHC54

Objectives

- To learn aspects of kinetic and radiochemical methods for analysis
- To understand the knowledge of applied aspects of recent needs by simple techniques

Course Outcome

- To understand the reaction kinetics
- To gain the principles of radiochemical methods
- To understand the applicability of radiometric assays

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and information and communications technology are used in class room teaching.
- Students will be assigned to solve the numerical problems to understand electrochemical concepts.

Course Content

Unit-I **[16 HOURS]**

Kinetic methods of analysis: Analytical uses of reaction rates relative, basis of reaction rate methods, rate laws-first and second order reactions relative rates of reactions, analytical utilityof first or pseudo first order reactions, determination of reaction rates, types of kinetic methods– differential methods, integral methods, multicomponent analysis-neglect of reaction of slow- reacting component, logarithmic extrapolation method, reaction rate method, applications- catalyzed reactions, measurement methods for catalyzed reactions, micro determination of inorganic species like iodide, selenium, cobalt & mercury in complex materials, determination of organic species, non-catalytic reactions. Applications of enzyme-catalysed reactions for the analysis of substratesstoichiometric and rate methods, determination of urea, uric acid, blood glucose, galactose and blood alcohol, determination of enzymes-LDH, GOT and GPT. A brief outline of IR, UV, NMR, Mass spectroscopy as tools for kineticstudy.

UNIT – II **[16 HOURS]**

Radiometric methods: Radioactive isotopes. Nuclear emissions-αandβ-particles, neutrons, gamma rays and miscellaneous nuclear particles. Nuclear reactions, radiochemical decay and activity. Instrumentation and measurement of radioactivity. Radiation detectors-gas ionization, scintillation and semiconductor detectors. Pulse height analysis. Autoradiography. Statistics of radioactive measurements.

Radiochemical analysis: **Neutron activation methods**-neutrons and their sources. Interaction of neutrons with matter. Theory, experimental considerations and applications.

Isotope dilution methods-direct isotope dilution and inverse isotope dilution methods and their applications. Radiometric titrations. Radiorelease methods. Radioactive tracers.

Radio immunoassay: Principles of immunoassay. Specificity of immuno assays. Preparation of the antibody, incubation period for the assay, separation of the bound and free antigen. Fluorescence immunoassay. Enzyme immunoassay.

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001 John Wiley & Sons, Inc. India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders CollegePublishing, California, 1990.
6. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean,7th edition, (1988).
7. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
8. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.

9. Introduction to Instrumental Analysis, Braun, Pharm. Med. Press. India.
10. Instrumental Method of Analysis, W. M. Dean and Settle, 7th edition, 1986, CBS Publishers, New Delhi.
11. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva books Pvt. Ltd., 2002.
12. Soil Chemical Analysis, M.L. Jackson, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.
13. Clinical Chemistry, Principles and Procedures, J.S. Annino, 2nd edition, Boston: Little, Brown, 1960.
14. Methods of Geochemical Analysis, D. Click, Ed., A Multivolume series, NewYork, Interscience.
15. Clinical Chemistry, Principles and Techniques, R.J. Henry, D.C. Cannon and J.W. Winkleman, Eds., 2nd edition,Hagerstorm, M.D: Harper and Row, 1974.
16. Fundamentals of Clinical Chemistry, N.W. Tietz, Ed., 2nd edition, Philaddphia: W.B. Saunders, 1976.

FRONTIERS IN INORGANIC CHEMISTRY

COURSE CODE: 21CHC55

Objectives

- To understand the basic concepts, synthesis and applications of materials.
- To learn the properties, fabrication and characterization of nanomaterials.

Course Outcome

- Gain knowledge on design and synthesis of new inorganic materials.
- Fabrication and characterization of nanomaterials.
- Applications of ceramics, pigments, silicates and biomaterials.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Materials chemistry: Historical Perspectives. Design of new materials through a Critical Thinking Approach. Materials sustainability.
Synthesis of materials: The formation of bulk material by different methods.
Defects and ion transport: Extended defects. Atom and ion diffusion. Solid electrolytes.
Metal oxides, nitrides and fluorides: Monoxides of the 3d metals, higher oxides and complex oxides, oxide glasses, nitrides and fluorides.
Sulfides, intercalation compounds and metal rich phases: Layered MS2 compounds and intercalation, Chevrel phases.
Ceramic materials: Sol-gel process and applications of biomaterials of ceramics.
Inorganic pigments: Coloured pigments, white and black inorganic materials.
Molecular materials and fullerides: Fullerides, Molecular material chemistry.
Silicates: Structure, classification - silicates with discrete anions, silicates containing chain anion, silicates with layer structure, silicones with three dimensional net work and applications.

UNIT-II

Nanomaterials-Introduction. **[16 HOURS]**

Fundamentals-Terminology and history.

Characterization and fabrication: Top-down and bottom-up fabrication. Solution based synthesis of nanoparticles. Vapour-phase synthesis of nanoparticles. Templated synthesis of nanomaterials using frameworks, supports and substrates. Sonochemical microwave methods for the synthesis of nanoparticles.

Structural study of nanocomposites by different methods.

Nanostructures and properties

One-dimensional control: carbon nanotubes and inorganic nanowires.

Two-dimensional control: grapheme, quantum wells and solid-state super lattices.

Three-dimensional control: mesoporous materials and composites.

Some applications of inorganic/organic/polymeric materials: Optical, electrical, magnetic, and chemical and biosensors.

References

1. Inorganic Chemistry, 4th edition. P. Atkins, T. Overton, J. Rourke, M. Weller and F. Armstrong, Oxford University Press (2006).
2. Inorganic Chemistry Principles of Structure and Reactivity: James E. Huheey, Ellen A. Keiter, Richard L. Keiter, Okhil K. Medhi, Delhi University, New Delhi (2006).
3. Chemistry of the Elements – N.N. Greenwood and A. Earnshaw, Pergamon Press (1985).
4. Industrial Inorganic Chemistry – 2nd edition. K.H. Buchel, H.H. Moretto and P. Woditsh, Wiley - VCH (2000).
5. Basic Inorganic Chemistry – 3rd edition. F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons (2002).
6. Inorganic Chemistry, 3rd edition. James E. Huheey, Harper and Row Publishers (1983).
7. Inorganic Chemistry, 3rd edition. G.L. Miessler and D.A. Tarr, Pearson Education (2004).
8. Inorganic Chemistry, 2nd edition. C.E. Housecroft and A.G. Sharpe, Pearson Education.

CHEMISTRY OF NATURAL PRODUCTS-II
COURSE CODE: 21CHC56

Objectives

- To familiarize with the chemical concepts of alkaloids and steroids.
- To learn the structural elucidation and biological importance of alkaloids and steroids.

Course Outcome

- Chemistry of alkaloids and their biological significances.
- Synthesis and characterization of several alkaloids and steroids.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Alkaloids: Introduction, classification, isolation and general methods of structural elucidation of alkaloids. Classification of alkaloids. Biological importance of alkaloids. Structural elucidation of nicotin, papavarine, quinine, reserpine and morphine. Biosynthesis of alkaloids (nicotin, conine and cocaine).

UNIT-II

[16 HOURS]

Steroids: Introduction, Structural elucidation of cholesterol, bile acids, Ergosterol and its irradiation products. Sex hormones and corticosteroids: Synthesis of estrone, progesterone, androsterone, testosterone. Barton reaction for the synthesis of aldosterone. Brief discussion of homosteroids, norsteroids and oral contraceptives. Biological significance of anabolic steroids.

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Organic Chemistry, Vol-II by I. L. Finar.
3. Schaum's outline of theory and problems of Organic Chemistry, Harbert Meislich, Howard Nechamkin and Jocob Sharefkin.
4. Natural products: Their chemistry and biological significance, J. Mann, R. S. Davidson, J. B. Banthorpe and J. B. Harborne.

