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

B. Sc. (Basic/Honors)
Program in Biochemistry

Biochemistry & Biotechnology
Biochemistry & Microbiology

Under

NATIONAL EDUCATION
POLICY -2020(NEP-2020)

2021-2022

B.Sc syllabus - Programme: Biochemistry-Biotechnology and Biochemistry-Microbiology

Scheme for examination and assessment for B.Sc. Biochemistry under NEP scheme 2021-22

Year	Sem	Course Type	Title of the Course	Combination	Course Code	Credits	Maximum Marks in the Exam/ Assessment				Exam Duration	
						L:T:P	SEE		IA			
I BSc	I	DSC-1 Theory	Chemical Foundations of Biochemistry-1	BC-BT	FSA49040	4:0:0	60	-	40 (20+20)	-	2.5h	-
				BC-MB	FSA49042							
		DSC-1 Practicals	Chemical Foundations of Biochemistry-1	BC-BT	FSA49040	0:0:2	-	25	-	25 (10+15)	-	3 h
				BC-MB	FSA49042							
		OE-1 Theory	Biochemistry in Health and Diseases	-	-	3:0:0	60	-	40 (20+20)	-	2.5h	-
		SEC-1 Theory	Biochemical Techniques-1	-	-	2:0:0	60	-	40 (20+20)	-	2.5h	-
		SEC-1 Theory	Microbiological quality of food and water	-	-	2:0:0	60	-	40 (20+20)	-	2.5h	-
	II	DSC-2 Theory	Chemical Foundations of Biochemistry -2	BC-BT	FSB49040	4:0:0	60	-	40 (20+20)	-	2.5h	-
				BC-MB	FSB49042							
		DSC-2 Practicals	Qualitative and Quantitatve analysis	BC-BT	FSB49040	0:0:2	-	25	-	25 (10+15)	-	3 h
				BC-MB	FSB49042							
		OE-2 Theory	Nutrition and Dietetics	-	-	3:0:0	60	-	40 (20+20)	-	2.5h	-
		SEC-2 Theory	Biochemical Techniques-2	-	-	2:0:0	60	-	40 (20+20)	-	2.5h	-
		SEC-2 Theory	Bioinformatics	-	-	2:0:0	60	-	40 (20+20)	-	2.5h	-

Preamble

Biochemistry, today is considered as an application oriented integrated basic science. It's an interdisciplinary science that has emerged by the confluence of principles of Chemistry, Physics and Mathematics to Biology. Advances in Biochemistry have immense positive implications on the understanding of biochemical interactions, cellular communications, hormonal mechanisms and the cross talks between them. The research in Biochemistry has been translational and there is a shift from hypothesis driven research to data dependent research that promises translational, product oriented research. Much of the advancement in Biochemistry is in the advancement of Biotechnology, as a basic science disciplineBiochemistry lead to Biotechnological advancement. Considering its pivotal role in Biological sciences, it is imperative to strengthen the fundamental concepts of Biochemistry. The current pattern is designed to provide a focused learning outcome-based syllabus at the Honors level providing structured teaching-learning experiences catering to the needs of the students. The honors course will prepare the students academically and prepare them for employability. The program also inculcate various attributes at the Honors level. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability. The new curriculum based on learning outcomes of B. Sc. (Honors) in Biochemistry offers basic knowledgeof chemistry in general, including the concepts in organic, inorganic, physical, analytical, spectroscopy and pharmaceutical chemistry. The course defines clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills. The course also offers skills to pursue research in the field of Biological Chemistry and thus would produce best minds to meet the demands of society.

