JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(AUTONOMOUS)
OOTY ROAD, MYSORE – 25

DEPARTMENT OF BIOTECHNOLOGY

SCHEMATIC SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

For B.Sc. Programmes

Chemistry, Zoology, Biotechnology

Biochemistry, Microbiology, Biotechnology

2017-18

YEAR	SEMESTER	COURSE CODE	TITLE OF THE PAPERS	NO. OF CREDITS		LECTURE/PRACTICAL/HOUR/WEEK		TOTAL TEACHING HOURS	
				TH	P	TH	P	TH	P
I	I	CMA22005	CELL BIOLOGY & GENETICS	4	2	4	4	60	60
	II	CMB22005	BIOMOLECULES & BIO-ANALYTICAL TECHNIQUES	4	2	4	4	60	60
II	III	CMC22005	MOLECULAR BIOLOGY & GENETIC ENGINEERING	4	2	4	4	60	60
	IV	CMD22005	PLANT TISSUE & ANIMAL CELL CULTURE	4	2	4	4	60	60
III	V	CME22005	IMMUNOLOGY & MEDICAL BIOTECHNOLO	4	1	4	4	60	30
		CME22205	MICROBIALTECHNOLOGY & AGRICULTURAL BIOTECHNOLOGY	4	1	4	4	60	30
	VI	CMF22005	ENVIRONMENTAL BIOTECHNOLOGY & BIOSTATISTICS	4	1	4	4	60	30
		CMF22205	BIOINFORMATICS AND BIOPROCESS TECHNOLOGY	4	1	4	4	60	30
III	VI SEC	CMF22405	MICROBIAL TECHNIQUES	2	-	2	-	30	-
		CMF22605	ENZYMOLOGY	2	-	2	-	30	-

B.Sc., UG SYLLABUS- PROGRAMME - CZBt

Scheme of study for B.Sc. Biotechnology under CBCS scheme from 2017-18

YEAR	SEMESTER	COURSE CODE	TITLE OF THE PAPERS	NO. OF CREDITS		LECTURE/PRACTICAL/HOUR/WEEK		TOTAL TEACHING HOURS	
				TH	P	TH	P	TH	P
I	I	CMA22006	CELL BIOLOGY & GENETICS	4	2	4	4	60	60
	II	CMB22006	BIOMOLECULES & BIO-ANALYTICAL TECHNIQUES	4	2	4	4	60	60
II	III	CMC22006	MOLECULAR BIOLOGY & GENETIC ENGINEERING	4	2	4	4	60	60
	IV	CMD22006	PLANT TISSUE & ANIMAL CELL CULTURE	4	2	4	4	60	60
III	V	CME22006	IMMUNOLOGY & MEDICAL BIOTECHNOLO	4	1	4	4	60	30
		CME22206	MICROBIALTECHNOLOGY & AGRICULTURAL BIOTECHNOLOGY	4	1	4	4	60	30
	VI	CMF22006	ENVIRONMENTAL BIOTECHNOLOGY & BIOSTATISTICS	4	1	4	4	60	30
		CMF22206	BIOINFORMATICS AND BIOPROCESS TECHNOLOGY	4	1	4	4	60	30
III	VI SEC	CMF22406	MICROBIAL TECHNIQUES	2	-	2	-	30	-
		CMF22606	ENZYMOLOGY	2	-	2	-	30	-

B.Sc., UG SYLLABUS- PROGRAMME - BMBt

Scheme of study for B.Sc. Biotechnology under CBCS scheme from 2017-18

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE

DEPARTMENT OF BIOTECHNOLOGY

Scheme of Examination Programme – B.Sc., CZBt ; Programme code–BSC05

Year	Sem	Course code	
I BSc	I	CMA22005	CELL BIOLOGY &
	II	CMB22005	BIOMOLECULES &
II BSc	III	CMC22005	MOLECULAR BIOL
	IV	CMD22005	PLANT TISSUE & A
III BSc	V	CME22005	DSE 1-IMMUNOLO
		CME22205	DSE 2-MICROBIAL
	VI	CMF22005	DSE 1-ENVIRONM
		CMF22205	DSE 2-BIOINFORMA
		SEC CMF22405	No. Of course 1 SEC 1 -MICROBIA
		CMF22605	SEC 2 -ENZYMOL