MATERIALS CHEMISTRY
COURSE CODE: 21CHC57

Objectives

- To familiarize with the preparation and characterization of different types of nanomaterials.
- To learn the properties and applications of semiconductors and superconductors.

Course Outcome

- Understand the fundamentals and importance of different types of nanomaterials, their methods of preparation and characterization by different techniques.
- Basic aspects of semiconductors and superconductors, their properties and applications.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Chemistry of nanomaterials: Fundamentals and importance, metal nanoclusters, magic numbers, theoretical modelling of nanoparticles, geometric structure, electronic structure, reactivity, fluctuations, magnetic clusters, bulk to nano transitions. Semiconducting nanoparticles: optical properties, photo fragmentation, Coulombic explosion.

Carbon nanoparticles: Introduction, carbon molecules, nature of carbon bond, new carbon structure. Carbon clusters: Small carbon clusters, C_{60}: Discovery, structure, alkali doping, super conductivity. Fullerenes and other bulky balls. Carbon nano-tubes: Fabrication structure, electrical properties, vibrational properties, mechanical properties. Quantum dots, Graphene, and applications of nanomaterials.

Methods of preparation: Plasma arc, Chemical vapour deposition (CVD), sol-gel, silica-gel, hydrolysis, condensation, polymerization of monomers to form nanoparticles, solvothermal, and hydrothermal methods, electrochemical, ball milling and pulsed laser methods. Characterization of nanomaterials (X- ray, IR, UV and SEM).

UNIT-II

[16 HOURS]

Semiconductors: Metals, insulators and semiconductors. Band theory, energy bands, intrinsic and extrinsic semiconductors. Conductivity: electrons and holes, temperature dependence on conductivity, Optical properties: absorption spectrum, photoconductivity, photovoltaic effect and luminescence. Junction properties: metal-metal junctions, metal-semiconductor junctions, p-n junctions, transistors, industrial applications of semiconductors: Mixed oxides, spinels and other magnetic materials.

Superconductors: Introduction, critical temperature and zero resistivity, Meissner effect, critical magnetic field and its variation with temperature. Type - I and II super conductors, specific heat, isotope effect, basic concepts of BCS theory. High temperature (Tc) superconductors and its applications.

References

1. Introduction to Nanotechnology, Charles P. Poole. Jr. and Frank J. Owens, Wiley-Interscience, Joh Wiley and Sons Inc, 2006.
2. Nanotechnology, Richard Booker and Earl Boysen, Wiley.
3. Nanometerials, A.K. Bandopadhyay, New Age International, 2nd edition.
4. Nanotechnology - Importance and Applications, M. H. Fulekar, Ink International publishing.
5. Solid State Chemistry – N.B. Hannay.
6. Introduction to Solids – Azaroff.
7. Solid State Chemistry and its applications – A.R. West.
8. Principles of the Solid State – H.V. Keer.
9. Basic Solid State Chemistry, 2nd edition, Anthony R. West.
10. Solid State Chemistry: An Introduction, 3rd edition, Lesley E. Smart and Elaine A. Moore.
11. Introduction to Solid state Physics-C. Kittel, 5th edition, Wiley Eastern, Limited.
12. C.N.R. Rao and J. Gopalakrishna –New Directions in solid state chemistry| Cambridge University Press, Cambridge (1999).

OPEN ELECTIVE (FOR NON-CHEMISTRY STUDENTS ONLY)
GENERAL CHEMISTRY
COURSE CODE: 21CHC80

Objectives

- To understand the basic concepts of chemistry including periodic properties of elements, structure and bonding.
- To learn the applications of synthetic products and biological importance of natural products. .
- To understand the basic concepts of thermodynamics, chemical kinetics, ionic equilibria and electrochemistry.
- To learn the statistical evaluation of experimental data. Applications of titrimetric methods and separation techniques.

Course Outcome

- Periodic properties of elements, structure and bonding of ionic compounds as well as various concepts of acids and bases.
- Hybridization, bonding and molecular structure of simple organic molecules. And also, biological importance of natural products.
- Basic concepts of thermodynamics, chemical kinetics, electrochemistry and ionic equilibria and their applications.
- Statistical evaluation of experimental data, concept of titrimetric and chromatographic methods.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.
- Students will be assigned to solve the numerical problems to understand the concepts.

Course content

UNIT-I

[16 HOURS]

Periodic table and chemical periodicity: Periodic properties of elements, State of Matter, their resources. Important periodic properties of the elements, covalent radii, ionic radii, ionization potential, electron affinity and electronegativity.
Structure and Bonding: Properties of ionic compounds, structure of crystal lattices (NaCl, CsCl, ZnS, Wurtzite and rutile), Lattice energy, Born-Haber Cycle, radius ratio rules and their limitations.MO treatment for homo- and heteronuclear diatomic molecules. VSEPR model to simple molecules. Factors affecting the radii of ions, covalent character in ionic bonds, hydration energy and solubility of ionic compounds.
Concepts of Acids and Bases: Review of acid base concepts**.** Lux-Flood and solvent system concepts. Hard-soft acids and bases. Applications.

UNIT-II

[16 HOURS]

Bonding and molecular structure: Introduction to organic chemistry, atomic orbitals, sigma and pi bond formation-molecular orbital (MO) method, sp, sp^2 and sp^3 hybridization, bond length, bond dissociation energies and bond angles (open chain and cyclic compounds). Electronegativity and polarity of the bonds. Classifications and reactions of organic compounds (with examples).

Acids and bases: Hydrogen bonding, resonance and inductive effective on strengths of acids and bases.

Biological importance of natural products: Amino acids, proteins, carbohydrates (cellulose, starch, glycogen), lipids (fats and oils, phospholipids), prostaglandins, nucleic acids, steroids, alkaloids, vitamins, flavonoids.

Applications of synthetic products: Dyes, drugs, polymers (plastics), soaps and detergents, pesticides and pheromones.

UNIT-III

[16 HOURS]

Thermodynamics: First and second laws of thermodynamics. Concept of entropy and free energy, entropy as a measure of unavailable energy. Entropy and free energy changes and spontaneity of process.

Chemical kinetics: Rate and order of reaction. Factor affecting the rate of reaction. and determination Order of reaction. Energy of activation and its determination. Brief account of collision and activated complex theories.

Ionic equilibria: pH scale, buffer solutions, calculation of pH of buffer solutions, buffer capacity and buffer index, buffer mixtures.

Solutions: Concentration units, solutions of liquids in liquids, Raoult's law, ideal and non-ideal solutions.

Electrochemistry: Electrolytic conductance, specific, equivalent and molar conductance, ionic mobility and transference number, factors affecting the electrolytic conductance, Arrhenius theory of strong and weak electrolytes, assumptions of Debye-Huckel theory of strong electrolytes. Single electrode potential, reference electrodes, galvanic cells, emf of galvanic cells and construction of electrochemical cells.

UNIT-IV

[16 HOURS]

Basic Statistics and Data Handling: Significant figures, accuracy and precision. Types of errors: Determinate error and indeterminate error. Definitions for statistics. Quantifying random error: Confidence limits, variance. Rejection of results.

Applications of titrimetric methods: Introduction, theory and applications of acid base titrimetry, complexometric titrations and redox titrimetry

Separation techniques: Purification-Crystallization, sublimation, fractional crystallization, distillation techniques (simple distillation, steam distillation, distillation under reduced pressure, and fractional distillation), solvent extraction.

Chromatography: Thin layer chromatography and ion-exchange chromatography and their applications in the separation of the components from the mixture.

References

1. Text Book of Physical Chem., by Samuel Glasstone, MacMillan Indian Ltd., 2ndEd., (1974).
2. Elements of Physical Chem., by Lewis and Glasstone, 2nd Edn. Macmillan & Co Ltd.
3. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
4. Organic Chemistry, Vol-I by I. L. Finar.
5. Vogel' text book of practical organic chemistry, V edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatehell.
6. Laboratory manual of Organic Chemistry by B. B. Dey and M. V. Sitaraman.
7. Practical Organic Chemistry by Mann F. G. and Saunders.
8. Fundamentals of analytical Chem., 8th Edition, D. A. Skoog, West, Holler and Crouch.
9. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
10. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.

