

**DEPARTMENT OF
BIOTECHNOLOGY**

**PERIYAR UNIVERSITY,
SALEM- 11**

**M.Sc. BIOTECHNOLOGY
(CURRICULUM DETAILS)**

DEPARTMENT OF BIOTECHNOLOGY
PERIYAR UNIVERSITY, SALEM- 11
M.Sc. BIOTECHNOLOGY
(CURRICULUM DETAILS)

I- SEMESTER		Credits
MBT101	Cell Biology	5
MBT102	Biochemistry	5
MBT103	Microbiology and Industrial Biotechnology	5
MBTEA104, B104 ELECTIVE PAPER:		
	MBTEA 104 Vermiculture and Sericulture/ MBTEB 104 Aquaculture	4
MBT 105	Practical I: Cell Biology, Biochemistry and Enzymology	3
MBT 106	Practical II: Microbiology and Industrial Biotechnology	3
 II - SEMESTER		
MBT201.	Genetics and Molecular Biology	5
MBT202.	Genetic Engineering and Nanobiotechnology	5
MBT203.	Plant Biotechnology	5
MBT204.	Practical III: Molecular Biology and Genetic Engineering	3
MBT205.	Practical IV: Plant Biotechnology	3
MBTEDA206	ED/ Basic Biotechnology	4
MBT207	Human Rights	2
 III - SEMESTER		
MBT301.	Immunotechnology	5
MBT302.	Developmental Biology	5
MBT303.	Animal Biotechnology	5
MBTEC, D304. ELECTIVE PAPER (Food and Medical Biotechnology/ Environmental Biotechnology)		
MBT305	Practical V: Immunotechnology, Developmental Biology and Animal Biotechnology	3
MBTED306	ED/Herbal Biotechnology	4
 IV - SEMESTER		
MBT401.	Bioinformatics and Analytical Techniques	5
MBT402.	Project Work	9
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Total Credits:		92
Total Hours:		92

DEPARTMENT OF BIOTECHNOLOGY
PERIYAR UNIVERSITY, SALEM- 11
MBT 101: CELL BIOLOGY

Credits: 5
Hours: 5/Wk

Unit I

Microscopy: Light, Confocal, SEM, TEM, Phase contrast, Fluorescence – Molecular organization of prokaryotic and eukaryotic cells. Structure and function of cell organelles: Mitochondria, chloroplast, golgi apparatus, lysosomes, endoplasmic reticulum, ribosomes, peroxisomes and Nucleus.

Unit II

Cell membrane and types: Unit membrane, sandwich model and Fluid Mosaic model. Membrane transport: passive and facilitated diffusion, active transport, symport, antiport, ATPase, ABC transporters, ion channels and aquaporins. Intercellular communication: Gap junctions, Tight junction and Desmosomes.

Unit III

Cell signalling: concept, ligands and receptors. Endocrine, paracrine and autocrine signalling. G protein coupled receptors, receptor kinases. Signal transduction: Cytoplasmic and nuclear receptors. Second Messengers: cAMP, Ca⁺, cGMP and Nitrous oxide.

Unit IV

Cytoskeleton: Microtubules, Microfilaments, Intermediate filaments, Amyloid fibers. Cell mobility: Endocytosis and Exocytosis. Proton pumps. Molecular motors: Actin and microtubules based motor proteins.

Unit V

Cell Division: Mitosis, Meiosis, Cell Cycle: phases, regulation, checkpoints. Cell death: Apoptosis and necrosis. Oncogenes and tumor suppressor genes.

Recommended Books

- Bruce Alberts , Alexander Johnson , Julian Lewis, Martin Raff , Keith Roberts, Peter Walter. 2014. Molecular Biology of the Cell, 6th Edn . Academic Press. New York.
- Gerald Karp. 2013. Cell and Molecular Biology: Concepts and Experiments, 7th Edn. Wiley.
- Geoffrey Cooper. 2013. The Cell: A molecular approach. 6th Edn. Sinauer Associates Inc.
- Lodish, Baltimore et al. 2007. Molecular Cell Biology. 6th Edn. W.H. Freeman & Co.

MBT 102: BIOCHEMISTRY

Credits: 5

Hours: 5/Wk

Unit I

Water and buffers: Molecular structure of water, hydrogen bonds and physical properties of water. Amino acids: Polar, nonpolar and neutral amino acids. Vitamins and minerals. Nucleic acids: purines, pyrimidines, DNA, RNA. Biosynthesis of purine and pyrimidine.

Unit II

Carbohydrates: Classification, functions of biologically important monosaccharides, disaccharides, homopolysaccharides. Overview of metabolism and biological oxidation. Carbohydrate metabolism: Glycolysis, citric acid cycle, gluconeogenesis, glycogen metabolism. Diabetes mellitus.