Curriculum

Name of the Degree Program : B.Sc. (Basic/Hon0rs)
Discipline Core : Biochemistry
Total Credits for the Program :184 Starting year of implementation: 2021-22

The learning outcomes are designed to help learners understand the objectives of studying B.Sc. Biochemistry (Honors) that is, to analyze, appreciate, and understand the basic concepts of biomolecular processes and chemical reactions occurring in the living system. This course is fundamental to tackle many of the health – related challenges facing society. Considering the rapid and far-reaching advances in biological sciences in 21st century, it is imperative to have curriculum incorporating these updated emerging concepts of biochemistry. The current pattern is designed to impart concept-based learning with emphasis on hands-on training, skill development and research. Aimed at multi-faceted development of a student, the curriculum includes courses encompassing core courses, intra and inters discipline specific courses, skill and ability enhancement courses to impart in-depth knowledge in biochemistry complemented with varied subjects and skills. The course seeks to discover and nurture typical attributes of a competent science graduate such as; spirit of inquiry, critical thinking, problem solving, analytical reasoning, aptitude to research/industry and entrepreneurial instincts.

Program Learning Outcome: The learning outcome-based curriculum is specific in terms of changes in cognitive and psychomotor behavior of students. Biochemistry Honors course is intended to provide a broad framework enabling students to acquire a skill set that helps them understand and appreciate the field of biochemistry. The structure or design of this framework shall ensure a high standard of the Honors degree in Biochemistry at national level. The program specification are intended as a reference point for prospective students, current students, academic in delivering the program and realizing its objectives. Keeping in pace with the developmental trends in Biochemistry and allied areas, it is expected that the students undertaking Biochemistry (Honors) course become conversant with the essence of Biochemistry and exhibit certain levels of learning outcomes as proposed below;

PROGRAMME OUTCOME (PO)

PO1	To create interest in Biochemistry and appreciation for chemical basis of biological processes.
PO2	To inculcate the spirit of inquiry and value of systematic study of a discipline. Provide a general understanding of the related disciplines with a holistic knowledge generation in biological sciences.
PO3	To provide an in-depth understanding of chemical reaction mechanisms in biological processes.
PO4	To provide a flavor of historical developments of enzymes and their applications in research, diagnostics and various industries.
PO5	Gain proficiency in basic laboratory techniques and be able to apply the scientific method to the processes of experimentation, hypothesis testing, data interpretation and logical conclusions.
PO6	Develop problem solving and analytical skills through case studies, research papers and hands-on-experience
PO7	To appreciate biochemical mechanistic basis of physiological processes, metabolism under normal and pathological conditions importance and levels of metabolic regulations.
PO8	To apply and effectively communicate scientific reasoning and data analysis in both written and oral forms. They will be able to communicate effectively with well-designed posters and slides in talks aimed at scientific audiences as well as the general public.
PO9	To bridge the knowledge and skill gap between academic out and industry requirements.
PO10	To give students experience in conducting independent, hypothesis-driven, biological research, project planning and management
PO11	To provide skills to publish research findings, and awareness of IP rights, and scientific publication ethics and problems of plagiarism.
PO12	To prepare competent human resource with better knowledge, hands-on-experience and scientific attitude, at national and global levels for careers in research and development, academia and Pharma-, biotech- and agro-, and food processing industries.

GRADUATE ATTRIBUTES B. Sc. BIOCHEMISTRY (Honors):

Graduates with strong academic knowledge, discipline-specific and generic skills complemented with social responsibility are greatest asset of the country. The curriculum frame work under NEP for Biochemistry graduates aims to build the following attributes;

Disciplinary Knowledge:

a) Ability to comprehend fundamental concepts of biology, chemistry and apply basic principles of chemistry to biological systems.
b) Ability to relate various interrelated physiological and metabolic events.
c) Ability to critically evaluate a problem and resolve to challenge blindly accepted concepts
d) Ability to think laterally and in an integrating manner and develop interdisciplinary
e) Good experimental and quantitative skills and awareness of laboratory safety
f) A general awareness of current developments at the forefront in biochemistry and allied subjects.
g) Awareness of resources, and their conservation.

Communication Skills:

a) Ability to speak and write clearly in English and local language
b) Ability to listen to and follow scientific viewpoints and engage with them.
c) Ability to understand and articulate with clarity and critical thinking one's position.

Critical Thinking:

a) Ability to conceptualize critical readings of scientific texts in order to comprehend.
b) Ability to place scientific statements and themes in contexts and also evaluate them in terms of generic conventions.