FOURTH SEMESTER
HARD CORE
BIOINORGANIC CHEMISTRY
COURSE CODE: 21CHD10

Objectives

- To understand the structural parameters of metallo-proteins and their biological role.
- To learn the biological properties of metal complexes in chemo and radio therapeutics.

Course Outcome

- Structural building blocks of proteins, nucleic acids and their metal ion interactions. Biological role of Na/K channel, Ca, Vit B12, and coenzymes.
- Biochemical reactions of several metallo-enzymes and oxygen transport proteins.
- Medicinal applications of metals and metal complexes, and also treatment of toxicity due to heavy metal ions.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Structural and molecular biology: Introduction, The structural building blocks of proteins, the structural building block of nucleic acids. Metal ion interactions with nucleosides and nucleotides. General features of DNA - metal complex interaction.

Bioenergetics: Introduction, Redox reactions in metabolism, the central role of ATP in metabolism. Kinetic stability of ATP, Mitochondrial flow of electrons from NADH to O_2. Phosphorylation and respiratory chain. Oxidative phosphorylation.

Sodium and potassium-channels and pumps: Introduction, transport across membranes. Potassium and sodium channels, The sodium-potassium ATPase, Macrocyclic crown ether compounds, cryptands and ionophores.

Biochemistry of calcium: Introduction - comparison of Ca^{2+} and Mg^{2+}. Biological roles of calcium, binding sites of calcium and proteins, storage of calcium, calcium in muscle contraction, calcium in blood clotting process.

Vitamin B12 and Coenzymes: Structural feature, names of different forms, chemistry of cobalamin, biochemical functions of cobalamins, model compounds. Special characteristics of B12 co-enzyme. Photosystems.

UNIT-II

[16 HOURS]

Metal ion transport and storage: Iron storage and transport: Transferrin, ferritin, phosvitin and gastroferrin. Iron transport in microbes: siderophores, *in vivo* microbial transport of iron.

Oxygen transport and oxygen uptake proteins: Properties of dioxygen (O2): thermodynamic and kinetic aspects of dioxygen as an oxidant, activation of dioxygen through complexation with metal ions. Haemoglobin (Hb) and Myoglobin (Mb) in oxygen transport mechanism: Introduction to porphyrin system, substituent effects on porphyrin rings, functions of Hb and Mb. Characteristics of O_2^--binding interaction with Hb and Mb. Model compounds for oxygen carriers (Vaska's complex and cobalt(III) – Schiff base complexes). Hemerythrin and hemocyanin.

Electron transport proteins and redox enzymes: Iron – sulfur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P450. Catalase and peroxidase: Structure and reactivity. **Superoxide dismutase**: Structure and reactivity.

Molybdenum containing enzymes: Aspects of molybdenum chemistry, Xanthine oxidase, aldehyde oxidase, sulfite oxidase, nitrogenase and nitrite reductase.

Non-redox metalloenzymes - Structure and reactivity: Carboxypeptidase-A, alcohol dehydrogenase, leucineaminopeptidase and carbonic anhydrase.

UNIT-III

[16 HOURS]

Medicinal Inorganic Chemistry: State of the Art, New Trends, and a Vision of the Future: Introduction, metals and human biochemistry, general requirements.

Disease due to metal deficiency and treatment: Iron, zinc, copper, sodium, potassium, magnesium, calcium and selenium.

Metal complexes as drugs and therapeutic agents: Introduction, Antibacterial agents, Antiviral agents, **Cancer Therapy**: Current Status and Mechanism of Action of Platinum-Based Anticancer Drugs. Non-platinum anticancer agents.

Gold-Based Therapeutic Agents: **A New Perspective**: Uses for the treatment of rheumatoid arthritis, **Diabetes**: Vanadium and diabetes,

Metal-Based Radiopharmaceuticals: Metal complexes as radio diagnostic agents.

Treatment of toxicity due to inorganics: General aspects of mechanism of metal ion toxicity,

(i) Mechanism of antidote complex with poison, rendering it inert: arsenic, lead, mercury, iron and copper.
(ii) Antidote accelerated metabolic conversion of poison to non-toxic product: cyanide and carbon monoxide.

References

1. The Inorganic Chemistry of Biological Process- 2nd edition, M. N. Hughes, John Wiley and Sons, (1988).
2. Bioinorganic Chemistry - R.W. Hay, Ellis Horwood Ltd., (1984).
3. Biological Inorganic Chemistry – An Introduction, R.R. Crichton, Elsevier, (2008).
4. Bioinorganic Chemistry - A.K. Das, Books and Allied (P) Ltd, (2007).
5. Bioinorganic Chemistry - K. Hussain Reddy, New Age International Ltd. (2003).
6. Bioinorganic Chemistry: A Survey - EiichiroOchiai, Academic Press, (2008).
7. Bioinorganic Chemistry: A Short Course - 2nd edition, R.M. Roat-Malone, Wiley Interscience, (2007).
8. Medicinal Applications of Coodination Chemistry - Chris Jones and John Thornback, RSC Publishing, (2007).
9. Transition Metal Complexes as Drugs and Chemotherapeutic Agents - N. Farrell, Kluwer Academic Publishers (1989).
10. The Biological Chemistry of the Elements: The Inorganic Chemistry of Life - 2nd edition, J.J.R. Frausto da Silva and R.J.P. Williams, Oxford University Press, (2001).
11. Essentials of Inorganic Chemistry, K. A. Strohfeldt, John Wiley and Sons Ltd.,(2015).
12. Bioinorganic Medicinal Chemistry (Ed) EnzoAlessio, Wiley-VCH Verlag and Co., (2011).

HETEROCYCLIC AND BIOORGANIC CHEMISTRY

COURSE CODE: 21CHD11

Objectives

- To familiarize with the chemistry of heterocyclic compounds.
- To learn the synthesis and biological importance of carbohydrates, proteins and nucleic acid.

Course Outcome

- Structure, reactivity and synthesis of several heterocyclic compounds.
- Synthesis, industrial and biological importance of carbohydrates.
- General synthesis of amino acids, peptides, nucleic acids and their biological significance.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Heterocyclic compounds: Nomenclature; Structure, reactivity, synthesis and reactions of furan, pyrrole, thiophene, indole, pyridine, quinoline, isoquinoline, pyrazole, imidazole, pyrone, coumarin, chromones, pyrimidines, purines. Synthesis and synthetic applications of azirines & aziridines, azetidines, oxazolines, isoxazolines, isoxazole, triazole and azepines and benzodiazepines.

UNIT-II

[16 HOURS]

Protecting groups: Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis.

Carbohydrates: Introduction, Ring size determination of monosaccharides, configuration and conformations of monosaccharides, anomeric effect, Hudson‘s rules, epimerization and mutarotation. Synthesis, industrial and biological importance of glycosides, amino sugars, sucrose, maltose and lactose. Polysaccharides: General methods of structure elucidation. Industrial importance and biological importance of cellulose, starch, glycogen, dextran, hemicellulose, pectin, agar- agar. Photosynthesis and biosynthesis of carbohydrates.

UNIT-III

[16 HOURS]

Amino Acids: General structure, physiological properties, protection of functional groups. **Peptides**: Structure and conformation of peptide bond, peptide synthesis: Solution phase and Merrifield’s solid phase synthesis, Racemization and use of HOBt, Synthesis of oxytocin and vasopressin, biological importance of insulin, selective cleavage of polypeptide bonds (chemical and enzymatic). Proteins: Structure determination: *C* and *N* terminal residue determination, primary, secondary, tertiary and quaternary structure determination, denaturing and renaturing of proteins.