Unit III

Amino acids: Classification and acid-base properties. Biologically important peptides. Proteins: Classification, functions, denaturation and renaturation. Orders of protein structure: Primary, secondary (α -helix, β -pleated sheet), tertiary, and quaternary structures. Urea cycle.

Unit IV

Lipids: Classification, structure and functions of cholesterol. Lipid metabolism: β -oxidation of fatty acids, biosynthesis of fatty acids – An overview. Coronary heart disease.

Unit V

Enzymes: Classification and nomenclature. Specificity, factors affecting enzyme activity-substrate, pH and temperature. Michaelis-Menten equation and L-B plot. Enzyme inhibition. Coenzymes and Isoenzymes - An overview. Applications of enzymes in clinical diagnosis and therapeutics.

Recommended Books

- Robert K. Murray, Daryl K. Granner, Victor W. Rodwell. 2015. Harper's Illustrated Biochemistry, 30th Edn. McGraw-Hills.
- David. L. Nelson and Michael. 2013. Lehninger, Principles of Biochemistry. 6th Edn. M. Cox.
- Lupert Styrer. 2012. Biochemistry. 7th Edn. W. H. Freeman & Co.
- Geoffrey Zubay. 1995. Principles of Biochemistry. 4th Edn.. Mcgraw Hill Publications.

MBT 103: MICROBIOLOGY AND INDUSTRIAL BIOTECHNOLOGY

Credits: 5
Hours: 5/Wk

Unit I

Introduction to bacteria: Ultrastructure of bacterial cell- Cell wall, cell membrane, flagella, cell inclusions. Staining: principle and types. Fungi, Algae and Protozoa. Introduction to bacterial, plant, animal and tumour viruses. Lytic cycle and lysogeny. DNA and RNA viruses. Viroids and prions.

Unit II

Microbial growth: Growth curve, factors affecting growth. Culture media. Sterilization. Isolation of pure culture, incubation, streak, spread and pour-plate methods. Cultivation of anaerobes, Chemoautotrophs and chemoheterotrophs. Culture collection and preservation. Microbial metabolism - an overview. Photosynthesis in microbes. Chemolithotrophy; methanogenesis and acetogenesis.

Unit III

Bioprocess engineering: Isolation and screening of industrially important microbes. Bioreactors: Fermentation media. Downstream processing: Solid-liquid separation, release of intracellular compartments, concentration of biological products, purification. Industrial production of ethanol, citric acid, butanol, penicillin and amino acids.

Unit IV

Wastewater treatment: Physical, chemical and biological treatment processes. Effluent treatment: Bioremediation and oil spill clean-up. Bioleaching: Use of microorganisms in mining gold and uranium. Renewable sources of energy (biogas, energy crops, cellulose); greenhouse effect. Biodegradable plastics. Biofilms.

Unit V

Immobilization of enzymes: Methods, and applications. Biosensors. Use of enzymes in detergents, textiles, leather and food industries. Production of glucose syrup. Methods of food

preservation. Elementary idea of canning and packing. Basic principles of food fermentation. Industrial production of wine and beer.

Recommended Books

- Peter F. Stanbury, Allan Whitaker, Stephen J. Hall. 2016. Principles of Fermentation Technology. 3rd Edn. Elsevier Science Ltd
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton. 2016. Prescott's Microbiology. 10th Edn. McGraw-Hill Education.
- Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton. 2001. Industrial Microbiology: An Introduction. Blackwell Science Ltd
- Nduka Okafor. 2007. Modern Industrial Biotechnology & Microbiology. Science Publishers, Edenbridge Ltd.,
- Pepler H. J. and Perlman. D. 2012. Microbial Technology. Vol. 1&2. Academic Press.
- Casida L. E. and John Jr. 2015. Industrial Microbiology. Wiley and Sons Inc.

ELECTIVE PAPER
MBTEA 104: Vermiculture and Sericulture

Credits: 4
Hours: 4/Wk

Unit I

Biology of composting earthworms: *Eudrilus eugeniae* and *Lampito mauritii*. Ecological groups of earthworms: Epigeic, anecic, endogeic earthworm- earthworm casts- an outline of earthworm importance in agriculture and pollution.

Unit II

Sources of organic wastes: Problems in traditional composting- vermicomposting: Definition and methods - pit method, heap method and indoor method. Factors affecting vermicomposting: pH, moisture, temperature, nutritional value of feed.

Unit III

Advantages of vermicomposting/vermicompost: Application of vermicompost in agricultural and horticultural practices. Economics of vermiculture: NABARD- Nationalised banks- KVIC supports for vermiculture and vermiculture marketing.

Unit IV

Silkworm: Morphology- life cycle. Rearing programme- hatching, feeding, cleaning and spacing- care at mounting- environmental conditions: Leaf quality- rearing early age silkworms- rearing late age silkworms- mounting and harvesting.

Unit V

Process of stifling: Reeling techniques- process of reeling- methods of collection of silk. Bacterial diseases: Viral diseases- fungal diseases- enemies of silk worm.