Problem Solving:

a) Ability make careful observation of the situation, and apply lateral thinking and analytical skills.

Analytical Reasoning:

a) Ability to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments. b. Ability to use scientific evidences and experimental approach to substantiate one's argument in one's reading of scientific texts.

Research Skills:

a) Ability to formulate hypothesis and research questions, and to identify and consult relevant sources to find answers.
b) Ability to plan and write a research paper.

Teamwork and Time Management:

a) Willingness to participate constructively in class room discussions and contribute to group work.
b) Ability to meet a deadline.

Scientific Reasoning:

a) Ability to analyze theories and beliefs, evaluate ideas and scientific strategies.
b) Ability to formulate logical and convincing arguments.

Reflective Thinking:

a) Ability to locate oneself and see the influence of location—regional, national, global— on critical thinking.

Self-Directing Learning:

a) Ability to work independently in terms of organizing laboratory, and critically analyzing scientific literature.
b) Ability to postulate hypothesis, questions and search for answers.

Digital Literacy:

a) Ability to use digital resources, and apply various platforms to convey and explain concepts of biochemistry.

Multicultural Competence:

a) Ability to engage with and understand cultures of various nations and respect and transcend differences.

Moral and Ethical Values:

a) Ability to interrogate one's own ethical values, and to be aware of ethical and environmental issues.
b) Ability to read values inherited in society and criticism vis-a-vis, the environment, religion, spirituality, and structures of power.

Leadership qualities:

a) Ability to lead group discussions, to formulate questions related to scientific and social issues.

Life-long Learning:

a) Ability to retain and build on critical thinking skills, and use them to update scientific knowledge and apply them in day to day business.

Exit Options and credit requirement

Progressive Certificate in Science, Diploma in Science, Bachelor of Science Degree or Bachelor of Science Degree with Honors in Biochemistry is awarded at the completion of every progressive year.

A student will be allowed to enter/re-enter only at the ODD semester and can only exit after EVEN semester. Re-entry at various as lateral entrants in academic programs based on the above mentioned earned credits and proficiency test records.

Exit with	**Credit requirements**
CERTIFICATE IN SCIENCE at the successful completion of First year (Two Semesters) of the Four Years Multidisciplinary Undergraduate Degree Program.	50
DIPLOMA IN SCIENCE at the successful completion of Second year (Four Semesters) of the Four Years Multidisciplinary Undergraduate Degree Programme.	100
BACHELOR OF SCIENCE DEGREE at the successful completion of Three year (Six Semesters) of the Four Years Multidisciplinary Undergraduate Degree Programme.	142
BACHELOR OF SCIENCE DEGREE WITH HONOURS IN BIOCHEMISTRY at the successful completion of Four year (Eight Semesters) of the Four Years Multidisciplinary Undergraduate Degree Program.	184

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 molarsolutions. (Problems to be given in exams). Calculation and preparation of normalsolutions 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

Open Elective Course Code: OE-1T:BC-103;
Course Title: Biochemistry in Health and Diseases (theory)

COURSE TITLE	Biochemistry in Health and Diseases
Couse code	OE-1T: BC-103
Course credits	03
Total contact hours	42
Duration of ESA (Hour)	03
Formative assessment marks	30
Summative assessment marks	70

Course Outcome: This open elective course offering to students of various streams gives knowledge about health and various terminologies used in health and disease conditions; Difference between communicable and non-communicable diseases; Health promotion and treatments for various diseases and disorders.

