

Year	Semester	Course Code	Course Title	L	T	P	C	
1	1	MBT-111	Cell Biology	3	1	6	6	
		MBT-112	Microbiology	3	1	6	6	
		MBT-113	Bioinstrumentation	3	1	6	6	
		MBT-114	Biomolecules and Metabolism	3	1	6	6	
				Total	12	4	24	24
	2	2	MBT-121	Molecular Biology	3	1	6	6
			MBT-122	Immunology and Immunotherapy	3	1	6	6
			MBT-123	Enzymology	3	1	6	6
			MBT-124	Plant and Animal Biotechnology	3	1	6	6
				Total	12	4	24	24
	2	1	MBT-211	Bioprocess Engineering & Microbial Technology	3	1	6	6
			MBT-212	Genetic Engineering	3	1	6	6
MBT-213			Biostatistics and Bioinformatics	3	1	6	6	
MBT-214			Entrepreneurship and IPR	3	1	0	4	
				Total	12	4	18	22
2		2	MBT-221	Dissertation	0	0	20	20
			MBT-222	Viva voce	0	0	0	04
					Total			20

M.Sc. BIOTECHNOLOGY

Subject Code: MBT-111 Subject Name: Cell Biology

L	T	P	Cr
3	1	6	6

RATIONALE

The development of cell biology major contributes to the quality and integrity of the biology.

UNIT S	CONTENTS	Contact Hrs.
I	<ul style="list-style-type: none">• Cell Membrane: physicochemical properties and asymmetrical organization carbohydrate, protein and lipid.• Transport of nutrients, ions and macromolecules across membranes: types and mechanism.• Active transport of molecules: p-type, v-type F- type ABC transporters.• Properties and mechanisms of transporters: patch pump technique.	8
II	<ul style="list-style-type: none">• Protein targeting cell map: protein signal hypothesis and protein secretory hypothesis.• Protein Sorting and Transport - the endoplasmic reticulum, golgi apparatus, and lysosomes and mitochondria.• Protein glycosylation golgi complex and endoplasmic reticulum.• Endocytosis and exocytosis.	8
III	<ul style="list-style-type: none">• Ultra structure and function of lysosome.• Ultra structure and function of peroxisome.• Cell motility: structure and function of microtubules microfilaments and intermediate filaments.• Cell junctions: types and their functions	8
IV	<ul style="list-style-type: none">• Molecular mechanisms of calcium dependent cell adhesion and calcium dependent cell adhesion.• Organization and function of extracellular matrix in animal.• Structure and function of integrins.• Cell signaling: G- protein signaling, MAP kinase, tyrosine kinase pathway.	8
V	<ul style="list-style-type: none">• Molecular events accompany in eukaryotic cell cycle.• Eukaryotic cell cycle regulation.• Apoptosis: molecular mechanisms, signalling pathways and significances of apoptosis.• Necrosis: types and their significance.	8

PRACTICALS

1	<ul style="list-style-type: none">• Subcellular fractionation and marker enzymes.
2	<ul style="list-style-type: none">• Identification of tissue typing: Histological preparation of tissue.

3 •	Chromosome preparation: Meiosis – Rats/Mouses
4 •	Identification of different biomolecules in different tissues by histochemical technique.
5	Electron Microscopy: Demonstration and good photographs for interpretation

REFERENCE BOOKS :	
1. •	Alberts, B., Johnson, A., Lewis J., Raff, M., Roberts, K., and Walter, P., Molecular Biology of the Cell, 5th Edition, Garland Science Publishing (2008).
2. •	Becker, W.M., Kleinsmith, L.J. and Haldin, J., The world of the Cell, Seventh Edition, Pearson Education (2008).
3. •	Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. Molecular Cell Biology, 4th edition W. H. Freeman and Compan (2004).
4. •	Gerald Karp, Cell and Molecular Biology 7th Edition (2013).
5. •	Hughes and Mehnet, Cell Proliferation and Apoptosis (2003).

Subject Code: MBT-112

Subject Name: Microbiology

L	T	P	Cr
3	1	6	6

RATIONALE
To understand the knowledge of common pathogens and their identification and diversity.

UNIT S	CONTENTS	Contact Hrs.
I	Microbial taxonomy and detailed classification of the microbial world as per Bergey's manual of classification (Bacteria, Archaea, Eukarya). Bacterial cell structure and morphological features (cell wall, outer membrane, flagella, endospores and gas vacuoles), microbes beyond cellular organization (Viruses, viroids, virusoids and prions). Preparation of culture media, pure culture techniques and microbial staining	8