Recommended Books

- Sultan Ismail, 1997. Vermicology. The biology of earthworm. Orient Longman Ltd., Chennai.
- Jawaid Ahsan and Subhash Prasad Sinha, 2000. A handbook of economic zoology. S. Chand & Co. Ltd., New Delhi.
- Edwards, C.A. and B.J. Bohlen, 1996. Biology and ecology of earthworms, Chapman & Hall, London.
- Lee, K.E., 1985. Earthworms- their ecology and relationships with soils and land use. Acad Press, Sydney.
- Ranganathan, L.S., 2006. Vermitechnology from soil health to human health, Agrobios (India), Agrohoude, Chopasani Road, Jodhpur.
- Ramalingam, R., 2007. Vermiculture. Tamil Nadu State Council for Higher Education (TANCHE), Chennai.

- Ramakrishnan Iyer, T.V., 1984. Handbook of economic entomology for South India. International Books and periodicals Supply Service, New Delhi.
- Fenemar, P.G. and Alka Prakash, 1992. Applied entomology. Wiley Eastern Ltd., New Delhi.

ELECTIVE PAPER

MBTEB 104: AQUACULTURE

Credits: 4

Hours: 4/Wk

Unit I

History, definition, scope and significance of aquaculture, comparison of aquaculture with agriculture and commercial fisheries. Different aquaculture systems. Aquaculture - Global and Indian Scenario.

Unit II

Feed and feeding habits: Herbivores, carnivores and omnivores. Feeding adaptations: Methods employed in the study of gut content analysis volumetric and gravimetric. Age and growth – Techniques used in the study – use of scales and otoliths, length frequency analysis. Length weight relationship. Equations used for deriving growth rates.

Unit III

Freshwater ecosystems: Lotic and Lentic ecosystems; Marine ecosystems: Oceans and seas, zonation of the seas: Rocky, sandy and muddy shores; classification of marine habitat - pelagic, benthic, neretic, oceanic, littoral and abyssal.

Unit IV

Aqua farms: Design and construction. Selection of cultivable species. Culture systems- extensive, semi intensive, intensive and raceway cultures. Induced spawning and Mass production of seeds. Cultivable freshwater fishes - carps, airbreathing fishes, tilapia, freshwater prawn. Brackish water fishes of commercial importance – Milk fish, mullet – Different organisms in Mariculture – mussel, edible oyster, pearl oyster and sea weeds.

Unit V

Bacterial, fungal, viral and protozoan diseases of fishes – Causative agents, symptoms, diagnosis and preventive measures.

Recommended Books

- Biswas, K. P. 1995. Prevention and Control of Fish and Prawn Diseases. Daya Publishing House, New Delhi.
- Luky. 1994. Methods for the Diagnosis of Fish Disease. Daya Publishing House, New Delhi.
- Pillay. T.V.R. and M.N. Kutty, 2005. Aquaculture – Principles and Practices, Black Well Sciences, U.K.

- James P. Mc Vey. 1993. 2nd Edn. Handbook of Mariculture Vol. I. Crustacean Aquaculture. CRC Press. Inc. Florida
- Joachim W. Hertrampf and Felicitas Piedad-Pascual. 2000. Handbook on ingredients for aquaculture feeds. Kluwer Academic Publishers, London.

MBT 105: PRACTICAL I: CELL BIOLOGY AND BIOCHEMISTRY

Credits: 3

Hours: 6/Wk

1. Stains and staining techniques: vital and differential staining.
2. Mitosis.
3. Meiosis.
4. Preparation of Polytene Chromosome.
5. Sex chromatin (Barr body).
6. Buffer Preparation; Molarity, Molality and Normality
7. Estimation of DNA.
8. Estimation of RNA.
9. Estimation of protein.
10. Extraction and estimation of starch from potato.
11. Separation of pigments by Paper chromatography
12. Separation of amino acids by paper chromatography/TLC.
13. Analysis of proteins by SDS-PAGE.
14. Enzyme assay of Peroxidase.

**MBT 106: PRACTICAL II: MICROBIOLOGY AND INDUSTRIAL
BIOTECHNOLOGY**

Credits: 3

Hours: 6/Wk

1. Gram staining and streaking methods.
2. Preparation of different media & Sterilization methods.
3. Enumeration of microorganisms in soil & water.
4. Isolation of microbes from spoiled vegetables.
5. Isolation of amylase producing microorganisms.
6. Microbial production of citric acid using *Aspergillus niger*.
7. Antibiotic Sensitivity Test by Kirby-Bauer Disk Diffusion method.
8. Isolation of antibiotic producing microbes and cross streak assay (antibiotic resistance).
9. Wine production (using Yeast).
10. Isolation of nitrogen fixing bacteria.
11. Isolation of carotenoid producing bacteria.
12. Isolation of microbial insecticides (*Trichoderma*, *Bacillus thuringiensis*, *Pseudomonas fluorescens*).
13. Industrial visit-Biofertilizers/Dairy plant/Fermentation unit.