Nucleic acids: Introduction, structure and synthesis of nucleosides and nucleotides, protecting groups for hydroxy group in sugar, amino group in the base and phosphate functions. Methods of formation of internucleotide bonds: DCC, phosphodiester approach and phosphoramide methods. Solid phase synthesis of oligonucleotides. Structure of RNA and DNA, Crick-Watson model, role of nucleic acids in the biosynthesis of proteins.

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Organic Chemistry, Vol-II by I. L. Finar.
3. Schaum's outline of theory and problems of Organic Chemistry, Harbert Meislich, Howard Nechamkin and Jocob Sharefkin.
4. Natural products: Their chemistry and biological significance, J. Mann, R. S. Davidson, J. B. Banthorpe and J. B. Harborne.
5. A text book of synthetic drugs, O. D. Tyagi and M. Yadav.
6. Synthetic drugs, Gurdeep R. Chatwal.
7. Carbohydrate Chemistry and applications of carbohydrates, K. M. Lokanatha Rai.
8. Heterocyclic chemistry by Achison.
9. Heterocyclic chemistry by Smith and Joule.
10. Heterocyclic chemistry by Pacquete.

NUCLEAR, RADIATION AND PHOTOCHEMISTRY
COURSE CODE: 21CHD12

Objectives

- To understand the theory and applications of photochemistry.
- To learn the fundamentals and physico-chemical applications of radiation chemistry.
- To familiarize with the concepts of nuclear chemistry including radiochemical separation techniques and nuclear power reactors.

Course Outcome

- Understand the principles of photochemistry, its experimental techniques and applications.
- Fundamentals of radiation chemistry, experimental methods of detection of radiation and applications of radioisotopes.
- General aspects of nuclear chemistry, different types of nuclear reactions, production and separation of radioisotopes and also basic features of different types of nuclear reactors.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Nuclear chemistry: Nuclear stability – nuclear forces, packing fraction, binding energy, liquid drop, shell and collective models. Radioactive decay – General characteristics, decay kinetics, parent –daughter decay growth relationships, determination of half-lives. Brief survey of alpha, beta and gamma decays. Nuclear reactions – Bethe‘s notation, types of nuclear reactions – specific nuclear reactions, photonuclear reactions, Oppenheimer – Phillips process, spallation reactions, Szilard-Chalmers process. Definition of Curie and related calculations. Production of radioisotopes and labelled compounds by bombardment.

Radiochemical separation techniques: carriers, solvent extraction and ion ion-exchange methods.

Nuclear power reactors: Types of nuclear power reactors, basic features and components of nuclear power reactors. An introduction to breeder reactors.

UNIT-II

[16 HOURS]

Radiation chemistry: Introduction, units, interaction of electromagnetic radiation with matter, G-value, LET of radiation. Chemical dosimetry - Fricke and ceric sulphate dosimeters. Radiolysis - cysteine, water and biphenyl. Radioisotopes as tracers, use of isotopic tracers in the elucidation of reaction mechanism, structure determination and solubility of sparingly soluble substances. ^{14}C dating, medical applications of isotopic tracers. Physico-chemical applications – isotope dilution method, activation analysis and radiometric titrations. Hazards in radiochemical work and radiation protection.

Radiation detection and measurement: Experimental techniques in the assay of radioisotopes. Radiation detectors – ionization chambers, proportional and Geiger-Muller counters – G.M. Plateau, dead time, coincidence loss, determination of dead time. Scintillation and semiconductor radiation detectors.

UNIT-III

[16 HOURS]

Photochemistry: Introduction to photochemistry, laws of photochemistry, laws of light absorption, quantum yield and its determination, factors affecting quantum yield, Actinometry - Uranyloxalate and potassium ferrioxalate actinometers, acetone and diethylketone actinometers. Term symbols for atoms and its significance. Photochemical properties of electronically excited molecules, nature of changes on electronic excitation, shapes of absorption band and Frank Condon principle. Experimental techniques to determine the intermediates in photochemical reactions. Photosensitization: by mercury, dissociation of H_2. Photochemical kinetics of: Decomposition of CH_3CHO, dissociation of HI and formation of HCl. Fluorescence and phosphorescence – theory and applications. Resonance fluorescence and quenching of fluorescence, Kinetics of colliosional quenching (Stern-Volmer equation).

Photocatalyst – Principle, application of ZnO/TiO_2photocatalysts in the photo cleavage of dyes, environmentally hazardous waste and industrial effluents. Effect of photo degradation on COD value.

References

1. Photochemistry, Calvert and Pitts, Wiley, New York (1996).
2. Fundamentals of Photochemistry, Gohatgi-Mukherjee, New Age International Ltd., 1986.
3. Principles and Applications of Photochemistry, R. P. Wayne, Elsevier, New York (1970).
4. Photochemistry, Paul Suppan, RSC, London (1994).
5. Introduction to Semiconductor Materials and devices, M. S. Tyagi, John Wiley & Sons, 1991.
6. Nuclear Chemistry by Friedlander and Kennedy, John Wiley and Sons (1987).
7. Essentials of Nuclear Chemistry by H.J. Arnikar, Eastern Wiley (1990).
8. Nuclear Chemistry by U.N. Dash, Sultan Chand and Sons (1991).
9. Fundamentals of Radiochemistry by D.D. Sood, A.V.R. Reddy and N. Ramamoorthy.
10. Nuclear Radiation Detectors by S.S. Kapoor and Ramamoorthy, Wiley Eastern (1986).

INSTRUMENTAL METHODS OF ANALYSIS
COURSE CODE: 21CHD13

Objectives

- To understand the theory, instrumentation and applications of atomic emission spectroscopy.
- To get excel the knowledge on electro analytical techniques
- To learn the principles, instrumentation and applications of thermal methods of analysis.

Course Outcomes

After studying this course, the student to:

- Gain the knowledge on the differences between classical and instrumental methods of chemical analysis.
- Explain different types of instrumental methods employed in chemical analysis.
- Develop an understanding of the range and theories of instrumental methods available in analytical chemistry.
- Make clear distinctions among spectrometric, electro-analytical, thermal and microscopic methods.
- Gain knowledge pertaining to the appropriate instrumental techniques.
- Obtain the practical experience in selected instrumental methods of analysis.
- Develop the skills on instrumental methods for planning, developing, conducting, reviewing, conducting experimentsand reporting results.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.
- Students will be assigned numerical problems to understand the concepts.

UNIT – I

Flame photometry and Atomic absorption spectrometry: Energy level diagrams-atomic absorption spectra. Flame characteristics.Flame atomizers and electrothermal atomization.Comparison of spectral interferences, chemical and physical interferences in FP and AAS.Background correction methods in AAS.Use of organic solvents. Quantitative techniques-calibration curve procedure and the standard addition technique. Typical commercial instruments for FP and AAS (Single and double beam atomic absorption spectrophotometers), applications of FES and AAS.Qualitative analysis and quantitative evaluations.Relative detectabilities of atomic absorption and flame emission spectrometry.

Molecular luminescence spectrometry: Theoretical basis for fluorescence and phosphorescence. Singlet and triplet excited states. Variables affecting luminescence-quantum efficiency, transition types, structure and structural rigidity, temperature and solvent effects, effect of *p*H, dissolved oxygen and concentration effect. Excitation spectra *vs* emission spectra.Origin of fluorescence, relationship between fluorescence and concentration.Fluorescence instrumentation-fluorometers and spectrofluorometers.Sensitivity and selectivity.Modification necessary to measure phosphorescence.Applications of fluorometry: inorganic and organic analyses.

Nephelometry and turbidometry: Principles, instrumentation and applications.

[16 HOURS]

UNIT – II

Electroanalytical methods: Classification. Potentiometers, galvanostats and potentiostats.