•	General account and economic importance cyanobacteria.	
II	<p>Nutrition based classification of Microorganisms, Different carbon and nitrogen sources, transport of nutrition across membrane.</p> <p>Cultural characteristics of microorganisms, Techniques for enumeration of microorganisms in soil and water, pure culture and enrichment culture techniques for the isolation of heterotrophs and autotrophs.</p> <p>Reproduction and growth, Growth measurement and growth yields, factors affecting growth, synchronous growth continuous culture.</p> <p>Oxygen toxicity: Study of catalase, peroxidase, superoxidase dismutase, mechanism of oxygen toxicity.</p>	8
III	<p>Culture collection and maintenance and preservation.</p> <p>Cryopreservation and lyophilization, Physical and chemical agents for the control of microbial growth.</p> <p>Antimicrobial agents, Antibiotics and their mode of action, Biosafety and levels of biosafety, Types of microbiological safety cabinets, GLP and GMP.</p> <p>Major diseases in plants and animals, food and water borne diseases; emerging and resurgent infectious diseases.</p>	8
IV	<ul style="list-style-type: none"> • Viruses: types, isolation, cultivation and identification • Lytic and lysogenic cycle of bacteriophages • Life cycle of DNA viruses: SV 40, RNA viruses: Retroviruses • Plant viruses: TMV and Gemini 	8
V	<ul style="list-style-type: none"> • Bacterial Recombination: transformation, conjugation, transduction, F-duction • Chemotherapeutic agents: classification of antibiotics, broad and narrow spectrum antibiotics; antibiotics from prokaryotes • Anti-fungal and antiviral antibiotics, mode of action of antibiotics • Mechanism of drug resistance and plasmids. 	8

PRACTICALS	
1.●	Preparation of Liquid and Solid media for growth of microorganisms.
2.●	Isolation and maintenance of organisms by plating, streaking and serial dilution method,

	slant and stab cultures, storage of microorganisms.
3.●	Isolation of pure cultures from soil and water
4.●	Growth; Growth curve; Measurement of bacteria population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.
5.●	Microscopic examination of bacteria, Yeast and mold and study of organism by Gram's stain, acid fast stain and staining for spores
6.●	Study of mutation by Ames's Test.
7.●	Assay of antibiotics and demonstration of antibiotic resistance
8.●	Analysis of water for potability and determination of most probable number (MPN).
9.●	Bacterial transformation.
10.●	Biochemical Characterization of selected microbes. <ul style="list-style-type: none"> ● One Step growth curve of coliphage

REFERENCE BOOKS :	
1. ●	General microbiology, R.Y. Ingraham, J.L. Wheelis, M.L. and Painter, P.R. The Macmillan Press Ltd.
2. ●	Brock Biology of microorganism, M.T. Martinko, J.M. and Parker, J. Prentice-Hall.
3. ●	Microbiology, Pelczar, M.J., Chan E.C.S. and Kreig, N.R., Tata McGraw Hill.
4. ●	Microbial Genetics, Malloy, S.R., Cronan, J.E. Jr and Freifelder, D.Jones, Bartlett Publishers
5. ●	Microbiology-A Laboratory Manual, cappuccino, J.G. Sherman, N. Addison Wesley.
6. ●	Microbiological Applications (A Laboratory Manual in General microbiology) Benson, H.J. WCB: Wm C Brown Publishers.

Subject Code: MBT-113

Subject Name: Bioinstrumentation

L	T	P	Cr
3	1	6	6

RATIONALE

The purpose of this course is to provide the advanced knowledge of bioinstrumentation, methodologies and with the capability of associating the most appropriate technique to the analytical problem on hand.

UNIT S	CONTENTS	Contact Hrs.
I	Centrifugation: Principle, types and applications; sedimentation coefficient and factor affecting centrifugation Photometry: Principle, instrumentation and application of UV-visible spectrophotometry Infrared (IR) spectroscopy: Principle, instrumentation and applications Fluorescence spectroscopy: Principle, instrumentation and applications	8
II	Atomic absorption spectroscopy: Principle, instrumentation and application Chromatography: Principle and applications of -Paper, thin layer and column chromatography HPLC, HPTLC, Gas chromatography, Gel filtration and Ion exchange chromatography Electrophoresis: Principle, types and applications; 2-D gel electrophoresis- Principle and its application	8
III	Electron spin resonance (ESR) spectroscopy: Principle, Instrumentation and applications Nuclear Magnetic resonance: Principle, Instrumentation and applications Circular dichroism spectroscopy (CD): Principle, Instrumentation and applications: X-ray crystallography: Principle, instrumentation and applications	8

IV	<p>Mass spectrometry: Principle and components of mass spectrometer Mass analyzers: Magnetic sector, Time of flight (TOF), Quadrupole, advantages and disadvantages; LC-MS.</p> <p>Quantitative proteomic analysis by iTRAQ.</p> <p>Flow cytometry: Principle, instrumentation and applications</p>	8
V	<p>Microtomy: Types, Principal and applications.</p> <p>Microscopy: Basic Principle and components of microscope, phase contrast and fluorescent microscopes</p> <p>Electron microscopes: TEM and SEM- Principle and applications</p> <p>Radioactivity: Principle, detection and measurement of isotopes: Autoradiography, types of radio isotopes used in biology and their application in biological science</p>	8

PRACTICALS	
1	Verification of Beer's law
2	Determination of absorption maxima
3	Electrophoresis of Proteins- native and under denaturing conditions.
4	Amino acid and carbohydrate separations by paper & thin layer chromatography Gas chromatography
5	Ion exchange and gel filtration chromatography
6	Separation of subcellular organelles by differential centrifugation
7	Separation of blood cells by density gradient centrifugation

REFERENCE BOOKS :	
1.	Physical Biochemistry: Applications to Biochemistry and Molecular Biology by Freifelder
2.	Biochemical Techniques: Theory and Practice by Robyt and White
3.	Principles of Instrumental Analysis by Skoog and West
4.	Analytical Biochemistry by Holme and Peck
5.	Biological Spectroscopy by Campbell and Dwek
6.	Organic Spectroscopy by Kemp A Biologist's Guide to Principles and Techniques of Practical Biochemistry by Wilson and Goulding
7.	Principles of Instrumental Analysis by Skoog, Hollar and Nicman

Subject Code: MBT-114

Subject Name: Biomolecules and Metabolism

L	T	P	Cr
3	1	6	6

RATIONALE

To strengthen the knowledge about various biomolecules, their structure, function and metabolic disorders.