MBT 201: GENETICS AND MOLECULAR BIOLOGY

Credits: 5
Hours: 5/Wk

Unit I

Mendelian principles: Segregation and independent assortment, mono & dihybrid, test cross, back cross. Incomplete dominance: Epistasis. Linkage and crossing over. Epigenetic. Heritability and genetic advance. Population genetics: gene pool, Hardy-Weinberg equilibrium, genetic drift and speciation.

Unit II

Recombination: Plasmids-origin of replication, incompatibility. Mutations & genetic analysis – auxotrophic, conditional lethal, resistant mutants. Isolation, selection and replica plating of mutants – complementation & recombination test. Transformation- natural and artificial. Transduction: Restricted and aborted transduction. Conjugation: Mating types, F-factor and chromosome mapping.

Unit III

DNA: Types and structure. Central dogma concept. DNA replication in prokaryotes and eukaryotes. Regulation of DNA replication. DNA Repair Mechanisms: SOS, thymine dimerization, mismatch repair. PCR: Principle, Types of PCR and its application in molecular biology.

Unit IV

RNA: Types of RNA, RNA polymerase, and Promoters: classes and consensus sequences, transcription factors. Transcription in prokaryotes and eukaryotes; RNA processing. Genetic Codes- Universal and Mitochondrial; Translation: Steps; protein folding and post translational modification. Intracellular protein trafficking and targeting.

Unit V

Regulation of gene expression in prokaryotes: Lactose and tryptophan; epigenetic regulation of gene expression in eukaryotes, DNA methylation – histone modification – acetylation and deacetylation, DNA binding motifs –Zinc finger, Leucine Zipper, HLH, and HTH.

Recommended Books

- Benjamin Lewin. Genes XI. 2013. Benjamin-Cummings Pub Co.
- Twyman, R.M. 2000. Advanced Molecular Biology: A Concise Reference. Garland/bios Scientific Publishers
- Sandy B Primrose. 1991. Molecular Biotechnology. 2nd Edn. Blackwell Scientific Publishers
- Brown. T.A. 2006. Genomes. 3rd Edn. Wiley-Liss (New York).
- Larry Snyder, Wendy Champness. 2002. Molecular Genetics of Bacteria. 2nd Edn. Amer Society for Microbiology.
- Sandy B. Primrose, Richard M. Twyman, Robert W. Old, 2002. Principles of Gene Manipulation and genomics. 7th Edn. Blackwell Science

MBT202: GENETIC ENGINEERING AND NANOBIO TECHNOLOGY

Credits: 5

Hours: 5/Wk

Unit I

Transcriptomes and proteomes: Bacteriophage and eukaryotic viruses. Prokaryotic and Eukaryotic genomes: *E. coli*, yeast and human. Repetitive DNA sequences. Mobile genetic elements and transposons.

Unit II

Genomic mapping: Genetic and physical - Restriction mapping, Sequence tagged site. Sequencing genomes: Chain termination, pyro sequencing. Sequence assembly: Shot gun, clone contig methods. Introduction to Human Genome Project (HGP).

Unit III

Enzyme for Gene manipulation: DNA polymerases, nucleases, DNA ligases. Restriction enzymes and transformation. Cloning and expression vectors- based on *E. coli* plasmids, M13 bacteriophage- Insertion and replacement vectors - 2 μ m plasmid, YACs, BACs and P elements, cohesive and blunt end DNA ligation.

Unit IV

Nanotechnology-Introduction. Nanoparticles: Definition, Types of nanoparticles: metal and bimetallic nanoparticles, CQD, dendrimers and fluorescent nanoparticles. Mechanisms of Nanoparticles synthesis and characterization: FTIR, XRD, EDX, DLS, SEM, HR-TEM and FRET.

Unit V

Application of nanoparticles: Agriculture, Environment and Medicine. Principles of nanosized drug delivery systems: Nanotubes, Nanorods, Nanofibres and Fullerenes.

Recommended Books

- Claudio Nicolini. 2009. Nanobiotechnology and Nanobiosciences Pan Stanford Publishing Pte. Ltd.
- Benjamin Lewin. 2013. Genes XI. Benjamin-Cummings Pub Co.

- Sandy B. Primrose , Richard M. Twyman , Robert W. Old. Principles of Gene Manipulation and Genomics. 7th Edn. by Blackwell Science
- Bhushan, Bharat. 2010. Springer Handbook of Nanotechnology. 2nd Edn. Springer-Verlag Berlin Heidelberg.
- Murty, B.S. Shankar, P. Baldev Raj, Rath, B B., James Murday. 2013. Textbook of Nanoscience and Nanotechnology. Springer Berlin Heidelberg.