Potentiometric methods of analysis.Potentiometric electrochemical cells.The Nernst equation.Liquid junction potentials.Reference electrodes-SHE, calomel electrode and silver/ silver chloride electrode.Metallic indicator electrodes-electrodes of first kind and second kind.Redox electrodes.Membrane electrodes –membrane potential, selectivity of membranes.Glass ion selective electrodes.Crystalline solid state ion selective electrodes.Liquid-based ion selective electrodes.Gas sensing electrodes.Potentiometric biosensors.Quantitative applications.Activity *vs* concentration.Quantitative analysis using external standards and the method of standard additions.Measurement of*p*H.Clinical and environmental applications.

Electrogravimetric analysis: Theory, apparatus, cell processes, deposition and separation, electrolytic separation of metals, applications.

Coulometric methods of analysis: General discussion, coulometry at controlled potential, apparatus and general technique, applications,coulometric titrations (amperometriccoulometric)-principles, apparatus, comparison of coulometric titrations with conventional titrations, automatic coulometric titrations, applications.

Amperometric titrations: Principle, titration curve, apparatus and techniques, applications.

Voltammetry: Fundamentals of voltammetry. Cyclic voltammetry**:** Principles and applications. Stripping analysis: Stripping voltammetry-basic principles, electrodes used for stripping analysis, apparatus for stripping analysis, applications, determination of lead in water voltammetry with micro electrodes.

[16 HOURS]

UNIT – III

Thermal method of analysis: Introduction,

Thermogravimetric analysis (TGA): Types of thermogravimetric analysis, principles and general thermal decomposition curve. Factors affecting the results-heating rate, furnace, instrument control/ data handling. Applications-purity and thermal stability, evaluation of correct drying temperature, analysis of complex mixture and determination of kinetic parameters of thermal degradation.

Differential thermal analysis (DTA): General principles. Theory-variables affecting the DTA curves. Instrumentation. Applications-analysis of the physical mixtures and thermal behaviour study. Determination of melting point, boiling point and decomposition point.

Differential scanning calorimetry (DSC): Basic principle. Instrumentation-power compensated DSC, Heat flux DSC. Applications- studies of thermal transitions and isothermal crystallization. Testing the purity of the pharmaceutical samples.

Thermomechanical analysis. Dynamic mechanical analysis**.**

Enthalpimetric analysis: Thermometric titrations and direct injection enthalpimetry: Principles, apparatus and applications.

Microscopic analysis: Principle and mechanism in characterization of compounds by scanning electron and transmission electron microscopic (SEM & TEM) techniques. Components of instruments of SEM and TEM.

[16 HOURS]

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001 John Wiley & Sons, Inc. India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 Prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders CollegePublishing, California, 1990.
6. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean,7th Edition, CBS Publishers, New Delhi, 1988.
7. Principles and Practice of Analytical Chemistry, F.W. Fifield and Kealey, 3rd edition, 2000, Blackwell Sci., Ltd. Malden, USA.
8. Modern Analytical Chemistry, David Harvey, McGraw Hill, New Delhi, 2000.
9. Introduction to Instrumental Analysis, Braun, Pharm. Med. Press. India.
10. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva Books Pvt. Ltd., New Delhi, 2002.
11. Analytical Transmission Electron Microscopy, An Introduction for OperatorsThomas, Jürgen, Gemming, Thomas., Springer, 2014.
12. Scanning Transmission Electron Microscopy, Imaging and Analysis.Pennycook, Stephen J., Nellist, Peter D. (Eds.), Springer, 2011.

SOFT CORE
ANALYTICAL CHEMISTRY PRACTICALS
COURSE CODE: 21CHD50 **[64 HOURS]**

Objectives

- To familiarize with the handling of instruments in the quantitative analysis of various samples.
- To understand the analysis of real samples like waste water, soil samples and biological samples and mixtures

Course Outcome

After studying this course, the student to:

- Get experience on analysis of various complex mixtures by following multistep reactions.
- Acquire the knowledge on handling instruments and to overcome the general problems arises during the analysis.
- Acquire industrial skills required for sampling, analytical and interpretation and presentation of results.
- Possess adequate knowledge on literature search for developed analytical methods.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Computer aided applications are used for the evaluation of experimental results.

[128 HOURS]

PART – III

1. Determination of calcium in limestone by redox, acid-base and complexation titrations.
2. Determination of vitamin C in orange juice by titration with cerium(IV) and with 2,6-dichlorophenol indophenol.
3. Determination of mercury in an algaecide by EDTA titration; and arsenic in ant control preparation by redox titration.
4. Determination of aluminium and magnesium in antacids by EDTA titration.
5. Analysis of a copper-nickel alloy sample for copper and nickel by EDTA titration using masking and selective demasking reactions.
6. Determination of saccharin in tablets by precipitation titration.
7. Determination of iodine value and saponification value of edible oils.
8. Determination of ascorbic acid in goose berry/bitter gourd by titrimetry and spectrophotometry using *N*-bromosuccinimide (NBS).
9. Analysis of a mixture of iron(II) and iron(III) by EDTA titration using *p*H control.
10. Determination of sulpha drugs by potentiometry using $NaNO_2$ and iodometric assay of penicillin.
11. Solvent extraction method for determination of silver as ion-associate with 1,10-phenanthroline and bromopyragallol red.
12. Electrolytic determination of copper and lead in brass.

13. Polarographic determination of copper and zinc in brass.
14. Determination of sodium, potassium and calcium in mineral waters by atomic emission spectrometry.
15. Determination of iron in mustard seeds and phosphorus in peas by spectrophotometry.
16. Analysis of waste water for anionic detergents and phenol by spectrophotometry.
17. Fluorimetric determination of riboflavin (vit.B_2) in tablets.
18. Colorimetric analysis of procaine by diazotization and coupling reaction.
19. Determination of manganese in steel by extraction-free spectrophotometry and molybdenum in steel by extractive spectrophotometry.
20. Determination of ethanol in wine by titrimetric and spectrophotometric dichromate methods

PART – IV

1. Analysis of waste waters for DO and COD by titrimetry.
2. Analysis of a ground water sample for sulphate by titrimetry (EDTA) and turbidimetry.
3. Potentiometric determination of formula and stability constant of a silver-ammonia complex ion.
4. Determination of aspirin, phenacetin and caffeine in mixture and APC tablets by solvent extraction and UV spectrophotometry.
5. Kinetic determination of urinary creatinine and purity of a commercial H_2O_2 sample.
6. Determination of chromium(III) and iron(III) in a mixture by kinetic masking methods.
7. Catalytic determination of traces of selenium in biological materials and iodide in blood serum.
8. Photometric and potentiometric titration of iron(III) with EDTA.
9. Photometric and potentiometric titration of copper with EDTA.
10. Determination of copper(II) and iron(III) in mixture by photometric titration with EDTA.
11. Analysis of brackish water for chloride content by a) spectrophotometry (mercuric thiocyanate method), b) conductometry (silver nitrate) and c) potentiometry (silver nitrate).
12. Conductometric titration of sodium acetate with HCl and NH_4Cl with NaOH.
13. Ascorbic acid determination in natural orange juice by coulometry.
14. Spectrophotometric determination of iron in natural waters using thiocyanate and 1,10-phenanthroline as reagents.
15. Determination of fluoride in drinking water/ground water by spectrophotometry(alizarin red lake method).
16. Analysis of waste water for
    a) Phosphate by molybdenum blue method
    b) ammonia-nitrogen by Nessler's method
    c) nitrite-nitrogen by NEDA method
15. Analysis of a soil sample for
    a) Calcium carbonate and organic carbon by titrimetry.
    b) Calcium and magnesium by EDTA titration.