Content of Theory course- Biochemistry in Health and Diseases Total credits =3	**42 hr**
Unit 1: Introduction	**14 hr**
WHO definition of health, Health and hygiene, General health care, Factors affecting health, Indices and evaluation of health, Disease patterns in developed and developing world; Classification of diseases - Endemic, Epidemic, Pandemic; Professional health hazards. Disease conditions: Acute disease, Chronic disease, Incurable disease, Terminal disease, Illness, disorders, Syndrome, Pre-disease.	
Treatment: Psychotherapy, Medications, Surgery, Medical devices, and Self-care. Dimensions of Health: Physical, Mental, Spiritual, Emotional, Environmental, and Philosophical.	
Unit 2: Types of Diseases	**14 hr**
Tuberculosis, Cholera, Typhoid, Conjunctivitis. Sexually transmitted diseases (STD): Information, statistics, and treatment guidelines for STD, Prevention: Syphilis, Gonorrhea, AIDS, etc. Non-communicable diseases: Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma. Genetic disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Thalassemia, Sickle cell anemia. Lifestyle disorders: Obesity, Liver cirrhosis, Diabetes mellitus, Hypertension (Causative agents, symptoms, diagnosis, treatment, prognosis, prevention)	

Unit 3: Health Promotions	**14 hr**
Preventing drug abuse, Oral health promotion by tobacco control. Mental hygiene and mental health: Concepts of mental hygiene and mental health, Characteristics of mentally healthy person, Warning signs of poor mental health, Promotive mental health, strategies and services, Ego defense mechanisms and implications, Personal and social adjustments, Guidance and Counseling. Infection control: Nature of infection, Chain of infection transmission, Defenses against infection transmission	

References

1. Modern Nutrition in Health and Disease 2006 10th Edition by Maurice E. Shils, Moshe Shike, A Catharine Ross.
2. Clinical Biochemistry and Metabolic Medicine, 2012 Eighth Edition by Martin Andrew Crook, CRC Press,
3. Nutrition & Health in Developing Countries, 2000, Editors: R. Semba and M.W. Bloem, Humana 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

Skill enhancement course: Course Code: SEC-1T:BC-104.1; Course Title: Biochemical Techniques-1 (theory)

Course title	Biochemical Techniques-1
Course code	SEC-1T: BC-104.1
Course credits	02
Total contact hours	28
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course Level Learning Outcomes: Students will be exposed to various spectrophotometry and chromatographic techniques and their applications in separation of chemicals like biomolecules, organic chemicals, drugs etc.

Content of Theory course- Biochemical Techniques-1 Total credits =2	**28 hr**
Unit 1: Photometry	14 hr
Principle of light absorption by molecules. Beer-Lambert law, Types of spectrophotometers. Principals and working of colorimeter, Visible spectrophotometer, UV-Visible spectrophotometer, Fluorescent spectrophotometry, nano-drop-spectrophotometry, Atomic absorption spectrophotometry. Types of Detectors-Phototube, Photomultiplier tube, Photo diode, Diode array detector, Charge coupled device detectors. Applications of spectrophotometry in estimation of organic compounds, enzyme assays, enzyme kinetics, recording spectrum, time-lapse studies,	
Unit 2: Chromatography	14 hr
Separation of small molecules by TLC, column chromatography, HPLC, and GLC.RP-HPLC, normal phase HPLC, HILIC. Column materials, ODS v/S BDS columns, Different columns used in HPLC, and GLC. Different types of detectors used in HPLC and GLC. Preparation of sample for separation by HPLC and GLC. Importance of column material and pore size. Isocratic v/s gradient HPLC	
References 1. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath –Himalaya Publ. House. 2. Principles & Techniques of Practical Biochemistry – Wilson, Walker- Cambridge Univ.Press. 3. Chromatography – G. Abbott. 4. Physical Biochemistry- Application to biochemistry and molecular biology by David Freifelder. W. H. Freeman & Co. San Fransisco. 2nd Edition	

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

Skill enhancement course: Course Code: SEC-1T: BC-104.2; Course Title: Microbiological quality of food and water (Theory)

Course title	Microbiological quality of food and water
Couse code	SEC-1T: BC-104.2
Course credits	02
Total contact hours	28
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course Level Learning Outcomes: Students will learn various means of microbial contaminations in water and food and their implications on health. Student will learn about the standard methods of detection of contaminating microorganisms in food and water samples.