MBT 203: PLANT BIOTECHNOLOGY

Credits: 5

Hours: 5/Wk

Unit I

Plant kingdom: Lower plants-Algae–food and its industrial applications, Higher plants- Economic important of Angiosperms: Food crops, Cash crops and Medicinal plants.

Unit II

Plant tissue culture: Totipotency, cytodifferentiation, callus culture, cell suspension culture, micropropagation, organogenesis, somatic embryogenesis, protoplast culture and somaclonal variation. Molecular markers: RAPD, AFLP, RFLP, SSR and SNP. Production of haploids: Bulbosum technique and its uses.

Unit III

Plant genome organization: Nuclear, Plastid and Mitochondrial. Construction and application of cDNA and genomic DNA libraries. Gene library Screening– colony hybridization. Tools for stress induced gene identification-mRNA differential display and SSH analysis.

Unit IV

Plant transformation: Vectors- Agrobacterium mediated transformation, particle bombardment and electroporation. Conformation of transgene expression by Molecular Techniques-PCR, Northern, Southern and Western blot analyses, Gene silencing by antisense and RNAi technology in plants – delayed ripening and seed terminator technology.

Unit V

Application of genetic manipulation in crop improvement: herbicide, insecticide and disease resistance. Techniques for industrial and pharmaceutical products: edible vaccines. IPR, Plant breeders and Farmers Right.

Recommended Books

- Kalyan Kumar De, 1997. Plant Tissue Culture 2nd Edn. New Central Book Agency, Calcutta
- Robert N. Trigiano, and Dennis J. Gray, 1999. Plant Tissue Culture Concept and Laboratory Exercises, 2nd Edn. CRC Press, London.

- Srivasta, P.S. 1998. Plant Tissue Culture and Molecular Biology, Narosa Publishing House, New Delhi.
- David W. Galbraith, Hans J. Bohnert and Don P. Bourque, 1995. Methods in Plant Cell Biology, Academic Press, New York.
- John H. Dodds and Lorrin W. Roberts, 2006. Experiments in Plant Tissue Culture, 3rd Edn. Cambridge University Press, USA.
- Singh, S.K. and Srivastava, Seema. 2006. Plant Tissue Culture Eastern Book Corporation, India.
- Narayanaswamy, S. 1994. Plant Cell and Tissue Culture, Tata Mcgraw Hill Publishers.

**MBT 204: PRACTICAL III: MOLECULAR BIOLOGY AND GENETIC
ENGINEERING**

Credits: 3

Hours: 6/Wk

- Culturing and selection of Auxotrophs
- Isolation of DNA
- Isolation of plasmids and Electrophoretic analysis
- Restriction analysis of DNA
- Determination of molecular size of DNA
- Ligation of DNA into vectors
- Transformation
- Amplification of gene by PCR.
- Southern blotting analysis
- DNA fingerprinting by RAPD

MBT 205: PRACTICAL IV: PLANT BIOTECHNOLOGY

Credits: 3
Hours: 6/Wk

1. Basic sterilization techniques and culture media preparation.
2. Shoot tip culture.
3. Root culture.
4. Endosperm culture.
5. Anther culture.
6. Plant DNA- isolation and analysis.
7. PCR and RAPD analysis
8. Restriction digestion of genomic DNA and AGE analysis
9. Protoplast isolation and culturing
10. Synthetic seed production (Artificial seed)
11. *Agrobacterium* mediated gene transformation

EXTRA DEPARTMENTAL SUPPORTIVE COURSE (EDS)

MBTEDA 206: BASIC BIOTECHNOLOGY

Credits : 4

Hours : 4/Wk

Unit I

Introduction and scope of biotechnology. Prokaryotic and eukaryotic cells. Mendelian principles of genetics. Sex determination in plants and animals.

Unit II

Structure of DNA and RNA. Central dogma- DNA – RNA - Protein. rDNA technology- Applications.

Unit III

Biotechnological tools: Plant and animal tissue culture. Transgenic plants and animals. Bioethics and biosafety. Development of diagnostic test kits.

Unit IV

Applications of Biotechnology in Agriculture: GM crops and Terminator technology. Medicine: Biochips – Genetic diagnosis. Stem cell lines, Insulin Production. Industry: Biofuel and Biopolymer.

Unit V

Biodiversity and conservation. Bioremediation (oil spills) and its application, Intellectual property right (IPR) and patents.

Recommended Books

- Becker, W.M. Kleinsmith L.J. and Hardin, J. 2007. The World of Cell. 6th Edn, Pearson Press.
- Smith, J.E. 2015. Biotechnology, 5th Edn. Cambridge University Press.
- Hames D. and Hooper, N. 2008. Instant notes in Biochemistry, Taylor & Francis, UK
- Gupta, P.K. 2009. Elements of Biotechnology, Rastogi Publications.