Year	Sem	Course code	Title of the Paper	Credits	Maximum Marks						Exam Duration	
				L:T:P	Th	Pr	IA-1		IA-2		Th	Pr
							Th	Pr	Th	Pr		
I BSc	I	CMA22006	CELL BIOLOGY & GENETICS	4:0:2	70	70	10	05	10	05	3H	3H
	II	CMB22006	BIOMOLECULES & BIO-ANALYTICAL TECHNIQUES	4:0:2	70	70	10	05	10	05	3H	3H
II BSc	III	CMC22006	MOLECULAR BIOLOGY &GENETIC ENGINEERING	4:0:2	70	70	10	05	10	05	3H	3H
	IV	CMD22006	PLANT TISSUE & ANIMAL CELL CULTURE	4:0:2	70	70	10	05	10	05	3H	3H
III BSc	V	CME22006	DSE 1-IMMUNOLOGY & MEDICAL BIOTECHNOLOGY	4:0:1	70	70	10	05	10	05	3H	3H
		CME22206	DSE 2-MICROBIALTECHNOLOGY & AGRICULTURAL BIOTECHNOLOGY									
	VI	CMF22006	DSE 1-ENVIRONMENTAL BIOTECHNOLOGY &BIOSTATISTICS	4:0:1	70	70	10	05	10	05	3H	3H
		CMF22206	DSE 2-BIOINFORMATICS AND BIOPROCESS TECHNOLOGY									
		SEC CMF22406	No. Of course 1 SEC 1 -MICROBIAL TECHNIQUES Or	2:0:0	50	-	10	05	10	05	2H	-
		CMF22606	SEC 2 -ENZYMOLOGY									

Scheme of Examination Programme – B.Sc., BMBt ; Programme code –BSC06

Programme Outcome for Bachelor of Science in Chemistry, Zoology, Biotechnology:

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Demonstrate the ability to justify, explain, and approach the concept both in written and oral forms

PO2. Demonstrate the ability to present clear, logical and succinct arguments

PO3. Develop state-of-the-art laboratory skills and professional communication skills.

PO4. Apply the scientific method to design, execute, and analyze an experiment.

PO5. Appreciate the central role of chemistry in the society and use this as a basis for ethical behaviour in issues facing chemists/drugs.

PO6. Understand Chemistry as an integral part for addressing social, economic, and environmental problems.

PO7. Identify the major groups of organisms with an emphasis on animals and plants.

PO8. Compare and contrast the characteristics of animals that differentiate themselves from other living and non-living creatures.

PO9. Give specific examples of physiological adaptations.

PO10. Design and develop solution to Biotechnology problems keeping in mind the safety measures for environment and society.

PO11. Support Biotechnology research activity with strong technical background knowledge.

Programme Specific Outcome

Bachelor of Science in Chemistry, Zoology and Biotechnology

After completing the graduation in the Bachelor of Science the students are able to:

PSO1. Find jobs at all level of chemical, pharmaceutical, food products and life oriented material industries

PSO2. Apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries.

PSO3. Recognize the relationship between different structures and functions at different levels.

PSO4. Characterize the biological, chemical and physical features of environments that Animals inhabit.

PSO5. Demonstrate effectively the applications of biochemical and biological sciences.

PSO6. Know and apply appropriate tools and techniques in biotechnological manipulation

PSO7. Understand his or her responsibilities in biotechnological practices.

Programme Outcome for Bachelor of Science in Biochemistry, Microbiology, Biotechnology:

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

PO2. Develop state-of-the-art laboratory and professional communication skills

PO3. Apply the scientific method to design, execute, and analyze an experiment

PO4. Explain scientific procedures and their experimental observations

PO5.Demonstrate an understanding of fundamental biochemical principles, structure and function

PO6. Work as a laboratory technician, biochemists or medical scientist

PO7. Explain the processes used by microorganisms for the growth

PO8. Explain the theoretical basis of tools, technologies and methods of microbiology

PO9. Design and develop solution to Biotechnology problems

PO10.Applying appropriate tools keeping in mind safety factor for environment & society

PO11. Create, select, and apply appropriate techniques, resources, and modern tools

PO12. Support biotechnology research activity with strong technical background

Programme Specific Outcome
Bachelor of Science in Biochemistry, Microbiology, Biotechnology

After completing the graduation in the Bachelor of Science the students are able to;

PSO 1: Gain and understand biochemical and molecular processes

PSO2: Communicate scientific information effectively, relating to microbes and their role in ecosystem and health

PSO3: Acquire, articulate, retain and demonstrate laboratory safety skills

PSO4: Demonstrate applications of biochemical and biological sciences

PSO5: Apply appropriate tools and techniques in biotechnological manipulation

PSO6: Understand the responsibilities of biotechnological practices

CMA22005/ CMA22006

SEMESTER I
CELL BIOLOGY AND GENETICS (4 CREDITS)

Course Outcome:

After completing the course students are able to:

CO1. Understand in depth cell organelles.

CO2. Understand the details of chromosomes and stem cells.