UNIT S	CONTENTS	Contact Hrs.
I	Carbohydrates: Structure, classification, properties, chemical reactions, stereoisomerism and functions. Home and hetero polysaccharides, animal, plant and microbe specific polysaccharides, bacterial cell wall, carbohydrate derivatives: peptidoglycans, glycolipids, sialic acid. Lipids; Classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, wax, sterols, terpenes, prostaglandins. Lipids with specific biological functions, lipoproteins and biological membrane, micelles and liposomes.	8
II	Amino acids: Structure, classification, properties and functions, peptides and polypeptides. Proteins: Properties, primary, secondary, tertiary and quaternary structure. Vitamins and cofactors: structure, distribution, interaction and biological properties. Nucleic acids: DNA: Structure, conformation, properties of purines and pyrimidine bases, nucleosides and nucleotides; RNA: Structure, types and functions of mRNA, tRNA and rRNA.	8

III	<p>First and second laws of thermodynamics & concept of free energy. High energy phosphor compounds, ATP cycle, structural basis of free energy change during hydrolysis of ATP.</p> <p>Carbohydrate metabolism: Basic concepts of glycolysis, glycogenesis, gluconeogenesis pathway and regulation.</p> <p>Krebs cycle:, pentose phosphate pathway, glyoxalate pathway, glycogenolysis pathway and regulation.</p>	8
IV	<ul style="list-style-type: none"> • Electron transport and oxidative phosphorylation: electron carriers, complexes I to IV, chemiosmotic theory, substrate level phosphorylation. • Lipid metabolism: Biosynthesis and degradation of odd carbon and even carbon • Saturated and unsaturated fatty acids, formation and of ketone bodies, regulation of Lipid metabolism, associated inborn errors. 	8
V	<ul style="list-style-type: none"> • Overview of amino acid metabolism: biosynthetic families of amino acids, breakdown of amino acids into six (to check) common intermediates. • Regulation of amino acid metabolism (Steps for the biosynthesis and breakdown of amino acids are not required), associated inborn errors. • Nucleic acid metabolism: biosynthesis and breakdown of purine, pyrimidines, nucleotides by de novo and salvage pathways, • Regulation of metabolism associated inborn errors. 	8

PRACTICALS

1	Titration of amino acids.
2	Colorometric determination of pK.
3	Model building using space filling/ ball and stick models.
4	Reactions of amino acids, sugars and lipids.
5	Quantitation of proteins and sugars.
6	Analysis of oils- iodine number, saponification value, acid number.

REFERENCE BOOKS :

1.	Principles of Biochemistry by Nelson, Cox and Lehninger.
2.	Biochemistry by G. Zubay
3.	Biochemistry by Stryer
4.	Biochemistry by Garrett and Grisham
5.	Biochemical Calculations, Irwin H. Segel, John Wiley and Sons Inc
6.	Biochemistry, DVoet and JVoet , J Wiley and Sons.

7.	Biochemistry, D Freifilder, W.H. Freeman & Company. Laboratory Techniques in Biochemistry and molecular Biology Work and Work. A Biologists guide to Principles and Techniques of practical Biochemistry, K.Wilson& K.H. Goulding, ELBS Edition,
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Subject Code: MBT-121

Subject Name: Molecular Biology

L	T	P	Cr
3	1	6	6

RATIONALE

To provide an opportunity for the student to distinguish the molecular basis of cellular processes and interrelationships in living systems.

UNIT S	CONTENTS	Contact Hrs.
I	Nature of Gene: Evolution of Gene Concept, Chemical Nature of Gene, Gene-cistron Relationship in prokaryotes and eukaryotes, Overlapping genes, Nested Genes, Gene families and pseudogenes. Proof of DNA as genetic material. Denaturation and Renaturation of DNA. Molecular Basis of Gene Mutation:, Biological Repair Mechanisms, Repair Defects and Human Diseases DNA Replication: General features of Chromosomal Replication. DNA Replication Machinery in Prokaryotes and its comparison with Eukaryotes. Enzymology of DNA Replication: DNA Polymerases; Primases; Ligases; Helicases; Topoisomerases; Gyases and Single stranded Binding Proteins. Regulation of DNA Replication; Inhibitors of DNA Replication	8
II	Transcription in prokaryotes: Initiation, elongation and termination Structure and Function of prokaryotic promoter Control of transcriptional initiation in prokaryotes: Structure and function of RNA Polymerase: Sigma factors- Types and functions Control of transcriptional termination: Attenuation and anti-termination	8
III	Regulation of gene expression in prokaryotes: Operon concept, induction and repression, Structure and regulation of lactose, arabinose and tryptophan operons Initiation of transcription in Eukaryotes: RNA Polymerases Types and properties Transcription factors- Types and properties; Enhancers- Structure and	8