16. Analysis of a soil sample for
    a) Nitrogen content by Kjeldahl method
    b) Available phosphorus by spectrophotometry.
    c) Nitrate-nitrogen/nitrite nitrogen/ammonia nitrogen by spectrophotometry.
    d) Sodium and potassium by flame photometry.
17. Analysis of urine for
    a) Urea and uric acid by titrimetry and spectrophotometry.
    b) Sulphate by precipitation titration after ion-exchange separation.
    c) Sugar by Benedict's reagent.
18. Analysis of blood for
    a) cholesterol by spectrophotometry
    b) Bicarbonate by acid-base titration.
19. Fluorimetric determination of quinine in an antimalarial tablet.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8thedition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th edition, 2001 John Wiley & Sons, Inc. India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993, prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, 2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Quantitative Analysis of Drugs in Pharmaceutical Formulations, P. D. Sethi, 3rdedition, CBS Publishers & Distributors, New Delhi, 1997.
7. Practical Clinical biochemistry methods and interpretations, R. Chawla, J.P. BothersMedical Publishers (P) Ltd., 1995.
8. Laboratory Manual in Biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
9. Experiments on Water Pollution, D.I. Williams and D. Anglesia, Wayland Publishers Ltd., England, 1978.
10. Experiments on Land Pollution, D.I. Williams and D. Anglesia, Wayland Publishers Ltd., England, 1978.
15. Experiments in Environmental Chemistry, P.D. Vowler and D.W. Counel, Pergamon Press, Oxford 1980.
16. Manual Soil Laboratory Testing, vol.I, K.H. Head, Pentech Press, London 1980.

INORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHD51 **[64 HOURS]**

Objectives

- To familiarize with the instrumental methods of analysis for determining metals present in the different samples.
- To familiarize with the preparation and characterization of different inorganic complexes.

Course Outcome

- Determination of alloy samples and understanding the electrochemical deposition of metals.
- Preparation and characterization of coordination compounds.
- Determination of composition, stability constant and magnetic susceptibility of metal complexes.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Spectroscopic tools are applied for the characterization of the synthesized complexes.

Course experiments

PART-A

1. Determination of bismuth, cadmium and lead in a mixture: Analysis of a low melting alloy (Wood's alloy).
2. Simultaneous spectrophotometric determination of chromium and manganese in a steel solution.
3. Determination of chromium(III) and iron(III) in a mixture: Kinetic masking method.
4. Electrogravimetric determination of:
   a) Copper in copper sulphate
   b) Nickel in nickel suphate
   c) Copper and nickel in alloy solution
   d) Lead in lead nitrate.
5. Flame photometric determination of the following metal ions from different samples: a) sodium b) potassium and c) sodium and potassium in a mixture.
6. Polarographic estimation of cadmium and zinc.
7. Determination of iron as the 8-hydroxyquinolate by solvent extraction method.
8. Quantitative determination of nickel using dithizone and 1,10-phenanthroline by synergistic extraction.
9. Spectrophotometric determination of the *p*Ka value of methyl red.
10. Semimicro gravimetric determination of aluminium.

PART-B

1. Preparation and characterization of:
   a) Chloropentammine cobalt(III) chloride
   b) Estimation of chloride in a complex by potentiometric or ion-exchange method
   c) Record the electronic absorption spectrum of a complex and verify Tanabe Sugano diagram.
2. Preparation of *cis*- and *trans*- dichlorobis(ethylenediammine) cobalt(III)chloride. Record the UV-Vis spectra and compare it with *cis*-form. Measure the molar conductance.

3. Preparation of hexammine cobalt(III) chloride and estimate cobalt ion.
4. Determination of magnetic susceptibility of any two compounds/complexes by Gouy method.
5. Determination of the composition of iron-phenanthroline complex by:
   (d) Job's method
   (e) mole-ratio method and
   (f) Slope-ratio method.
6. Determine the stability constant of iron-tiron/iron-phenanthroline by Turner-Anderson method.
7. Preparation of potassium tris(oxalato)ferrate(III) and estimate the metal ion.
8. Preparation of acetyl acetonatomanganese(III) complex.
9. Preparation of tris(en)nickel(II) chloride and hexamine nickel(II) chloride complexes. Record electronic spectra and evaluate spectrochemical series.
10. Using chloropentammine cobalt(III) chloride, prepare nitro and nitritopentammine cobalt(III) chloride. Record the IR spectra of the isomers and interpret.
11. Estimate the chloride ion in a given complex by silver nitrate titration after ion-exchange separation.
12. Demonstration Experiments:
    (d) Recording and interpretation of IR and NMR spectra of complexes.
    (e) Spectrochemical series-Evaluation of Dq value.
    (f) DNA interaction with metal complexes by UV-visible absorption and viscosity methods.

References

1. Advanced Physico-Chemical Experiments – J. Rose.
2. Instrumental Analysis Manual - Modern Experiments for Laboratory – G.G. Guilbault and L.G. Hargis.
3. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel, 5th edition.
4. Experimental Inorganic Chemistry – G. Palmer.
5. Inorganic Synthesis – O. Glemser.
6. Experimental Inorganic/Physical Chemistry- Mounir A. Malati.
7. Quantitative Chemical Analysis – Daniel C. Harris, (2006) 7th edition.
8. Spectrophotometric Determination of Elements – Z. Marczenko

ORGANIC CHEMISTRY PRACTICALS

COURSE CODE: 21CHD52 **[64 HOURS]**

Objectives

- To understand the concepts of isolation and purification of natural products.
- To familiarize with the estimation of different functional groups in organic compounds.

Course Outcome

- The isolation of caffeine, carotene, lycopene, cincole, azelaic acid and piperine from respective natural sources.
- Estimation of ketones, sugars, nitro and amino groups in natural products.
- Interpret UV, IR, NMR and MS data of different organic compounds.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Spectroscopic tools are applied for the characterization of isolated natural products.

Course experiments

PART-A

1. Fractional crystallization: separation of mixture of naphthalene and biphenyl.
2. Thin layer chromatography: Separation of plant pigments.
3. Column chromatography: Separation of *o*- and *p*-nitro aniline
4. Isolation of piperine from pepper.
5. Isolation of caffeine from tea.
6. Isolation of azelaic acid from castor oil.
7. Isolation of carotene from carrot.
8. Isolation of lycopene from tomato.
9. Isolation of cincole from eucalyptus leaves.

PART-B

Isolation of natural products & estimations:

1. Estimation of ketones by haloform reaction.
2. Estimation of sugars by Bertrand's method.
3. Estimation of nitro groups.
4. Estimation of amino group.
5. Determination of enol content by Meyer's method.
6. Determination of iodine value of an oil or fat.
7. Determination of saponification value of oil.
8. Determination of equivalent weight of carboxylic acid by silver salt method

Interpretation of Spectra: Structural elucidation of some simple organic compounds by UV, IR, NMR and mass. Spectra have to be provided by the Teachers/ Examiners.

References

1. Vogel' text book of practical organic chemistry, V edition, B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatehell.
2. Elementary practical organic chemistry, Part-III: Quantitative organic analysis, By Arthur I, Vogel.
3. Laboratory manual of Organic Chemistry by B. B. Dey and M. V. Sitaraman.
4. Practical Organic Chemistry by Mann F. G. and Saunders.
5. Natural products: A laboratory guide by Raphael Ikhan.

PHYSICAL CHEMISTRY PRACTICALS

Objectives **COURSE CODE: 21CHD53** **[64 HOURS]**

- To understand the significance of various factors influencing the reaction rate in proposing the reaction mechanism.
- To understand electrochemical and spectrophotometric methods of quantification of samples, and also determination of physico-chemical parameters of some important samples.

Course Outcome

- Students can able to develop experimental skill and interpretation of plausible mechanisms of reactions.
- Gain practical knowledge on the theoretical basis of electrochemistry, thermodynamics, and spectrophotometry experiments.
- This helps in academics, research and industries.

Pedagogy

- Each student performs experiments as per the protocol in practical classes.
- Electrochemical and spectrophotometric tools are used to conduct the experiments.