CO3. Learn the details of Mendelian Genetics and deviation to mendalism.

CO4. Specify in details with examples mutations and chromosomal aberrations.

CELL BIOLOGY

NO. HOURS

UNIT I **15**

Cell: Introduction and Historical perspective, the cell theory, ultra structure of plant and animal cell.

Cell organelles: Structure and functions of – cell wall, plasma membrane, membrane protein, cytoplasm, mitochondria, chloroplast, Golgi complex , endoplasmic reticulum, ribosome, lysosomes, peroxisomes, nucleus. Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

UNIT II **15**

Eukaryotic chromosomes: Types, chromatin structure, nucleosomes, and higher order chromatin organization.

Special chromosomes – Polytene and B chromosome, lamp brush chromosome.

Cell interaction and motility: Cell motility flagellar and ciliary motion .Structure and function of muscle cells, muscle contraction, nerve cell structure and function.

Stem cells, differentiation of stem cells (eg: Haematopoitic stem cells) and their application, blood cells, identification, structure and different types of blood cells, cancer cells.

GENETICS

UNIT III **15**

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Mendelian genetics: Mendel's experimental on monohybrid and di-hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses. Deviation to Mendelian inheritance of genes (13:3 ratio), incomplete dominance (Flower colour in sweet peas) , co dominance (Blood groups in human beings), epistasis(Dominant &recessive epistasis). Sex-linked inheritance (colour blindness), chromosomal theory of inheritance, linkage, crossing over and cytoplasmic inheritance (Plastid inheritance in Mirabilis)

UNIT IV

15 Mutation: Natural and induced mutations, chemical, physical and biological mutagens with an example each.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin.

Chromosomal aberrations: Deletion, duplication, inversion and translocation. Chromosomal aberrations in human beings, abnormalities– Aneuploidy and Euploidy.

PRACTICALS (2 CREDITS)

HOURS : 4 HOURS /WEEK

1. Cell counting methods: using Haemocytometer.
2. Measurements with the help of light microscope.
    a Calibration of ocular micrometer
    b Measurement of biological materials (cells/spores etc.).
    c Demonstration-Separation of cell organelles by differential centrifugation
3. Study of Mitosis -onion root tips.
4. Study of Meiosis –onion flowers buds/rheo flowers
5. Demonstration of plasmolysis and deplasmolysis
6. Isolation of chloroplast from leaves
7. Study of at least five simple mutants of Drosophila-Photographic demonstration
8. Preparation of polytene chromosome from salivary glands of Drosophila
9. Genetic Problems; Monohybrid, Di hybrid and interactions of Genes
10. Special Chromosomes; Lampbrush and Polytene chromosomes
11. Comment (Types of chromosome (slide/picture), chromosomal disorders in humans-Humans -Down's Turner's and Klinefelter's Syndrome

REFERENCES

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. ASMPress& Sunderland, Washington, D.C.; Sinauer Associates, MA.

4.Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.

5.Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons
Inc.

6.Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.

CMB22005/ CMB22006

SEMESTER II
BIOMOLECULES & BIO-ANALYTICAL TECHNIQUES
(4 CREDITS)

Course Outcome:
After completing the course students are able to:
CO1. Understand the properties, structure and biological importance of bio molecules.
CO2. Learn the details of lipids and nuclei acids.
CO3. Identify the classification and characteristics of enzymes.
CO4. Understand in depth bio analytical techniques.

BIOMOLECULES

NO. HOURS

UNIT I: **15**
Carbohydrates: Structure (Fischer and Haworth structure), function and properties of Monosaccharide's (Glucose, Fructose), disaccharides (Sucrose, Maltose and Lactose) and Heteropolysaccharide's- hyaluronic acid and heparin. Reducing and Non reducing Sugars, Stereochemistry- Epimers, Enantiomers, Anomers and Isomers.
Proteins: Amino acids- Zwitter ionic structure, classification based on polarity, pka value. D and L amino acids, optical activity. Peptide bond, primary, secondary, tertiary and quaternary structural organization of proteins. Globular and fibrous proteins with special reference to structure of haemoglobin and collagen.

UNIT II: **15**
Lipids: Classification of lipids with examples. Simple and compound lipids, unsaturated and saturated fatty acids, physical and chemical properties of fats and oils. Structure and biological importance of phospholipids and cholesterol.
Nucleic acids: Structure of bases, nucleosides, nucleotides and secondary structure of DNA and different forms of DNA. Types and functions of RNA, cloverleaf structure of tRNA.