	properties; Response Elements Post-transcriptional Modification Eukaryotes- 5' and 3' modification of mRNA	
IV	Post- transcriptional Processing of pre mRNA, pre rRNA and pre tRNA transcripts Genetic Code: Evidence and properties; Wobble hypothesis; Transcriptional adaptors and amino acyl tRNA synthases Translation: Successive stages of protein synthesis in prokaryotes and its comparison with eukaryotes Post-translational Modification: Types and Significance	8
V	Regulation of Gene Expression in Eukaryotes: cis- acting DNA elements; Chromatin organization and regulation of gene expression; regulation at the level of processing of transcripts Regulation of Gene Expression in Eukaryotes: RNA editing; Gene Alteration; DNA methylation and gene regulation; Regulation of gene expression by hormones: regulation of gene expression at translational level Transposable elements in Prokaryotes and Eukaryotes: Types and Significance Oncogenes and Tumor Suppressor Genes: Properties and Significance	8

PRACTICALS	
1	Isolation of Genomic DNA and restriction Digestion
2	Size fractionation of restricted DNA fragments by Agarose Gel Electrophoresis
3	Quantitations of DNA
4	Determination of Amax of purified DNA fragments
5	Determination of Tm of nucleic acid
6	Isolation of RNA
7	Fractionation of poly (A) RNA
8	In vitro transcription
9	In vitro translation
10	Metabolic labeling of proteins and immunoprecipitation
11	Protein-DNA interaction

REFERENCE BOOKS :	
1. •	Genes IX Benjamin Lewin •
2. •	Molecular Biology, turner et al

3. •	Cell and Molecular Biology: Concepts and Experiments, Gerald Karp
4. •	Translational regulation in eukaryotes (2000), Carey and Smale
5. •	Translational control of Gene Expression (2000), Sonenberg et al
6. •	Chromatin and Gene Regulation (2001), Turner
7. •	An Introduction to Genetic Analysis, Griffiths et al
8. •	Genome (1999), Brown Concepts of Genetics, Klug and Cummings Proteins, Creighton
9. •	Molecular Cell Biology, Lodish et al
10. •	Biochemistry and Molecular Biology of Plants (2000), Buchanan
11. •	Plant Biochemistry and Molecular Biology, Lea and Leegood
12. •	Plant Biochemistry (1997), Dey and Harborne

Subject Code: MBT-122

Subject Name: Immunology and Immunotherapy

L	T	P	Cr
3	1	6	6

RATIONALE

To strengthen the knowledge of students about immune system (defense mechanism) and how they fight against pathogens.

UNIT S	CONTENTS	Contact Hrs.
I	<p>Immune response: Innate and adaptive immune system: Cells and molecules involved characteristics and mechanism. Hematopoiesis and differentiation of hematopoietic cells by cytokines. Toll-like receptor-component of innate immune system; clonal selection theory.</p> <p>Anatomical organization of immune system: Primary lymphoid organ, secondary lymphoid organs. Ontogeny and phylogeny of lymphocytes, lymphocyte traffic.</p> <p>Cell of immune system: Mononuclear cells and granulocyte, antigen presenting cells; APCs: professional and Nonprofessional; Lymphocytes and their subsets, lymphocyte surface molecules and receptors and flow cytometry.</p> <p>Artigens, Heptanes: factor effecting immunogenicity; super antigen, Antigenicity and immunogenicity.</p> <p>Inflammation: its mediators and the process, cell -adhesion molecules and their role in inflammation, Leukocyte migration, lymphocyte homing, tissue injury and immune response leading to an inflammatory reaction, role of an aphylotoxins, granulocytes in inflammatory process.</p>	8
II	<p>Major histocompatibility systems: Structure of MHC I and II molecule, polymorphism, distribution variation and function. Organization of MHC with complex in Mouse and human. Association of MHC with disease.</p> <p>Recognition of antigens by T and B Cells: Antigen processing, role of MHC</p>	8

	<p>molecules in antigen presentation and co stimulatory signals.</p> <p>T-cell receptor complex, T-cell accessory membrane molecules, activation of T-cell, organization and arrangement of T-cell receptor genes.</p> <p>B-cell receptor complex, activation and differentiation of B-cells,</p> <p>Immunoglobulin's (Class and subclass): Molecular Structures type and function. Antigenic determinants of immunoglobulins (isotype, allotype and idiotype).</p>	
III	<p>Molecular mechanism of antibody diversity organization of genes coding for constant and variable regions of heavy and light chain. Mechanism of antibody diversity, Class switching.</p> <p>Antigen-Antibody infestation and affinity amusement.</p> <p>Monoclonal Antibodies: Principle of hybridoma technology, production characterization and application in diagnosis, therapy and basic research, Fusion methods.</p> <p>Compliment system, components, Activation pathway and regulation of activation pathway, complement deficiency, role of complement system in immune responses opsonization (opsonin).</p>	8
IV	<p>Cytokines: Suctions and function, cytokine receptors, Signal transduction mediated by cytokine receptors, cytokine regulation of immune response, cytokine related diseases and therapeutic application of cytokine.</p> <p>Cytotoxic T-Cell and their mechanism of action, NK cell and mechanism of target cell destruction, Antibody dependent cell mediated cytotoxicity, techniques of cell mediated immunity.</p> <p>Immunoregulation by antigens, Antibodies, immune complexes, MHC and cytokines.</p> <p>Hypersensitivity: Definition, IgE mediated Hypersensitivity, mechanism of mast cell degranulation, mediators of type I reactions and consequences type II reaction, immune complex mediated Hypersensitivity and delayed type Hypersensitivity.</p>	8
V	<p>Autoimmunity: Organ specific and systemic diseases, mechanism of autoimmunity.</p> <p>Immune response during bacterial (tuberculosis), Parasitic (malaria) and viral</p>	8