MBT 301: IMMUNOTECHNOLOGY

Credits: 5
Hours: 5/Wk

Unit I

Introduction to Immunology: Innate and adaptive immunity, cells and organs of immune system, epitopes, antibody-structure, classes and biological activity. Techniques: ELISA, Western blot, immunohistochemistry, immunoprecipitation, flow cytometry, gene knockout and FISH.

Unit II

Multigene organization of Ig genes, mechanism variable region gene rearrangements, generation of antigenic diversity, class switching among constant region genes. Antigen processing and presentation.

Unit III

Structure of T- cell receptor and TCR gene. Organization and TCR genes, T-cell: activation, maturation and differentiation. Structure of B - cell receptor. B- cell: Activation, maturation and differentiation.

Unit IV

Role of MHC in immune response: Complement system- activation, regulation, biological consequences. Cytokines: Cytokine receptors, cytokine secretion by T-cells. Hypersensitive reaction types: I, II, III and IV.

Unit V

Transplantation Immunology: Graft rejection, Primary and acquired immunodeficiencies. Cancer immunotherapy. Immune response to infective diseases: Viral, Bacterial and Parasitic. Vaccines: Active and passive immunization, subunit and DNA vaccines.

Recommended Books

- Thomas J. Kindt, Barbara A. Osborne, Janis Kuby, Richard A. Goldsby, Janis Kuby. Immunology. 2013. 7th Edn. W H Freeman & Co.
- Charles Janeway, Paul Travers, Mark Walport, Mark Shlomchik, Mark J. Shlomchik. 2004. Immunobiology: The Immune System in Health and Disease . Garland Pub.
- Abul K Abbas, Andrew K. Lichtman & Jordan S. Pober. 2015. Cellular and Molecular Immunology, 8th Edn. W.B.Saunders Company.

MBT 302: DEVELOPMENTAL BIOLOGY

Credits: 5
Hours: 5/Wk

Unit I

Epigenesis and preformation, karl ernst principles, fate mapping of embryo. Cellular basis of morphogenesis. Evolution of differentiation and morphogenesis. Evolution of developmental patterns in flowering plants and metazoans. Types of cell specification and morphogens gradients.

Unit II

Ultrastructure of sperm, egg, pollen and ovule. Spermatogenesis and Oogenesis vis-a-vis their gene action. Gametogenesis in plant. Sea Urchin: External fertilization, Prevention of polyspermy and egg activation. Mammalian fertilization: Acrosome reaction and Capacitation. Transcription of Lampbrush Chromosomes.

Unit III

Cleavage and gastrulation in Sea Urchins. Axis specification in *Drosophila* - fertilization, cleavage, gastrulation, primary axis formation during oogenesis, dorsal - ventral pattern in embryo, segmentation, anterior-posterior body plan, segmentation genes and homeotic selector genes.

Unit IV

Cleavage and gastrulation in mammals: Anterior-posterior, dorsal-ventral and right-left axis information. Development of tetrapod limb: formation of limb bud, generation and specification of antero-posterior axis, dorso-ventral axis and formation of digits and joints.

Unit V

Sex determination: Chromosomal and environmental. Metamorphosis in amphibians and insects. Regeneration of Salamander limbs. Diapause, sex determination vis-a-vis season and developmental symbiosis. Biology of aging.

Recommended Books

- Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith. 2002. Principles of Development, 2nd Edn. Oxford University Press.
- Scott F Gilbert. 2006. Developmental Biology. 8th Edn. Sinauer Associates Inc.
- Manfred D. Laubichler and Jane Maienschein. 2007. From embryology to Evo-Devo: a history of developmental evolution. Edited by Cambridge, Mass: MIT Press.

MBT 303: ANIMAL BIOTECHNOLOGY

Credits: 5

Hours: 5/Wk

Unit I

Animal cell and tissue culture: Laboratory facilities and culture media. Culture procedures: preparation, sterilization, disaggregation of tissue (mechanical and enzymatic), subculture and contamination. Primary culture, Secondary culture, cancer cell lines. Measurement of cell viability and cytotoxicity. Large-scale culture of cell lines.

Unit II

Organ and histotypic culture: Technique, advantages and applications. Stem cells: Types - embryonic and adult, isolation, identification, expansion, differentiation and uses. Commercial applications of animal culture.

Unit III

Manipulation of reproduction in animals: Artificial insemination, embryo transfer, *in vitro* fertilization. Embryo transfer in cattle and applications. Somatic cell cloning: Cloning of Dolly. Production of recombinant vaccine for foot and mouth diseases. Probiotics for disease control.

Unit IV

Vectors for gene transfer in animals: Adenovirus and retrovirus. Gene constructs-promoter/enhancer sequences for transgene expression in animals. Selectable markers for animal cells- thymidine kinase, CAT. Transfection of animal cells: Electroporation, direct DNA transfer and microinjection.