Content of Theory course- Microbiological quality of food and water **Total credits =2**	**28 hr**
Unit 1: Water Quality & Assessment	**14 hr**
Sampling of water to detect the microbiological quality of water. Isolation of microorganisms from water sample. Medium: Growth medium, differential medium and specific medium. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for fecal coliforms (b) Membrane filter technique and (c) Presence/absence tests	
Unit 2: Microbiology of Food	**14 Hr**
Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods. Cultural and rapid detection methods of food borne pathogens in foods. Food borne diseases: Food intoxication, food infection, shigellosis. Food sanitation and control: HACCP, Indices of food sanitary quality and sanitizers.	

References:

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, NY.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Gould GW. (1995). New Methods of Food Preservation. Blackie Academic and Professional, London.
7. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th Ed., CBS Publishers and Distributors, Delhi, India.
8. Lund BM, Baird Parker AC, and Gould GW. (2000). The Microbiological Safety and Quality of Foods. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
9. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

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

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 Age International Publications
4. Introduction to Stereochemistry 2012, Kurt Mislow, Dover Publications
5. A text book of Organic Chemistry 2016, Raj K Bansal, 6th edition, New Age International 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, India Ltd.
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
Seminar/ class work	10
Assignment/ open discussion/ quiz	10
Total	40

Course code: DSC-2P: BC-202;
Course Title: Qualitative and Quantitatve analysis – practicals-2

Course title	**Qualitative and Quantitative analysis-practical's-2**
Couse code	DSC-2P: BC-202
Course credits	02
Total contact hours	56 (4 h/ week)
Duration of ESA (Hour)	3
Formative assessment marks	25
Summative assessment marks	25

Course Outcome: The Course Objective is to provide experimental practice of quantitative and qualitative analysis. Also it provides training in physical chemistry laboratory techniques. Upon successful completion, students should develop skills in handling instruments and understand its application in research work.

Content of Practical course- Qualitative and quantitative analysis-2	
Total Teaching Hours = 56; **Total Credits = 2**	**56 hr**
List of experiments to be conducted	
1. Systematic Semi micro–Qualitative Analysis of Inorganic Salt Mixtures Systematic semi micro qualitative analysis of two acid and two basic radicals in the given inorganic salt mixture. The constituent ions in the mixture to be restricted to the following. (Any four binary mixtures shall be given) Anions: HCO -, CO_2-, Cl-, Br-, NO -, BO 3-, SO 2- and PO_3-. Cations: Pb_2+, Al_3^+, Fe_2^+, Fe_3^+, Mn_2^+, Zn_2^+, Ca_2^+, Sr_2^+, Ba_2^+, Mg_2^+, K^+, Na^+ and NH^+. Determination of density and viscosity of the given liquid using specific gravity bottleand Ostwald's viscometer. 2. Determination of density and surface tension of the given liquid using specific gravity bottle and stalagnometer. 3. Determination of molecular weight of non-volatile solute by Walker-Lumsden method. 4. Determination of rate constant of decomposition of H_2O_2 using $KMnO_4$ by volumetric analysis method using ferric chloride as catalyst. 5. Determination of distribution coefficient of benzoic acid between water and benzene or iodine between water and carbon tetrachloride. 6. Separation of Two Components from given Binary Mixture of Organic Compounds Qualitatively. (Types of binary mixtures- Solid – Solid, Solid – Liquid, Liquid – Liquid) 7. Verification of Beer's Law. Estimation of unknown concentration of a	

biomolecule by using colorimeter 8. Calibration of pH meter and determination of pH of aerated soft drinks.	

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

Open Elective Course Code: <u>OE-2T:BC-203</u>;
Course Title: <u>Nutrition and Dietetics</u> (theory)

Course title	Nutrition and Dietetics
Couse code	OE-2T: BC-203
Course credits	03
Total contact hours	56
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course outcomes:

- The student will gain knowledge about energy requirements and the Recommended Dietary Allowances.
- The student will understand the functions and role of macronutrients, their requirements and the effect of deficiency and excess
- The student learns the impact of various functional foods on our health
- The student will be able to apply basic nutrition knowledge in making foods choices and obtaining an adequate diet.
- The student gains competence in connecting the role of various nutrients in maintaining health and learn to enhance traditional recipes.