	<p>(HIV.) infection, congenital and acquired immunodeficiency; diagnosis and therapeutic approaches.</p> <p>Vaccines: Active and passive immunization, whole organism vaccines, macromolecules as vaccines, Recombinant-vector vaccines, DNA vaccines, synthetic peptide vaccines and sub-unit vaccines, Anti-idiotypic vaccines.</p> <p>Immunodiagnosics: development of immunodiagnosics kits for infectious and non-infectious diseases with example. Precipitation techniques, Agglutination, fluorescence techniques (FACS), ELISA, RIA, western Blotting and immunohistochemical techniques (Avidin and Biotin system), Antibody engineering.</p> <p>Immunotherapy: Immunosuppressive therapy, Immunostimulation, Cytokines therapy, Immunotherapy for infectious diseases, allergies, autoimmune diseases and cancer.</p>	
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PRACTICALS	
1	Blood Film Preparation and identification of cells.
2	Lymphoid organs and their microscopic organization.
3	Immunization and production of polyclonal antibodies.
4	Double diffusion and Immuno-electrophoresis.
5	Radial immunodiffusion.
6	Purification of IgG from serum.
7	Separation of mononuclear cell by Ficoll-paque.
8	Con-A induced proliferation of thymocytes (by MTT Method).
9	Western blotting.
10	ELISA
11	Preparation o antibody-enzyme conjugates.

REFERENCE BOOKS :	
1. •	Immunology, Kubey, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne (Freeman).
2. •	Immunology- A short Course, Eli Benamini, Richard Coico, Geoffrey Sunshine.
3. •	Immunology by Tizzard
4. •	Fundamentals of Immunology, William Paul.
5. •	Immunology by Roitt and others.
6	Immunology by Abbas

Subject Code: MBT-123

Subject Name: Enzymology

L	T	P	Cr
3	1	6	6

RATIONALE

To understand structure and mechanism of enzymes inside the biological system.

UNIT S	CONTENTS	Contact Hrs.
I	Enzyme: Historical aspects, classification and nomenclature, EC number Mechanism of enzyme action and properties of enzymes as catalysts Sub-cellular localization and organization of enzymes Methods of enzyme assay: continuous and sampling techniques, coupled enzyme assays, specific activity, turn over number	8
II	Enzyme purification: Objectives and strategy, methods of isolation overview of purification techniques and crystallization Criteria of purity and tabulation of purification data, stable storage of enzymes Characterization of purified enzyme. Enzyme engineering: Site directed mutagenesis	8
III	Enzyme kinetics: Equilibrium and steady state theory, rate equation and determination of K_m and V_{max} Factors affecting rate of enzyme reaction: pH, temperature and pressure Enzyme inhibition: reversible and irreversible inhibition, Applications of inhibitors Rapid reaction techniques	8
IV	Isoenzymes and their physiological significance Allosteric enzymes: co-operativity, MWC and KNF Models Regulation of enzymes Ribozymes and catalytic antibodies	8
V	Enzyme Immobilization: methods, applications and its effect on kinetic	8

parameters	
Enzyme Biosensor: Principle, components of biosensor and types	
Development of enzyme biosensors	
Applications of biosensor for clinical diagnosis	

PRACTICALS	
1	Urease estimation by titrimetric method
2	Urease estimation by colorimetric method
3	Acid phosphatase estimation
4	Alkaline phosphatase estimation
5	Determination of optimum time, optimum temperature & optimum pH
6	Determination of Km value
7	Acetylcholine esterase/pseudocholinesterase estimation
8	Enzyme purification

REFERENCE BOOKS :	
1.	The nature of Enzymology by R.L. Foster
2.	Enzymes by Dixon and Webb
3.	Fundamentals of Enzymology by Price and Stevens
4.	Enzyme Catalysis and Regulation by Hammes
5.	Enzyme Reaction Mechanisms by Walsch
6.	The Enzymes vol I and II by Boyer
7.	Enzyme Structure and Mechanism by Alan Fersht
8.	Enzyme Assays: A Practical Approach by Eisenthal and Danson

Subject Code: MBT-124

Subject Name: Plant and Animal Biotechnology

L	T	P	Cr
3	1	6	6

RATIONALE

To understand the methodology of animal and plant tissue culture and their application in the field disease treatment and improvement in crops respectively.