Unit V

Methods for producing transgenic animals: Retroviral, microinjection and engineered stem cell. Targeted gene transfer. Transgenic cattle, sheep, fish and pigs. Uses of transgenic animals - Transgenic animals as models of human disease. Ethical issues in transgenesis.

Recommended Books

- Freshney RI. 2010. Culture of animal cells: A manual of basic technique. 6th Edn. Wiley-Liss.
- Glick and Pasternak. 2009. Molecular Biotechnology. 4th Edn. ASM Press.
- Primrose Twyman and Old. 2014. Principles of gene manipulation. 8th Edn. Blackwell Sci.

ELECTIVE PAPER

MBTEC 304: FOOD AND MEDICAL BIOTECHNOLOGY

Credits: 4

Hours: 4/Wk

Unit I

Biotechnology in relation to the food industry. Nutritive value of food. Types and sources of microorganisms associated with food. Conditions for microbial growth in food. Food hazards: bacterial diseases, staphylococcal intoxication, botulism, food poisoning, Salmonellosis, fungal illness, mycotoxins and aflatoxins.

Unit II

Principles of food packaging: Methods of food preservation. Control of microorganisms by retarding growth- low temperature, drying, chemicals. Control of microorganisms: Gas treatments, heat, ionization radiation and ultraviolet radiation.

Unit III

Basic principles of food fermentation. Fermented foods- fermented milk - cheese, bread, fermented vegetables. Fermented meats and fish. Production of vinegar. Mushroom farming. Uses of enzymes in food industry: Proteases in food processing, enzymes used in baking and dairy industry, enzymes in fruit juice and brewing industries.

Unit IV

Genetic diseases: Chromosomal disorders - Down syndrome. Monogenic disorders: Autosomal dominant, autosomal recessive and sex-linked. Cancer: Growth characteristics of cancer cells and Agents causing cancer. The HIV genome and life cycle.

Unit V

Diagnostic kits. Tumor markers: hormones and enzymes. Prenatal and neonatal screening for genetic disorders. PCR in disease diagnosis. Monoclonal antibodies. Therapeutic agents from nonrecombinant and recombinant organisms. Drug delivery and targeting.

Recommended Books

- Hans-Joachim Jördening, Josef Winter. 2005. Environmental Biotechnology: Concepts and Applications. Wiley.

- Dwivedi, S.K. Kalita, M.C. Padmanabh Dwivedi. 2007. Biodiversity and Environmental Biotechnology. 1st Edn. Scientific Publishers (India)
- Hisham K. Hamadeh and Cynthia A. Afshari. Hoboken. 2004. Toxicogenomics: Principles and Applications. NJ:Wiley-Liss,
- Sharma. P.D. 2015. Environmental Biology. 12th Edn. Rastogi Publishers.
- Chatterjee A.K. 2002. Introduction to Environmental Biotechnology. Printice- Hall, India.
- Bernard R. Glick, Terry L. Delovitch, Chery L. Patten. 2014. American Society of Microbiology Press and distributed by Taylor and Francis.
- Judit Pongracz, Mary Keen. 2009. Medical Biotechnology. Elsevier Health Sciences.

ELECTIVE PAPER

MBTED 304: ENVIRONMENTAL BIOTECHNOLOGY

Credits: 4
Hours: 4/Wk

Unit I

Ecosystem: Components, types, structure and function. Biodiversity: Types, values, threats, hotspots, IUCN redlisted flora and fauna and their conservation. Global warming, greenhouse effect and climate change. Environmental impact assessment (EIA), Environmental Policy and Ethics.

Unit II

Environmental Pollution: Air, Water, Soil and Acid rain. Pollution control measures: physical, chemical and biological. Role of plants - mycorrhizae and phytochelators in heavy metal contaminated lands. Phytoremediation - molecular aspects of heavy metal extraction. Management of E-wastes and nanoparticles.

Unit III

Toxic chemicals in environment: Genotoxicity and toxicogenomics risk assessment. Endocrine disruptors, Xenoestrogens and thyroid hormone disruptors.

Unit IV

Microbial degradation: Pesticides, leaching, heavy metals, plastics and oil spills. Bioremediation of contaminated soil.

Unit V

Applied Ecotechnology: Composting, vermiculture, biofuels, biofertilizers, bioplastics and biopesticides in Integrated Pest Management (IPM).

Recommended Books

- Hans-Joachim Jördening, Josef Winter. 2005. Environmental Biotechnology: Concepts and Applications. Wiley.
- Dwivedi, S.K. Kalita, M.C. Padmanabh Dwivedi. 2007. Biodiversity and Environmental Biotechnology. 1st Edn. Scientific Publishers (India)
- Hisham K. Hamadeh and Cynthia A. Afshari. Hoboken, NJ. Toxicogenomics: Principles and Applications. Wiley-Liss
- Sharma. P.D. 2105. Environmental Biology. 12th Edn. Rastogi Publishers.
- Chatterjee A.K. 2002. Introduction to Environmental Biotechnology. Printice- Hall, India.