Content of Theory course- Nutrition and Dietetics **Total credits =3**	**42 hr**
Unit 1: Basic Concepts of Nutrition	**14 hr**
Introduction, Basic principles of a balanced diet to provide energy and nutrients. Composition of foods and proximate analysis of foods. Calorific value of foods and Basal metabolism. Basal Metabolic Rate (BMR), Factors affecting BMR, Energy requirements for different physical activities, Specific dynamic action of food, Nutritive value of proteins. Energy requirements and recommended dietary allowance (RDA) for infants, children and pregnant women. Protein calorie malnutrition.	
Unit 2: Macronutrients and Micronutrients	**14 hr**
Carbohydrates- Digestible and non-digestible, Dietary fibers, Essential fatty acids, lipoproteins and cholesterol. Essential amino acids, Fortification of foods, Protein requirement for different categories. Vitamins-Sources, requirements, functions and deficiency symptoms of Vitamin-C, Thiamine, Riboflavin, Pyridoxine, Folic acid, Vitamin B12. Absorption of fat-soluble vitamins- A, D, E and K. Micronutrients: Source, Daily requirement, functions and deficiency disease symptoms of Macro-minerals (Ca, P, and Cl) and micro minerals/trace elements (I, Fe, Zn and Se).	

Unit 3: Dietetics and Diet Therapy	**14 hr**
Introduction. Food pyramid. Diet planning and introduction to diet therapy. Nutritional requirements for different age groups, anemic child, expectant women, and lactating women. Diet planning for prevention and cure of nutritional deficiency disorders. Diet therapy: Functional foods, Anthropometric measurements, dietary considerations during fever, malaria, and tuberculosis. Prevention and correction of obesity, underweight, and metabolic diseases by diet therapy. Dietary interventions to correct and or manage the gastrointestinal diseases (indigestion, peptic ulcer, constipation, diarrhea, steatorrhea, irritable bowel syndrome. Functional foods-based diet therapy for diabetes, cardiovascular disease and cancer.	

References

1. Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.
2. Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holds worth M. Oxford University Press, Print ISBN-13: 9780199585823.
3. Krause's Food, Nutrition and Diet therapy, 2003, Mahan KL and Escott-Stump S. Elsevier, ISBN: 9780721697840.
4. Human Nutrition and Dietitics. 1986, Passmore R. and Davidson S. Churchill Livingstone Publications, ISBN-10: 0443024863.
5. Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & SchusterPublishers, Australia, ISBN 10: 0731812999
6. Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN: 9780199489084/0199489084.
7. Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/ 8122420222.

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

Skill enhancement course: Course Code: SEC-2T:BC-204.1; Course Title: Biochemical Techniques-2 (theory)

Course title	Biochemical Techniques-2
Couse code	SEC-2T: BC-204.1
Course credits	02
Total contact hours	28
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course Level Learning Outcomes: Students will be exposed to various electrophoretic and mass spectrometry techniques and their applications in biomolecular separations and drug discovery. A thorough understanding of the above techniques would provide job opportunities in CROs for drug discovery and metabolism and also in diagnostic development companies.

Content of Theory course- Biochemical Techniques-2 Total credits =2	**28 hr**
Unit 1: Electrophoresis	14 hr
Protein and nucleic acid Separations: PAGE, Non-denaturing PAGE, Non-reducing SDS-PAGE. 2-D electrophoresis, Preparation of pH gradient gel. Procedure of preparation of polyacrylamide gels, importance of buffers in electrophoretic separations, importance of stacking and resolving gels, use of denaturing agents and reducing agents in electrophoresis. Applications of electrophoretic techniques in disease diagnosis. Staining techniques- Coomassie staining, PAS staining, Silver staining, Fluorescent dye staining, Submerged-gel electrophoresis for the separation of nucleic acids. Nucleic acid staining Techniques. Zymography.	
Unit 2: Mass spectrometry	14 hr
Ionization techniques: Electro ionization, Fast-atom bombardment, Electro-spray ionization, Chemical ionization, Photo-ionization, MALDI. Construction and applications of Mass spectrometer, LC-MS/MS, GC-MS/MS. Preparation of samples for LC-MS and GC-MS. Detectors: Electron multiplier, Faraday's cup, Photomultiplier conversion dynode, Array detectors. Application of LC-MS and GC-MS in drug discovery and metabolic studies.	
References 1. Biophysical Chemistry, Principles & Techniques – Upadhyay, Upadhyay and Nath –Himalaya Publ. House. 2. Principles & Techniques of Practical Biochemistry – Wilson, Walker-Cambridge Univ.Press. 3. Chromatography – G. Abbott. 4. Physical Biochemistry- Application to biochemistry and molecular biology by David Freifelder. W. H. Freeman & Co. San Fransisco. 2nd Edition 5. LC-MS in drug analysis Methods and protocols. Edr.Lorali J. Langman, Christine L H Snozek, Springer publications	