UNIT S	CONTENTS	Contact Hrs.
I	Plant tissue culture – theory and methods: Introduction of plant tissue culture and cell suspension culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement, continuous culture, techniques for immobilization of plant cells, continuous product recovery system using immobilized plant cell system.	8
II	Plant tissue culture – product and recovery: Primary and secondary metabolic products (phytochemicals) of plant cells, biosynthesis of secondary metabolites of biotechnological importance, biotransformation for product development and selection of cell culture, process technology with salient features for specific products.	8
III	Structure and organization of plant genome, regulation of plant genome expression, transcriptional, translational and post transcriptional regulation of plant genome. Transposons, chloroplast and mitochondrial genome. Plant tissue culture – genetic engineering: Transfer of nucleic acid to plant cells, Direct transformation by electroporation and particle gun bombardment, Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic traits, conferring resistance to herbicide, pesticide, plant pathogens. Plant engineering towards development of enriched food products, plant growth regulators.	8
IV	Animal Cell Culture: Equipments and materials for animal cell culture technology. Various systems of tissue culture, their distinguishing features, advantages and limitations.	8

	<p>Culture medium: natural media, synthetic media, sera. Introduction to balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon di oxide, serum and supplements.</p> <p>Characteristics of cells in culture: Contact inhibition, anchorage dependence, cell-cell communication etc.; Cell senescence; cell and tissue response to trophic factors.</p>	
V	<p>Primary Culture: Behavior of cells, properties, utility. Explant culture; suspension culture.</p> <p>Established cell line cultures: Definition of cell lines, maintenance and management; cell adaptation.</p> <p>Measurement of viability and cytotoxicity. Cell cloning, cell synchronization and cell manipulation. Various methods of separation of cell types, advantages and limitations; flow cytometry.</p> <p>Scaling up of animal cell culture. Cell transformation.</p> <p>Stem cell cultures, embryonic stem cells and their applications. Somatic cell genetics.</p> <p>Apoptosis: Measurement of cell death. Apoptosis (death domain, role of cytochrome C)</p>	8

PRACTICALS	
1 •	Isolation of explant.
2	Preparation of culture medium for plants cell
3	Preparation of culture medium for animal cell
4	Preparation of culture medium for serum free cell
5	Organ culture
6	Production haploid

REFERENCE BOOKS :	
1.	An Introduction to plant tissue culture, M.K. Razdan, Oxford and IBH publishing.
2.	Experiments in Plant tissue culture, J.H. Dodds and L.K. Roberts, Cambridge University Press.
3.	Plant Biotechnology and Transgenic Plants, K.M.O. Caldenty, W.H. Barze and H.L. Wills Marcel Dekker.

4.	Plant Biotechnology, J. Hammond, P.McGarvy and V. Yusibov, Springer Verlag
5.	Plant Tissue culture: Theory & Practice, S.S. Bhojwani and M.K. Razadan Elsevier Health Science.
6.	Animal biotechnology by V Kumaresan
7.	Textbook of animal biotechnology by B Singh, S K Gautam and M S Chauhan
8.	Animal biotechnology: models in discovery and translation by AshishVerma, Anchal Singh.
9.	Animal tissue culture by ianfreshney

Subject Code: MBT-211 Subject Name: Bioprocess Engineering & Microbial Technology

L	T	P	Cr
3	1	6	6

RATIONALE

To understand the biological systems; and to understand the role of microorganisms in the upstream processing and importance of downstream processing in biotechnology.

UNIT S	CONTENTS	Contact Hrs.
I	Introduction and basic principle of Biochemical engineering Isolation, preservation and maintenance of industrially important microbes: Strain improvement of industrially important microorganisms Kinetics of microbial growth and death Media for industrial fermentation, media formulation; Sterilization; Aeration and agitation in bioprocess. Air sterilization.	8
II	Scale of fermentation process: small scale, large scale and pilot scale fermentations Bioreactors: Principle, types, design and applications Types of fermentation processes; batch, fed-batch, and continuous bioreactions. Measurement and control of fermentation: pH, temperature, pressure, media, air, Automation of the monitoring and control process	8
III	Upstream processing and downstream processing: Introduction and concept. Downstream processing: removal of microbial cells and solid matter, foam separation, precipitation, centrifugation, cell disruption, chromatography, reverse osmosis Extraction: Solvent, two phases, liquid extraction Product recovery process. Crystallization, storage, packaging and quality control	8

IV	<p>Industrial production of important bioproducts: Vitamins and amino acids (Vit B12 & Glutamic acid)</p> <p>Industrial production of important bioproducts: antibiotics-Penicillin; and streptomycin</p> <p>Enzyme- Amylase, Protease, Production, recovery and scaling up of enzymes and their role in food and other industries.</p> <p>Immobilization of enzymes and their industrial applications.</p>	8
V	<p>Microbial production of alcoholic beverages: Distilled alcoholic beverages- Beer, microbial production of Vinegar.</p> <p>Microbial production of organic acids: Citric acid and Acetic acid</p> <p>Microbial production of solvents: Ethanol and acetone</p> <p>Microbial production of food- SCP Mushroom cultivation, Biofertilizers and their Applications.</p>	8

PRACTICALS

1	Isolation of industrially important microbes from the environment
2	Determination of TDP and TDT of microorganisms for a design of a sterilizer
3	Determination of growth curve of an industrial organism and compute substrate, degradation profile, specific growth rate and growth yield
4	Screening and enrichment for a primary/ secondary metabolite from the environment
5	Strain improvement for higher yield of a product
6	Random and strategic screening for a metabolite
7	Media balancing experiments
8	Alcohol fermentation using different substrates and its downstream processing

REFERENCE BOOKS :

1.	Biochemical Engineering, Aiba, S., Humphrey, A.E. and millis, N.F. Univ. Tokyo Press, Tokyo.
2.	Biochemical Reactors, Atkinson, B., Pion Ltd. London.
3.	Biochemical Engineering Fundamentals, Baily. J. E. and ollis , D.F. Mcgraw- Hill Book Co. New York.
4.	Bioprocess Technology: Fundamentals and Applications, KTH, Stockhlom.
5.	Process Engineering in Biotechnology, Jackson, A.T. , Prentice Hall, Englewood Cliffs.
6	Bioprocess Engineering: Basic Concepts Shuler, M.L. and Kargi , F., Prentice Hall, Englewood Cliffs..