UNIT III: **15**
General characteristics of enzymes, nomenclature and classification of enzymes. Mechanism of enzyme action: active site, enzyme substrate complex formation-lock and key and induced fit theory. Concept of co-enzymes and cofactors with an example. Factors influencing enzyme activity: pH, temperature, substrate concentration, metal ion, inhibitors (allosteric) and activators, energy of activation. Isozymes, multienzyme complex and multifunctional enzymes with an example to each

BIO-ANALYTICAL TECHNIQUES
UNIT IV: **15**
Bio-analytical Techniques: Lambert-Beer Law, working principles of UV-Visible spectrophotometry and colorimetry.
Centrifugation: Basic principle of centrifugation, ultracentrifuge and its application.
Chromatography: Principles of chromatography, Types- Partition chromatography- paper and thin layer chromatography & Adsorption chromatography - column chromatography, ion exchange& molecular sieve (principle &application).
Isotopes: Their importance in biological studies, measure of radioactivity & GM counter.

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1. Qualitative analysis of Carbohydrates.
2. Qualitative analysis of Lipids.
3. Estimation of reducing sugar by DNS method.
4. Estimation of Protein by Biuret method.
5. Estimation of amino acid by ninhydrin method /formal titration
6. Determination of activity and specific activity of enzyme-Salivary amylase.
7. Effect of pH on enzyme activity
8.. Effect of temperature on enzyme activity.
9. Effect of metal ions on enzyme activity.
10. Preparation of buffer solution.
11. Identification of amino acids by circular paper chromatography.

REFERENCES

1.Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 th edition, W.H. Freeman and Company, New York, USA.

2. Biochemistry, LubertStryer, 6th Edition, WH Freeman, 2006.

3. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.

4. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons, 1995.

5. Biochemistry by Mary K.Campbell& Shawn O.Farrell, 5th Edition, Cenage Learning,2005.

6. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999

7. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004

8. Practical Enzymology Hans Bisswanger Wiley–VCH 2004

CMC22005/ CMC22006

SEMESTER III
MOLECULAR BIOLOGY & GENETIC ENGINEERING
(4 CREDITS)

Course Outcome:
After completing the course students are able to:
CO1. Learn the details of concept of gene and replication.
CO2. Understand in depth transcription and translation.
CO3. Specify in depth enzymes in genetic engineering and cloning vectors.
CO4. Understand in depth recombinant DNA technology and genetic engineering techniques.

MOLECULAR BIOLOGY

NO. HOURS

UNIT I **15**

Central Dogma of Molecular biology and modification.
Concept of gene: Definition, types, generalized structure of Prokaryotes and Eukaryotes.
DNA Replication: DNA as genetic material, Replication of DNA in prokaryotes and eukaryotes: Semiconservative, conservative and dispersive method. Components of replication –lagging strand leading strand Okazaki fragment, role of SSBP, gyrase, helicase, RNA polymerase, DNA polymerase. Inhibitors of replication- role of actinomycin, novobioci, amphidicolin and N-ethylmaleimide.
Genetic code: outline of Deciphering of genetic code, major features of genetic code, Wobble hypothesis.

UNIT II **15**

Transcription and RNA processing : RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Inhibitors of Transcription- rifampicin, actinomycin, alpha amantinin and platinum antitumor drugs. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.
Translation: Activation of amino acids, ribosome (composition & components), formation of initiation complex. Initiation, elongation and termination, inhibitors of protein synthesis.

GENETIC ENGINEERING

UNIT III **15**

Enzymes in Genetic engineering and its importance-Restriction endonucleases-types of restriction enzymes, ligases, alkaline phosphatases, polynucleotide kinase, terminal deoxynucleotidyl transferase, S1 nuclease, Klenow fragment, taq DNA polymerases, ribonuclease, reverse transcriptase
Gene cloning vectors: Types of vectors –Cloning vector and expression vector . Plasmids (pBR322, pUC 19) and cosmids (pLFR5, pJB8). Importance of plasmids as cloning vectors, stability of plasmids, different forms of plasmid, concepts of YAC and BAC.

UNIT IV **15**

Recombinant DNA technology: Isolation of gene, construction and preparation of complementary DNA. Probes- types, preparation and hybridization, genomic library. Genetic engineering techniques: Gel electrophoresis, southern and northern blotting techniques, PCR and its types, Sanger's, Maxam& Gilbert method of DNA sequencing. Applications of Genetic Engineering: Therapeutic products produced by genetic engineering-blood proteins, human hormones.Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenes, Ti plasmids, Direct DNA transfer to plants.

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1.Preparation of stock solution for molecular biology experiments.
2. Colorimetric estimation of DNA.
3. Colorimetric estimation of RNA.
4. Demonstration of Tm value of DNA.
5. Extraction of DNA from plant and microbial source.
6. Quantification of DNA by spectrophotomery.
7. Determination of purity of DNA.
8. Agarose gel electrophoresis of DNA.
9. Southern blotting (demonstration).
10. Isolation of plasmid DNA.