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

Skill enhancement course: Course Code: SEC-2T:BC-204.2; Course Title: Bioinformatics (theory)

Course title	Bioinformatics
Couse code	SEC-2T: BC-204.2
Course credits	02
Total contact hours	28
Duration of ESA (Hour)	03
Formative assessment marks	40
Summative assessment marks	60

Course level learning outcomes:

By studying this course the students completing B.Sc. (Hons) Biochemistry will have an understanding of the tools of bioinformatics and computational biology and will be in a position to access biological data bases and softwares which will be helpful in understanding sequence alignments and predicting the structures of biomolecules such as proteins. Students will be exposed to available bioinformatics tools and databases. They will be in a position to comprehend the fundamental aspects of in-silico protein structure prediction. They will understand application of theoretical approaches to biological systems. Students will get trained in the application of programs used for database searching, protein and DNA sequence analysis, and prediction of protein structures.

Content of Theory course- Bioinformatics **Total credits =2**	**28 hr**
Unit 1: Introduction to Bioinformatics	**14 hr**
Bioinformatics: Introduction, Basics of Computer and operating systems, Hardware, Software, Introduction to programming Languages and Paradigms, PERL/R programming, role of supercomputers in biology. Scope of bioinformatics - Genomics, Proteomics, comparative and functional genomics, Genome annotation, gene prediction approaches and tools. Transcriptome and Proteome, Tools of proteome analysis. DNA microarray: understanding of microarray data and correlation of gene expression data to biological processes and computational analysis tools. Computer aided drug design (CADD) and Systems Biology.	
Unit 2: Database & Sequence Alignment	**14 hr**
Biological databases: Introduction to biological databases - primary, secondaryand composite databases, useful programs, ClustalW, BLASTp. NCBI, EBI,ExPaSy, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), proteindatabases (PIR, Swiss-Prot,TrEMBL, PDB), metabolic pathway database(KEGG, EcoCyc). Sequence alignment: Similarity, identity and homology. Concept of Alignment: Pair-wise sequence alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62, local and global sequence alignment, multiple sequence alignment, Progressive Alignment Algorithm, Application of multiple sequence alignment. BLAST and CLUSTALW.	

References:

1. Bioinformatics – 2008. Principles and Applications, 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India),
2. M. Michael Gromiha, 2010. Protein Bioinformatics: From Sequence to Function, Academic Press.
3. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York)
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey).
5. NCBI data base, open source learning

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

B. Sc. Degree Examinations according to NEP 2021

60 : 40 pattern

Theory papers: Total marks = 100 marks

C1= 20 marks(IA)
C2= 20marks(IA)
C3= 60marks (Main exam.)

Practical papers: Total marks = 50 marks

C1= 10 marks (IA)
C2= 10 marks(IA) +05(Record)
C3= 25 marks (Main Exam.)

IA = Internal assessment (Assignment/seminar/test/viva-voce).