7	Principles of fermentation Technology, Stanbury,P.F. and Whitakar A., Pergmon Press, Oxford.
8	Bioreaction Engineering Principles, Nielson, J and Villadsen , J., Plenum Press.
9	Chemical Engineering, Problems in Biotechnology, Shuler, M.L.(Ed.), AICHE.
10	Biochemical Engineering, Lee, J.M., Prentice Hall Inc.
11	Bioprocess Engineering- Kinetics, Mass Transport, Reactors and Gene Expression, Vieth, W.F., John Wiley & Sons, Inc.

Subject Code: MBT-212

Subject Name: Genetic Engineering

L	T	P	Cr
3	1	6	6

RATIONALE

This course helps the student to understand about the different types of vectors and their use in preparing recombinant DNA.

UNIT S	CONTENTS	Contact Hrs.
I	The recombinant DNA Technology : General concept and Principle of cloning Enzymes: Nucleases and restriction endonucleases – properties and types; phosphomonoesterases; polynucleotide kinase; DNA ligase; DNA polymerase I; RNA Dependent DNA Polymerase; terminal deoxynucleotidyltransferase; poly A polymerase Prokaryotic host-vector system: Characteristics of E. coli as host; vectors for cloning in E. coli (plasmid, bacteriophage and plasmid-phage) Other Prokaryotic host vector systems: Characteristics of Gram positive and Gram negative organisms as host and suitable vectors for cloning; Shuttle Vectors	8
II	Design and characteristics of expression vectors for cloning in prokaryotes, factors that affect expression. Cloning in yeast: Properties of yeast as host for cloning and different types of vectors designed for cloning in yeast.	8

	<p>Cloning in animal system: Animal system as model host, methods of introduction of foreign DNA in animal system; Vectors for cloning in animal system-SV-40, vaccinia virus, baculovirus and retrovirus vectors, pMal, GST, pET based vectors, Pichia based vectors.</p> <p>Plant transformation technology: Features of Ti and Ri plasmids, mechanism of DNA transfer</p>	
III	<p>Methods for constructing rDNA and cloning: Inserts; vector insert ligation; Infection, Transferring and cloning</p> <p>Methods for screening and selection of recombinant clones</p> <p>DNA Libraries: types, advantages and disadvantages of different types of libraries; Different methods for constructing genomic and full length cDNA libraries</p> <p>Gross anatomy of cloned insert-size, restriction mapping and location</p>	8
IV	<p>Fine anatomy of DNA segment-General principle of chemical and enzymatic methods of nucleotide sequence analysis and advantages of automatic gene sequencers.</p> <p>Localization of cloned segments in genomes – molecular and chromosomal location</p> <p>Methods for determination of copy number of a cloned gene in genome</p> <p>Mutant construction: Introduction, deletion, insertion and point mutation</p>	8
V	<p>Principles and applications of Blotting techniques – Southern, Northern, Western and Eastern blotting; Polymerase Chain reaction and types (multiplex, nested, RT, real time, touchdown PCR, hot start PCR, colony PCR), Oligonucleotide synthesis,</p> <p>Principle and applications of Gel Mobility Shift Assay, DNA Fingerprinting and DNA Foot printing, Restriction fragment length polymorphism, Chromosome mapping and chromosome painting</p> <p>Applications of Recombinant DNA Technology in Medicine and Industry</p> <p>Si RNA and Si RNA technology: Micro RNA construction of Si RNA vectors: Gene silencing and its applications in agro industry.</p>	8

PRACTICALS

1	Bacterial Culture and antibiotic selection media. Preparation of competent cells
2	Isolation of plasmid DNA
3	Isolation of phage DNA
4	Quantitation of nucleic acids
5	Restriction mapping of plasmid DNA
6	Cloning in plasmid/phagemid vectors
7	Preparation of helper phage and its titration
8	Preparation of single stranded DNA template
9	Gene expression in E .coli and analysis of gene product
10	Polymerase Chain Reaction

REFERENCE BOOKS :	
1.	Recombinant DNA – By Watson et al
2.	Principles of Gene Manipulation, Old and Primrose
3.	Gene Cloning: An introduction , Brown
4.	Biotechnology: Theory and Techniques (Vol I & II, 1995), Chirikjian
5.	Molecular Genetics of Bacteria , Dale
6.	Molecular Cloning (Vol I, II & III, 2001), Sambrook& Russell
7.	Applied Molecular Genetics (1999), Miesfeld
8.	Genes and Genome (1991), Singer & Berg
9.	Molecular Biotechnology , Glick & Pasternak
10.	Plant Molecular Biology (Vol I & II, 2002), Gilmartin& Bowler

Subject Code: MBT-213

Subject Name: Biostatistics and Bioinformatics

L	T	P	Cr
3	1	6	6

RATIONALE
Implementation of statistical tools in evaluation of various parameters and use of information technology in biology.