Course experiments

PART-A

1. Determination of order of reaction for the acid hydrolysis of methyl acetate and evaluation of activation parameters.
2. Evaluation of Arrhenius parameters for the reaction between $K_2S_2O_8$ and KI (First order reaction).
3. Study of kinetics of autocatalytic reaction between oxalic acid and $KMnO_4$ and determine the order of reaction with respect to $KMnO_4$.
4. Kinetics of saponification of ethyl acetate by conductivity method and study the effect of dielectric constant of the medium (using CH_3OH).
5. Study of effect of salt (ionic strength) on the kinetics of reaction between potassium persulphate and potassium iodide (second order reaction).
6. Spectrophotometric kinetics of oxidation of indigocarmine (IC) by chloramine-T (CAT) – Determination of order of reaction with respect to [CAT] and [IC].
7. To study the acid catalysed kinetics of oxidation of glycine by chloramine-T (CAT) - determination of order of reaction with respect to [CAT] and [glycine].
8. Study the phase diagram of three component system (Glacial acetic acid-Chloroform-water system / Glacial acetic acid-Acetone-Water system).
9. Study the rate of corrosion and inhibition efficiency of an inhibitor (thiourea) on mild steel/Al/Cu by weight loss method.

PART-B

1. Conductometric titration of orthophosphoric acid against NaOH.
2. Conductometric titration of a mixture of HCl, CH_3COOH and $CuSO_4$ against NaOH.
3. Conductometric titration of thorium nitrate with potassium tartarate.
4. Potentiometric titration of mixture of weak acids (acetic acid and monochloroacetic acid) against NaOH.
5. Dwtermination of pK_a values of phosphoric acid by potentiometric / pH metric method.

6. Potentiometric titration of mixture of KCl+KBr+KI against $AgNO_3$.
7. Potentiometric titration of FAS against ceric sulphate and sodium metavenadate, determine the concentration of FAS and redox potential.
8. Potentiometric titration of lead nitrate against EDTA and determine the concentration of lead nitrate solution.
9. Determination of *p*K value of an indicator (methyl orange/methyl red).
10. Spectrophotometric analysis of a mixture of (a) $KMnO_4$ and $K_2Cr_2O_7$.
11. Study of complex formation between ferric salt and salicylic acid.

References

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry – F. Daniels *et al.*
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments – J. Rose.
7. Practical Physical Chemistry – S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.
10. Experiments in Chemistry – D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
11. Experimental Physical Chemistry – R.C. Das and B. Behera, Tata Mc Graw Hill.

SOFT CORE

DISSERTATION/PROJECT WORK–SOFT CORE

COURSE CODE: 21CHD54

Course Outcome
After studying this course, a student will be to:

- Carry out literature survey on the problem/s to be solved.
- Learn and follow suitable research methodologies to propose and to perform Experiments.
- Attain the state of ability to take up research work.
- Better understanding about research articles, patents, book chapters or books on relevant research problem.
- Acquire skills of writing research reports in the form of articles or thesis.

Student may take up Project Work/ Dissertation under the guidance of the faculty of the department during the IV Semester as a Soft Core course.

SOFT CORE
AUTOMATED METHODS AND REAL SAMPLE ANALYSIS
COURSE CODE: 21CHD55
Course content

Objectives

- To understand the instrumentation and applications of automated methods of analysis.
- To familiarize with analysis of real samples and clinical analysis.

Course Outcome

- Understand various types of automated methods of analysis.
- Identify activities that can be fully or partially automated.
- Automated chemical analysis will be very helpful in the clinical as well as pharmaceutical field to perform the purity analysis of the sample, although the sample size is very small, expensive and fast analysis.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.
- Students will be assigned numerical problems to understand the concepts.

UNIT-I

[16 HOURS]

Automated methods of analysis: An overview, definition, distinction between automatic and automated systems, advantages and disadvantages by automation, types of automated techniques. Nondiscrete techniques, segmented flow methods and basic equipment, special techniques and devices, theoretical considerations and problems, applications. Single channel and multi channel auto analysers, BUN analyzers, automatic glucose analyzers and ammonia in water analyzers, COD analyzers, CFA in industry. Non-segmented flow methods: Flow injection analysis. Principles, types of dispersion, factors affecting dispersion, applications of small, medium and large dispersions. Stopped flow methods, flow injection titrations. Discrete methods: Centrifugal fast scan analyzer, automatic multipurpose analyzers, Automatic elemental analyzer, automated analyzer based on multi layer film-principles, film structure, instrumentation applications. Comparison of discrete and non-discrete methods. Advantages of flow injection measurements over continuous flow measurements.

UNIT-II

[16 HOURS]

Analysis of real samples-real sample, choice of analytical method-defining the problem, investigating the literature, choosing or devising a method, testing the procedure, analysis of standard samples, using other methods, standard addition to the sample. Accuracy in the analysis of complex materials.

Decomposing and dissolving the sample- sources of error in decomposing and dissolution. Decomposing samples with inorganic acids. Microwave decomposition. Combustion methods for decomposing organic samples. Decomposition of inorganic materials with fluxes.

Clinical Analysis- Introduction, features of clinical analysis. Composition of blood, collection and preservation of samples. Common determinations - serum electrolytes, blood glucose and blood urea nitrogen, uric acid, albumin and globulins, acid and alkaline phosphates, barbiturates, chloride, sodium and potassium, bicarbonate, serum creatinine and cholesterol. Urine analysis- Principle components. Sample collection and preservation. Determination of creatinine, chloride, uric acid, ammonia, ascorbic acid, bilirubin and calcium.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, NewYork.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc,India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prenticeHall, Inc. NewDelhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney,J.D. Barnes and M.J.K. Thomas, 6th edition, Third Inidan Reprint.2003 PearsonEducation Pvt. Ltd., NewDelhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California,1990.
6. Principles and practice of analytical chemistry. Fifield andKealey.
7. Instant Notes of Analytical Chemistry, Kealey and Haines, Viva Books Pvt.Ltd.,2002.

BIOINORGANIC PHOTOCHEMISTRY

COURSE CODE: 21CHD56

Objectives

- To understand the photochemistry of inorganic compounds.
- To familiarize with the applications of fluorescents and chromogenic sensing and labeling.
- To learn photodynamic inactivation of microorganisms.

Course Outcome

- Basic concepts of photochemistry and photochemical reactions.
- Understand many organometallic compounds as fluorescent agents in the detection of cations, anions and toxic ions in the living system.
- Theory of photodynamics, and photocatalysis.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I **[16 HOURS]**

Introduction, Philosophy of bioinorganic photochemistry

Fundamentals: Light and matter. Nature of light, Accessible light sources and Interaction between light and matter.

Formation and properties of electronic excited states: Wave mechanics and quantum numbers and Electronic excitation.

Photophysical deactivation of electronic excited states: Spontaneous deactivation, Quenching and Coordination and organometallic compounds.

Photochemical reactions: Photochemical reaction channels, Intramolecular photoreactions, Photodissociation and photoionization, Photoisomerization, Intermolecular photoreactions, the coordination compound specificity. Ligand field photochemistry, Photochemistry from LC or LLCT states, Inner-sphere charge transfer photochemistry, Outer-sphere charge transfer photochemistry, Photosensitized reactions, Homogeneous photocatalysis.

Natural photo-processes involving inorganic compounds

From interstellar space to planetary atmospheres: Homogeneous systems: from interstellar space to planetary atmospheres and primitive soup models. Heterogeneous photochemistry in ice phases.

UNIT-II

[16 HOURS]

Applications: Fluorescent and chromogenic sensing and labeling: Cations as targets in biochemical sensing Cations common in biological systems, Fluorescent detection of toxic cations, Fluorescent and chromogenic sensing of anions, Common anions and Toxic anions. Optical detection of neutral molecules. Nanoparticles in biochemical sensing and labeling.