REFERENCES

1. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rdedition. Benjamin Co. 7. Sambrook&Russel. Molecular Cloning: A laboratory manual. (3rd edition) 8. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

2. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California,USA.

3. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.

4. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNAgenes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

5. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.

CMD22005/ CODECMD22006

SEMESTER IV

PLANT TISSUE & ANIMAL CELL CULTURE (4 CREDITS)

Course Outcome:
After completing the course students are able to:
CO1. Understand the details of introduction and principles of plant tissue culture.
CO2. Learn in depth micropropagation, somoclonal variation and protoplast culture.
CO3. Understand the details of laboratory facilities and culture medial of animal cell culture.
CO4: Learn the details of primary culture, established cell lines and hybridoma technology.

PLANT CELL CULTURE

NO. HOURS

UNIT I **15**

Plant tissue culture introduction: History and development, Importance of plant tissue culture. Laboratory organization and culture techniques: general requirements and aseptic conditions. Media preparation, culture media, sterilization, and pre-treatment to explants. Principles of tissue culture: Callus culture- Definition of callus, initiation, maintenance, sub culture and organogenesis .Factors affecting organogenesis .organ culture- culture protocols and importance of root and meristem culture.

UNIT- II **15**

Micropropagation in plants: stages of micropropagation, methods, advantages, applications. Somaclonal variation for disease resistance and agronomic traits.
Somatic embryogenesis: Embryoid and embryogenesis. Protocol and importance of somatic embryogenesis, Synthetic seeds and its applications, germplasm conservation and preservation.
Suspension culture: Batch and continuous cell suspension culture. Importance of suspension culture in production of secondary metabolites. Protoplast culture and fusion: Definition of protoplast, isolation principle, culture protocol, action of enzymes, regeneration of plants, protoplast fusion, somatic cell hybridization and its application.

ANIMAL TISSUE CULTURE

UNIT - III **15**

Introduction: History, developments and importance of animal cell culture. Characteristics of animal cell growth, Advantages and disadvantages of tissue culture methods and laboratory facilities (Essential Equipment, Washing facilities, beneficial equipment's, Consumable items). Animal tissue culture media: Culture media containing naturally occurring ingredients, blood plasma, blood serum, serum-free media, tissue extracts, complex natural media, chemically defined media, and basal salt solution –HBSS.

UNIT – IV **15**

Primary culture, cell lines and cloning: Preparation of primary culture –mechanical and enzymatic method. Primary and established cell lines, somatic cell fusion. Tissue cultures-cover slip method, watch glass method and use of agar.

Whole embryo culture. (e.g. Chick embryo).
Hybridoma technology: Production of monoclonal antibodies.
Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer. Animal propagation –Artificial insemination, superovulation, embryo transfer, in-vitro fertilization, embryo splitting. Genetic modification in Medicine -vectors in gene therapy

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1. Media preparation and sterilization techniques.
2. Callus cultures: choice of explants, preparation of explants, callus induction, subculture and maintenance.
3. Regeneration of plants from growth hormones.
4. Meristem culture for pathogen free plants.
5. Preparation synthetic seed
6. Suspension culture – initiation of suspension culture from callus.
7. Plant protoplast Isolation.
8 . Cell viability test by tryphan blue method.
9. Preparation of HSS and glasswares of cell culture experiments
10.Isolation of PMN leucocytes from human peripheral blood sample and staining and identification.(lishman stain).
11. Demonstration of dissegration of cells by mechanical and enzymatic methods.
12. Photographic Demonstration of Animal Cell culture Lab equipments

REFERENCES

1. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.

2. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.

3. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.

4. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers. 3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology-Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

5. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.

CME22005/CME22006

SEMESTER V
DSE: IMMUNOLOGY AND MEDICAL BIOTECHNOLOGY
(4 CREDITS)

Course Outcome:

After completing the course students are able to:

CO1. Identify the characteristics of cells and organs of immune system.

CO2. Specify in detail with examples immune disorders and techniques

CO3. Understand the details of vaccines, diagnostics and therapeutic enzymes.

CO4. Learn the details of therapeutic hormones, proteins and gene therapy.

IMMUNOLOGY

NO. HOURS

UNIT I **15**

Historical account and chronological events of EdwardJenner and Louis Pasture.

Antigens: Definition, 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 (HBV).

Enzymes in diagnosis: Enzymes used for diagnosis, immobilized enzymes as diagnostic tools, proteins in diagnosis.

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.