UNIT S	CONTENTS	Contact Hrs.
I	Introduction to Biostatistics, Common terms, notions and Applications Statistical population and Sampling Methods	8

	<p>Classification and tabulation of data</p> <p>Diagrammatic and graphical presentation</p> <p>Frequency Distribution, Measures and central value</p> <p>Measures of variability, Standard deviation, Standard error, Range, Mean Deviation</p> <p>Coefficient of variation, Analysis of variance</p>	
II	<p>Basic tests, Test of Significance, t-test, chi-square test.</p> <p>Regression; Basics of regression, regression analysis, Estimation, Testing, prediction, checking and residual analysis.</p> <p>Multivariate Analysis</p> <p>Design of Experiment, randomization, replication, local control, complimentary randomized, randomized block design</p>	8
III	<p>Introduction: Goals, applications and limitations of Bioinformatics.</p> <p>Biological sequence and molecule file formats, DNA and protein sequence databases, Structure databases.</p> <p>Pairwise sequence alignment and database searching: Evolutionary Basis of sequence alignment, Homologous sequence, Global alignment and local alignment, Gap penalties</p> <p>Dot matrix method, Scoring matrices Dynamic programming methods: Needleman-Wunsch and Smith-Waterman algorithm, Database similarity search, Heuristic methods: FASTA, BLAST.</p>	8
IV	<p>Multiple sequence alignment and phylogenetic: Scoring multiple sequence alignments, Progressive alignment method, Iterative alignment method, Block-based alignment.</p> <p>Molecular evolution and phylogenetics, Phylogenetic trees, Molecular clock theory, Maximum Parsimony.</p> <p>Distance based methods: UPGMA, Maximum likelihood method, Bayesian statistical analysis.</p>	8
V	<p>Structural Bioinformatics: Ramachandran plot, protein secondary structure prediction, Chou-Fasman and GOR method, neural networks, Protein three dimensional structure prediction: Homology modeling and protein Threading, Molecular visualization, Computer aided drug design, Docking and QSAR .</p>	8

PRACTICALS	
1	DNA and protein sequence and PDB file formats,
2	Local and global sequence alignment of protein and DNA sequences, Needleman Wunsch and Smith-Waterman algorithm, BLAST,
3	Multiple sequence alignment and Sequence logo, Phylogenetic tree construction,
4	Secondary structure prediction, Visualization and editing of three dimensional structure,
5	Homology modeling, Active site prediction, Docking, Perl

REFERENCE BOOKS :	
1.	An Introduction to Computational Biochemistry by C Stan T sai
2.	Statistics for Agricultral Sciences by NageswaraRao, G.
3.	Fundamentals of statistics by Goon et al, 1962.
4.	Methods in Biostatistics by B.K. Mahajan
5.	Statistical methods by S.P. Gupta
6	Statistical methods by G.W. Snedecor and W.G. Cochran
7	Fundamental of artificial Neural Networks, Prentice-Hall of India, N.Delh Xiong J, Essential Bioinformatics, Cambridge University Press (2006)
8	Mount D W, Bioinformatics - Sequence and Genome Analysis, Cold Spring Harbour Laboratory Press (2001)
9	Ghosh Z, and Mallick B, Bioinformatics – Principles and Applications, Oxford University Press (2008)
10	Dwyer, R.A., Genomic Perl: From Bioinformatics Basics to Working Code, Cambridge University Press (2004)
11	Higgins, D. and Taylor, W., Bioinformatics: Sequence, Structure and Databanks – A Practical Approach, Oxford University Press (2000)

Subject Code: MBT-214

Subject Name: Entrepreneurship and IPR

L	T	P	Cr
3	1	6	6

RATIONALE
Intellectual Property rights (IPR) allow innovative entrepreneurs to protect their inventions.

UNIT S	CONTENTS	Contact Hrs.
I	Entrepreneurship: Entrepreneurship and principles of entrepreneurial development, Qualities of an entrepreneur, Functions and types of entrepreneur. Project Management: Formulation, Identification and selection based on size, Technological assessment, Project cost and market potential and marketing concepts.	8
II	Project Appraisals: Technical reports and feasibility reports with commercial viability, Break-even analysis, Depreciation, Sources of funding. Financing: Sources of finance, Initial capital, Capital structure, Venture capital and Institutional finance.	8
III	Economics: Demand-supply-pricing, Business ethics, Industrial laws, Women entrepreneurs – Role, problems and development. Industrial Sickness: Symptoms, control and rehabilitation of sick units.	8
IV	Introduction to Intellectual Property: Intellectual property and IPR, patent, copyrights, geographical indications, trademarks, trade secret, Industrial designs, Patent law, Legislations covering IPR's in India, product planning and development, filing patent, provisional and complete specification, patentable and non-patentable items, Valuation & business concerns.	8
V •		8

PRACTICALS	
1 •	Nil
2	Nil
3	Nil
4	Nil
5	Nil

REFERENCE BOOKS :	
1.	Desai, V., Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House (2007).
2.	Singh, I. and Kaur, B., Patent law and Entrepreneurship, Kalyani Publishers (2006).
3.	Sateesh, M.K., Bioethics and Biosafety, IK International (2008).