Therapeutic strategies; Photobio-stimulation, Photo-activation of drugs, Photodynamic therapy, Mechanisms of PDT and PTT. Photosensitizers, Inorganic photosensitizers, Supporting role of metal ions in photodynamic therapy, and Combination of polypyrrolic photosensitizers and metallo-pharmaceuticals, Recent PDT development and Nanomedical methods.

Photodynamic inactivation of microorganisms: Bacteria, Viruses, Fungi and Parasites.

Phototoxicity and photoprotection: Chemical and physical photoprotection. Inorganic sunscreens.

Photocatalysis in environmental protection: Development of homo- and heterogeneous methods. Homogeneous photocatalysis and heterogeneous photocatalysis. Water and air detoxification. Other applications of photocatalysis.

References

1. Bioinorganic Photochemistry- Grazyna Stochel, Malgorzata Brindell, Wojciech Macyk, Zofia Stasicka, Konrad Szacilowski. Wiley Publishers (2009).
2. Photochemistry and Photophysics of Coordination Compounds I-Volume Editors: Balzani, V., Campagna, Springer Publications.Vol.280, 2007.
3. Photochemistry and Photophysics of Coordination Compounds II - Volume Editors: Balzani, V., Campagna, Springer Publications.Vol.281, 2007.

MEDICINAL CHEMISTRY

COURSE CODE: 21CHD57

Objectives

- To familiarize with the methods of isolation, structural elucidation and synthesis of carotenoids and vitamins.
- To learn the basics of medicinal chemistry.
- To understand the synthesis and applications of synthetic drugs.

Course Outcome

- To acquire the knowledge of biological significances of Carotenoids and vitamins.
- Understand the pharmacodynamics, pharmacokinetics and chemotherapy of several drugs.
- Synthesis and mechanism of drug actions of antimalarial, anticancer agents and cardiovascular drugs.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are used in class room teaching.

Course content

UNIT-I

[16 HOURS]

Carotenoids: Methods of isolation. Structure elucidation and synthesis of β-carotene. Structural relationship of α-, β- and γ-carotenes.
Vitamins: Introduction, constitution, synthesis and biological significance of thiamine, riboflavin, pyridoxine, biotin, ascorbic acid, vitamin A1 & A2, E1 and E2 , B12 and K groups.

UNIT-II

[16 HOURS]

Medicinal chemistry: Introduction, pharmacodynamics, pharmacokinetics, chemotherapy, metabolites antimetabolites, agonists and antagonists. Classification of drugs on the basis of therapeutic action. Concept of pro drug and soft drug. Theories of drug activity: Occupancy theory, rate theory, induced fit theory, concept of drug receptors. Evaluation methods: Free-Wilson analysis, Hansch-analysis, ID_{50} and IC_{50} (mathematical derivation of equation excluded).
Antipyretics: Aspirin, paracetamol, phenacetin, novalgin and their mechanism of action.
Antimalarials: Structure, synthesis and mechanism of action of quinine and chloroquine.
Hypnotics: Analgesics and sedatives: phenoborbitol, chlordiazepoxide, meprobamate.
Stimulants: Structure, action and synthesis of caffeine.
Antineoplastics: Structure, pharmacological action and synthesis of 5-flurouracil, chlorambucil, cyclophosphaminde and podophyllotoxin.
Cardiovascular drugs: Introduction, synthesis of dithiazem, verapamil, methyldopa, atenolol and oxprenolol.

References

1. Organic Chemistry, VI edition, Robert T. Morrison, Robert N. Boyd.
2. Organic Chemistry, Vol-II by I. L. Finar.
3. A text book of synthetic drugs, O. D. Tyagi and M. Yadav.
4. Synthetic drugs, Gurdeep R. Chatwal.
5. Medicinal chemistry by Graham Patrick.

QUANTUM CHEMISTRY AND BIOSENSORS
COURSE CODE: 21CHD58

Objectives

- To understand the applications of quantum mechanics to HMO theory.
- To learn the basics of biosensors and their applications.

Course Outcome

- Applications of quantum chemical methods in the theoretical evaluation of energies of molecules and reactions.
- Development of chemical and biochemical sensors and their applications in the determination of biomolecules.

Pedagogy

- Conventional method such as black board and chalk is used.
- Modern methods like power point presentation and animations are also used in class room teaching.
- Students will be assigned to solve the numerical problems.

Course content

UNIT-I

16 HOURS]

Applications of quantum mechanics: Variation theorem: Statement and proof, application of variation theorem to a particle in one dimensional box, linear oscillator, H and He-atoms. Molecular orbital theory, LCAO-MO approximation, application to hydrogen molecule ion (H^{2+}), energy levels of H^{2+}, bonding and antibonding molecular orbitals, energy distribution, potential energy diagrams. Valence bond theory (VB), theory of H_2 molecule, Heitler-London method, energy levels, various modifications of Heitler-London wave function. Comparison of MO and VB theories. SCF method for many electron atom. Slater Orbitals –Effective nuclear charge (ENC), expressions for slater orbitals for 1s, 2s, 3s, 2p and 3d electrons (no derivation), Slater‘s rules for calculation of ENC. Theories of valence – Introduction, linear and non-linear variation functions, secular equations, coulombic, exchange, normalization and overlap integrals, secular determinants.

Huckel molecular orbital theory: Outline of method, assumptions. Application to ethylene, allyl radical, cyclopropenyl radical, butadiene, cyclobutadine, bicyclobutadine and benzene. Calculation of delocalization energy, charge density, π-mobile bond order and free valence.

UNIT-II

[16 HOURS]

Biosensors: Introduction, electrochemical biosensors: Amperometric, potentiometric and conductometric biosensors. Optical based biosensors: Surface plasma resonance, chemiluminesence, fibre optic biosensors, piozoelectronic sensors, mass selective and thermal sensors. Bio-recognition elements in biosensors, immobilization methods, principles of biorecognition, natural, semi-synthetic and synthetic biorecognition elements. Metabolism sensors: Glucose sensors, galactose sensors. Determination alcohol, ascorbic acid, D-isocitrate, oxalate, oxaloacetate, nitrite, nitrate, carbon monoxide, glycerol, triglycerides and sucrose. Biosensors using coupled enzyme reactions.

Applications of biosensors: Determination of glucose in blood, survey of biosensor methods for the determination of glucose. Determination of copper (I) in water using anodic stripping voltammetry.

References

1. Introductory Quantum Chemistry – A.K. Chandra. Second Edition, Tata McGraw Hill Publishing Co. Ltd., (1983).
2. Quantum Chemistry – Eyring, Walter and Kimball. John Wiley and Sons, Inc.
3. Quantum Chemistry –I.N. Levine. Pearson Education, New Delhi, (2000).
4. Theoretical Chemistry – S. Glasstone. East West Press, New Delhi, (1973).
5. Quantum Chemistry – R.K. Prasad, New Age International Publishers, (1996).
6. Valence Theory – Tedder, Murel and Kettle.
7. Surface chemistry: Theory and applications, J. J. Bikertman, Academic press, (1972).
8. Chemical Kinetics, K. J. Laidler 3rd Edn., Harper International Edn., (1087).
9. Test Bok of Physical Chemistry, S. Glasston, McMillan India Ltd., 2nd Edn. (1986).
10. Physics at Surfaces, A. Zangwill, Combridge University Press (1988).
11. Surface Crystallography, L. J. Clarke, Wiley-Interscience (1985).
12. Biosensors: Fundamentals and Applications, Bansi Dhar Malhotra and Chandra Mouli Pandey, Smither Group Co., 2017, UK.
13. Biosensors: Techniques and Instrumentations in Analytical Chemistry, Frieder Scheller and Florian Schubert, Vol. 11, Elsevier Sci. Publishers, 1992.
14. Chemical Sensors and Biosensors, Brian R. Eggins, John Wiley & Sons Ltd, UK, 2004.