UNIT IV **15**

Hormone therapy: List of hormones and their therapeutic applications, 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, one example each, principle and applications.
Transgenic plants for production of biopharmaceutical (tobacco, tomatoes, and potatoes)

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1 Determination of blood group
a) ABO blood grouping
b) Rh blood grouping.
2 Immuno diffusion :
a) ODD
b) RID.
3 Separation of serum from blood
4 Demonstration of ELISA
5Demonstration of Western blotting
6 MIC assay
7 Isolation of antibiotic resistant strains using gradient plate method
8 Estimation of urea by BAMO method
9 Qualitative analysis of normal and abnormal constituents of urine
10 Photographic demonstration of transgenic animals and plants for production of biopharmaceutical

REFERENCES

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6 th edition Saunders Publication, Philadelphia.

2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.

3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

4. Murphy K, Travers P, Walport M. (2008). Janeway'sImmunobiology. 7th edition Garland Science Publishers, New York.

5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

CME22205/CME22206

SEMESTER V
DSE: MICROBIALTECHNOLOGY &AGRICULTURAL BIOTECHNOLOGY (4 CREDITS)

Course Outcome:
After completing the course students are able to:
CO1. Understand in depth metabolic pathways and production of secondary metabolites.
CO2. Specify the details of microbial growth kinetics and bioreactors.
CO3. Learn in detail with example crop improvement, nitrogen fixation and bio fertilizers.
CO4. Deliberate the details of genetic engineering of crop plants and microbial pesticides

MICROBIALTECHNOLOGY

NO. HOURS

UNIT I **15**

Introduction to biotechnological importance of microorganisms.
Metabolic pathway involved in microbial products, primary and secondary metabolites, enzymes and microbial biomass.
Microbial production: Use of microbes in production of vitamins (vit-C), enzymes (Amylase), organic acids (citricacid),amino acids (glutamicacid),polysaccharides (xanthan),growth regulators (auxins), colorants (phycocyanin) ,flavors (diactyl), antibiotics (penicillin).

UNIT II **15**

Kinetics of microbial growth and product formation: Phase of cell growth in batch cultures and continuous culture. Growth associated and non-growth associated product formation kinetics, substrate and product inhibition on cell growth and product formation. Bioreactors-Types and functions. Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Immobilization of cell- Introduction and methods of microbial cell immobilization.

AGRICULTURAL BIOTECHNOLOGY

UNIT III **15**

Introduction: Biotechnology for crop improvement, future prospects of biotechnology for agriculture.
Biological nitrogen fixation: Nitrogen fixing microorganisms, role of nitrogenase, genetics of nitrogen fixing microorganisms, regulation of nif gene expression and mechanism of nitrogen fixation.
Bio fertilizers and phyto-stimulations: Mechanism of growth promotion by microbial inoculants- microbial production and application methods of microbial inoculants- *Rhizobium, azospirillum, azotobacter, mycorhizae.*

UNIT IV **15**

Genetic engineering of crop plant: Gene transfer technique for desirable traits in crop plants. Agro bacterium mediated gene transfer, Direct gene transfer methods to protoplast. Few examples of transgenic plants, plants obtained through gene transfer techniques –BT cotton, herbicide tolerant soybean, virus resistance (papaya ring spot). Microbial pesticides: Fungicides and herbicides. Bacterial, fungal and viral bio agents- *Bacillus Thurengensis* (BT) and *BeaveriaBassiana*. Mechanism of control of plant disease-hypo virulence, competition antibiosis, induced resistance, mycoparasitism.

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1 . Identification of important microorganisms relevant to biotechnology: E.coli, sacchromycescervisiae, spirulina.

2 .Demonstration of commercial products-single cell proteins microbial flavours.

3 .Entrapment of yeast for enzyme action & estimation of invertase activity

4. Preparation of wine.

5. Estimation of percentage of alcohol by Specific gravity method .6 .Seed inoculation with rhizobium culture and observation for root nodulation.

7. Preparation of bio control formulations.

8. Biofertilizers formulation.

9. Isolation and identification of *Rhizobium.*

10. Isolation and identification of *azospirillum.*Isoalation and Identification of *azotobacter.*Study of morphology of*mycorhizae.*

11. Photographic demonstration of BT cotton, herbicide tolerant soybean, virus resistance (papaya ring spot).

12. Demonstration of steps involved in large scale production of biofertilizers.

REFERENCES

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

3. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.

4. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.

5. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers. 3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology-Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.