**MBT 305: PRACTICAL V: IMMUNOLOGY, DEVELOPMENTAL BIOLOGY AND
ANIMAL BIOTECHNOLOGY**

Credits: 3

Hours: 6/Wk

- Blood Typing and analysis: ABO grouping, Rh factor, WBC, TLC, Platelets counts.
- Animal handling, collection of blood samples from test animals - Intravenous, Subcutaneous and Intraperitoneal methods.
- Preparation of antigen, serum and antiserum
- Antigen- antibody interaction: Flocculation, Precipitation and agglutination reaction.
- ELISA
- Preparation of culture media and sterilization
- Preparation of single cell suspension from spleen
- Trypsinization of monolayer and sub culturing
- Measurement of doubling time
- Cryopreservation and thawing
- Cell counting and viability
- Acrosome reaction
- *In vitro* fertilization (IVF)

EXTRA DEPARTMENTAL SUPPORTIVE COURSE (EDS)

MBTEDB 306: HERBAL BIOTECHNOLOGY

Credits : 4

Hours : 4/Wk

Unit I

Medicinal plants in the traditional system of medicine: Ayurveda, Siddha, Unani, and Homeopathy. Plant tissue culture and molecular markers: RAPD, RFLP and AFLP. Authentication of medicinal plants.

Unit II

Plant diseases: Blast, blight, tikka, smelt and wilt. Control measures and use of herbicides.

Unit III

Herbal extraction methods: Steps, solvents and equipment. Types of herbal extract preparations and storage methods. Plant biomolecules and their future prospects in drug industry.

Unit IV

Parasitic diseases: Malaria and filaria. Metabolites as potential insecticides. Control of malarial parasite and vector.

Unit V

Herbs to treat human diseases: Diabetic, cancer, diarrhoea, skin and HIV.

Recommended Books

- Kiritikar K.R. and Basu, B.D. 1980. Indian medicinal plants Vol. I-V, CSIR Publications, New Delhi.
- Janardhan Reddy, K. 2007. Advances in medicinal plants, University Press
- Sharma, P.D. 2006. Plant Pathology, Alpha Scientific International, India
- Cheng, 1975. Molecular parasitology, Elsevier Publications, London
- Lee Lerner and Brenda Wilmoth, 2007. Biotechnology: Medicine Vol. I, Thomas-Gale Publications, US
- Lee Lerner and Brenda Wilmoth, 2007. Biotechnology: Agriculture Vol. II, Thomas-Gale Publications, US
- Lee Lerner and Brenda Wilmoth, 2007. Biotechnology: Industry Vol. III, Thomas-Gale Publications, US

MBT 401: BIOINFORMATICS AND ANALYTICAL TECHNIQUES

Credits: 5

Hours: 5/Wk

Unit I

Useful search engines: PubMed. Biological databases: primary, secondary and organism-specific. Data submission and retrieval. Sequence alignment. Database similarity searching: BLAST, FASTA. Multiple sequence alignments: CLUSTAL. Molecular Phylogenetics: Phylogenetic tree construction and analysis. Protein structure database-protein structure visualization, comparison. Protein motifs and domain prediction.

Unit II

Collection and classification of data - diagrammatic and graphic representation of data. Measurement of central tendency: standard deviation – parametric and nonparametric hypothesis testing. Student *t* test. Correlation and regression. Chi square test. ANOVA.

Unit III

Laws of absorption. Principle, instrumentation and applications of UV-visible spectrophotometry and Atomic absorption spectroscopy. An outline of the principles and biological applications of NMR. Autoradiography. Liquid scintillation counter. Applications of radioisotopes in biology. Radiation hazards.

Unit IV

Electrophoresis: General principles. Principle, technique and applications of Native-PAGE, agarose gel electrophoresis, isoelectric focusing and MALDI-TOF. Basic principles and types of centrifugation: analytical and preparative. Subcellular fractionation. Ultracentrifugation.

Unit V

General principles of partition and adsorption chromatography. Principle, and applications of thin layer, ion-exchange, molecular exclusion, and affinity chromatography. HPLC & GC: Types, principle and applications.

Recommended Books

- Wilson and Walker. Principles and techniques of Biochemistry and Molecular biology. 7th Edn. Cambridge University Press 2012.
- Upadhyay, Upadhyay and Nath. Biophysical Chemistry principles and Techniques. Himalaya Publ. 2010.

- Donald L. Pavia, Gary M., Lampman, George S., Kriz, James A. Vyvyan. Pavia Intro to spectroscopy 2009. U.S.A.: Prentice Hall
- Boyer, Rodney F. Modern Experimental Biochemistry. 3rd Edn. 2000 Prentice Hall.
- Norman T.S. Bailey, 1995. Statistical methods in Biology, 3rd Edn. Cambridge University Press, UK.