B.Sc. DEGREE (BASIC/HONS) I AND II SEMESTERS EXAMINATION
MODEL QUESTION PAPER
BIOCHEMISTRY

TIME : 3 h MAX. MARKS: 60

NOTE: ALL SECTIONS ARE COMPULSORY

SECTION – A

1. Answer any FIVE of the following 5 x 2 = 10
   a.
   b.
   c.
   d.
   e.
   f.
   g.

SECTION – B

Answer any FOUR of the following 4x 5 = 20

2.
3.
4.
5.
6.
7.

SECTION – C

Answer any THREE of the following 3 x 10 = 30

8.
9.
10.
11.
12.

Note*: section C may include sub questions a, b*

B. SC. DEGREE (BASIC/ HONS.) I AND II SEMESTERS EXAMINATION

MODEL QUESTION PAPER (PRACTICALS)

BIOCHEMISTRY

Time: 3 h Max. Marks: 25

1.	Write the principle and procedure of_____experiment	05
2.	Major experiment (Conduct and report the results)	15
3.	Viva-voce	05

B.Sc. DEGREE (BASIC/HONS) I AND II SEMESTERS EXAMINATION

SCHEME OF THEORY EXAMINATION

I B.Sc., I SEMESTER

DSC-I

TITLE: Chemical Foundations of Biochemistry-1

Times: 3hrs **Max Marks: 60**

Question Paper to be set for total of 94 marks including choices

UNITS	2 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: 1 **Scope of Biochemistry and Units of measurement**	2	1	1.5	24
UNITS: 2 **Atomic structure and Chemical bonds**	2	2	1	24
UNITS: 3 **Buffers and Colligative properties**	2	1	1.5	24
UNITS: 4 **Electrochemistry and Redox reactions**	1	2	1	22

I Main: 2x7=14 Marks

II Main: 5x6=30 Marks

III Main: 10x5=50 Marks

DSC 1- PRACTICALS
SCHEME OF PRACTICAL EXAMINATION
I B.Sc., I SEMESTER

TITLE: Volumetric Analysis-Practicals-1

Times:3hrs **Max Marks: 25**

Practical proper :15
Vivo voce : 05

NOTE :- Candidates are required to submit the records duly signed by the teacher-in charge and certified by the Head of the Dept.

PART- A **05 Marks**

I. Any one of the following experiment may be given for procedure writing.

1. Concept of molarity, molality and normality. Calculation and preparation of molarsolutions. (Problems to be given in exams). Calculation and preparation of normalsolutions 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.

PART – B 15 Marks

II. Any one of the following experiment may be Set

1. Preparation of standard Sodium carbonate solution, standardization of HCl (Methylorange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein).
2. Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H_2SO_4 in the given solution (phenolphthalein).
3. Preparation of standard Oxalic acid. Standardization of $KMnO_4$ and estimation of H_2O_2 in the given solution.
4. Preparation of standard $K_2Cr_2O_7$. Standardization of $Na_2S_2O_3$ and estimation of $CuSO_4$ in the given solution.
5. Preparation of $ZnSO_4$. Standardization of EDTA and estimation of total hardness of water using Eriochrome-Black-T indicator.
6. Preparation of standard potassium bipthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).
7. Estimation of sulphuric acid and oxalic acid in a mixture using standard NaOH solution and standard $KMnO_4$ solution.
8. Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration).
9. Preparation of standard oxalic acid solution. Standardization of NaOH solution and estimation of acidity in vinegar.
10. Preparation of standard potassium bi-phthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids
11. Preparation of standard Oxalic acid solution. Standardization of $KMnO_4$ solution and estimation of calcium in milk.

III. Viva-voce 05 Marks

Total marks: 25: [15 (Practical Exam) + 05 (viva)]

SCHEME OF VALUVATION
(ASSESMENT OF EXPARIMENTAL RESULTS)

PART - B

Preparation of standard solution and calculation of normality - 3 Marks

Standardization and estimation

Discrepancy in titre values	Standardization	Estimation
□ 0.1 ml	4 Marks	4 Marks
□ 0.2 ml	3 Marks	3 Marks
□ 0.3 ml	2 Marks	2 Marks
□ 0.5 ml (or) any other value	1 Marks	1 Marks
CALCULATIONS	2 Marks	2 Marks