6. Agricultural Biotechnology, S.S. Purohit

CMF22005/ CMF22006

SEMESTER VI
DSE: ENVIRONMENTAL BIOTECHNOLOGY AND BIOSTATISTICS
(4 CREDITS)

Course Outcome:
After completing the course students are able to:
CO1. Understand the details of issues of environmental pollution, pollution detection and abatement.
CO2. Specify in detail with examples bio degradation, mining and industrial waste treatment.
CO3. Understand in detail with examples basic concepts and sampling methods of biostatistics.
CO4. Deliberate in detail with examples diagrammatic and graphical representation of data.

ENVIRONMENTAL BIOTECHNOLOGY

NO. HOURS

UNIT I **15**

Introduction: Major issues in environment pollution. Role of Biotechnology to solve the problems.
Biotechnological methods of pollution detection: General bioassay, cell biological methods, immunoassay, DNA based methods, use of biosensor.
Biotechnological methods in pollution abatement: reduction of CO_2 emission, Waste water treatment – conventional waste treatment, Use of Algae, Eutrophication, Use of Cell Immobilization.

UNIT II **15**

Biotechnology and biodegradation: Degradation of Xenobiotic compounds-organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides and surfactants.
Biohydrometallurgy and Biomining: Bioleaching, biosorption, oil degradation and creation of super bugs.
Treatment of Industrial wastes: Pulp, Dye, leather and solid waste management. Genetically engineered microbes for waste treatment.
Ecofriendlybioproducts: Biomass resources, biogas, and alcohol as a fuel, biological hydrogen generation and biodegradable plastics.

BIOSTATISTICS

UNIT III **15**

Introduction, Basic concepts- population, data, sample and variable. Types of data-primary and secondary, methods of data collection- direct personal interview, indirect oral interview, through correspondence, questionnaire and census. Classification of data- qualitative, quantitative and simple classification. Sampling methods- random and non-random. Tabulation of data- structure of a table, simple and complex table.

UNIT IV **15**

Graphical and diagrammatic representation of data- histogram, bar graph and pie diagram. Frequency of distribution- without class intervals, with class intervals and cumulative

frequency distribution. Measures of central tendency- mean, median and mode. Measure of dispersion- range, mean deviation, co-efficient of deviation and standard deviation.

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1 & 2. Analysis of sewage water for BOD & COD.
3 Estimation of Hydrogen sulphides in the sewage water.
b. Estimation of chloride in sewage water sample.
c. Estimation of residual chloride in sewage water sample.
d. Estimation of carbon dioxide in sewage water sample.
4. Identification of microbial flora in the given water sample.
5 . Estimation of percentage of alcohol by specific gravity bottle method
6 a. Photographic demonstration of septic tank, sand filters, Imhoff's tank and biosensors.
b. Photographic demonstration of creation of superbug.
c. Photographic demonstration of genetically modified microbes.
d. Photographic demonstration of genetically modified plants.
e. Photographic demonstration of genetically modified animals.

Biostatistics problems
7 Problems on graphical and diagrammatic representation of data
(histogram, bar graph and pie chart)
8 Calculation of mean, median, mode, standard deviation

REFERENCES

1. Environmental Science, S.C. Santra

2. Environmental Biotechnology, Pradipta Kumar Mohapatra

3. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter

4. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA

5. Glaser AN (2001) High YieldTM Biostatistics. Lippincott Williams and Wilkins, USA

6. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.

7. Danial W (2004) Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

CMF22205/ CMF22206

SEMESTER VI
DSE: BIOINFORMATICSAND BIOPROCESS TECHNOLOGY
(4 CREDITS)

Course Outcome:
After completing the course students are able to:
CO1. Understand the details of bioinformatics basics and data base.
CO2. Learn in depth genomics, proteomics and human genome project.
CO3. Deliberate the details of basic principles of bio processing technology.
CO4. Learn the details of designing of bioreactors and upstream processing.

BIOINFORMATICS

NO. HOURS

UNIT I **15**

Bioinformatics and the Internet: Introduction, Internet basics, connecting to the internet electronic mail, File transfer protocol, The World Web.
Database- DNA, protein, genomic mapping database, sequence alignment software-pair wise& multiple alignments, gene families

UNIT II **15**
Information retrieval from databases: Databases similarity searching, FASTA, BLAST SEARCH, Clustal W, Clustal X,DIALIGN2,Multalign Navigating the NCBI web site.
Genomics and Proteomics: Types of genomes, bacterial genome sequence project. Human genome project, Micro array technologies-types and applications.

BIOPROCESS TECHNOLOGY

UNIT-III **15**
Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture.

UNIT IV **15**
Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inoculation, development and sterilization. Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

PRACTICALS **(2 CREDITS)**

HOURS : 4 HOURS /WEEK

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W.
8. Bacterial growth curve.
9. Production and analysis of ethanol.
10. Production and analysis of amylase.
11. Production and analysis of lactic acid.
12. Isolation of industrially important microorganism from natural resource.

REFERENCES

1. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

2. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

4. Waste Water Engineering, Metcalf and Eddy, Tata McGraw hill

5. Wong, K.C.92016). Computational bilolgy and bioinformatics: gene regulation, CRC press/ Taylor & Francis Group.

6. Joyce, A. P.; Zhang, C.; Bradley, P.; Havranek, J. J. (2015). "Structure –based modeling of protein : DNA specificity". Briefings in Functional Genomics.

CMF22405/ CMF22406

SEC

MICROBIAL TECHNIQUES (2 CREDITS)

Course Outcome:

After completing the course students are able to:

CO1. Deliberate in depth concept of prokaryotes, eukaryotes and classification of microbes.

CO2. Understand in depth sterilization techniques.

CO3. Specify the details of microscopy and staining technique.

CO4. Learn in depth microbial nutrition and growth measurement.

MICROBIAL TECHNIQUES **NO. HOURS**

UNIT I **07**

General introduction. Concept of Prokaryotes and Eukaryotes. General account on Structure, Classification & Reproduction of Bacteria, Fungi & Viruses.

UNIT II **08**

Microbial Techniques: Sterilization: Principles and applications of

a. Physical Methods: Autoclave, Hot air oven, Laminar airflow, Seitz filter, Sintered glass Filter, membrane filter.

b. Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents.

c. Radiation Methods: UV rays and Gamma rays.

UNIT III **08**

Microscopy: working principle and applications of Light microscopy, phase contrast microscopy and electron microscopy.

Staining-Types, Simple and differential (Gram's and acid fast)

UNIT IV **07**

Microbial nutrition and growth: nutritional classes of microorganisms, culture media, pure culture, microbial growth pattern and methods of growth measurements, method of maintenance and preservation of cultures.

.

REFERENCES

1 Prescott L.M. Harley J.P and Klein D.A (Microbiology 5th Edition)

2. Pelzar Jr, M.J. Chan, E.C.S. and Krieig N.R (Microbiology)

3. Salle. A.J Fundamental Principles of Bacteriology .

4. Caldmell, D.R. Microbial Physiology and metabolism

CMF22605/ CMF22606:

SEC
ENZYMOLOGY (2 CREDITS)

Course Outcome:

After completing the course students are able to:

CO1. Understand in details with examples classification and characteristics of enzymes.
CO2. Understand in depth enzyme kinetics.
CO3. Learn in detail with applications allosteric, isozymes and multifunctional enzymes.
CO4. Understand in depth large scale production and immobilization of enzymes.

ENZYMOLOGY

NO. HOURS

UNIT – I **7**

Enzyme classification . Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, factors affecting initial rate, E, S, temp. &pH.

UNIT – II **8**

Kinetics of enzyme activity, Michaelis-Menten equation, Different plots for the determination of Km and Vmax and their physiological significance. Enzyme inhibition types of inhibition, Mechanism of enzyme action: General mechanistic principle.

UNIT – III **7**

Allosteric enzymes with special reference to phosphofructokinase. Kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme- eg Fatty Acid synthase.

UNIT – IV **8**

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry.

REFERENCES

1.Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 th edition, W.H. Freeman and Company, New York, USA.

2. Biochemistry, LubertStryer, 6th Edition, WH Freeman, 2006.

3. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.

4. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley andSons, 1995.

5. Biochemistry by Mary K.Campbell& Shawn O.Farrell, 5th Edition, Cenage Learning,2005.

6. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999

Pattern of Question Paper
Semester I to VI
Paper I to VI (DSC)

Time : 3 Hrs Max Marks: 70

I. Answer all the questions 5 X 1 = 5

1 ----------
2----------
3----------
4----------
5----------

II. Answer any five questions 5 X 3 = 15

6----------
7----------
8----------
9----------
10----------
11----------

III. Answer any four questions 4 X 5 = 20

12 ----------
13----------
14----------
15----------
16----------

IV. Answer any three questions 3 X 10 = 30

17----------
18----------
19----------
20----------

(Note- 10 Marks may be divided in to 6+4 or 5+5)

Pattern of Question Paper
Semester VI
(SEC)

Time : 2 Hrs Max Marks: 50

I. Answer all the questions 5 X 1 = 5

1 ----------
2----------
3----------
4----------
5----------

II. Answer any five questions 5 X 3 = 15

6----------
7----------
8----------
9----------
10----------
11----------

III. Answer any four questions 4 X 5 = 20

12 ----------
13----------
14----------
15----------
16----------

IV. Answer any one question 1 X 10 = 10

17----------
18----------

(Note- 10 Marks may be divided in to 6+4 or 5+5)