

DEPARTMENT OF BIOTECHNOLOGY

**PERIYAR UNIVERSITY,
SALEM- 11**

**M.Sc. BIOTECHNOLOGY
(CURRICULUM DETAILS, 2018-19)**

UPDATE: 10.07.2018

DEPARTMENT OF BIOTECHNOLOGY
PERIYAR UNIVERSITY, SALEM- 11
M.Sc. BIOTECHNOLOGY
(CURRICULUM DETAILS-2018-2019)

I- SEMESTER		Credits
MBT101	Cell Biology	5
MBT102	Biochemistry	5
MBT103	Plant Biotechnology	5
MBTEA104, B104	ELECTIVE PAPER: MBTEA 104 Vermiculture and Sericulture/ MBTEB 104 Aquaculture	4
MBT 105	P- I: Cell Biology and Biochemistry	3
MBT 106	P- II: Plant Biotechnology	3
MBT 107	MOOC Course I	-
 II - SEMESTER		
MBT201.	Genetics and Molecular Biology	5
MBT202.	Genetic Engineering and Nanobiotechnology	5
MBT203.	Microbiology and Industrial Biotechnology	5
MBT204.	Recombinant DNA (rDNA) Technology	5
MBT205.	Practical III Molecular Biology, Genetic Engineering and rDNA Technology	3
MBT206.	Practical- IV Genetics, Microbiology and Industrial Biotechnology	3
MBTEDA207	ED/ Basic Biotechnology	3
MBT208	Human Rights Industrial Visit/ In-Plant Training	2
 III - SEMESTER		
MBT301.	Immunotechnology	5
MBT302.	Animal Biotechnology and Developmental Biology	5
MBT303	Bioinformatics, Biostatistics and Bioinstrumentation	5
MBTEA304, B304	ELECTIVE PAPER MBTEA 304 Environmental Biotechnology MBTEB 304 Food and Medical Biotechnology	4
MBT305	Practical V: Immunotechnology, Developmental Biology and Animal Biotechnology	3
MBTED 306	Herbal Biotechnology	3
MBT 307	MOOC Course II	-
 IV - SEMESTER		
MBT 401	Project Work	10
<hr/>		
Total Credits:		91
Total Hours:		91

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

Credits: 5
Hours: 5/Wk

Unit I

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 structure: Fluid Mosaic model. Membrane transport: passive and facilitated diffusion, active transport, symport, antiport, ATPase, ABC transporters, ion channels and aquaporins. Intercellular communication: Gap junction, 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. Secondary Messengers: cAMP, Ca⁺, cGMP and Nitrous oxide.

Unit IV

Cytoskeleton: Microtubules, Microfilaments, Intermediate filaments, Amyloid fibers. Cell mobility: Endocytosis and Exocytosis. Proton pumps.

Unit V

Cell Division: Mitosis, Meiosis, Cell Cycle: phases, regulation, checkpoints. Cell death: Apoptosis and necrosis. Microscopy: Light, Confocal, SEM, TEM, Phase contrast and Fluorescence.

Recommended Books

1. Bruce Alberts , Alexander Johnson , Julian Lewis, Martin Raff , Keith Roberts, Peter Walter. 2014. Molecular Biology of the Cell, 6th Edn . Academic Press. New York.
2. E. D. P. De Robertis, E. M. F. De Robertis Jr. Cell and Molecular Biology 8th Ed., South Asian Edition. Lippincott, Williams and Wilkins.
3. Gerald Karp. 2013. Cell and Molecular Biology: Concepts and Experiments, 7th Edn. Wiley.
4. Geoffrey Cooper. 2013. The Cell: A molecular approach. 6th Edn. Sinauer Associates Inc.
5. 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. Vitamins and minerals. Nucleic acids: Purines, pyrimidines, DNA and RNA. Biosynthesis of purine and pyrimidine.

Unit II

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

Unit III

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

Unit IV

Lipids: Classification, structure and functions of cholesterol. Lipid metabolism: β -oxidation and 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. 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: 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. Production of haploids: Bulbosum technique and its uses. seed terminator technology.

Unit III

Plant genome organization: Nuclear, Plastid and Mitochondrial. Tools for stress induced gene identification-mRNA differential display and SSH analysis. Molecular markers: RAPD, AFLP, RFLP, SSR and SNP.

Unit IV

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

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.

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 their 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 and nutritional value of feed.

Unit III

Advantages of vermicomposting/vermicompost: Application of vermicompost in agricultural and horticultural farms. Economics of Vermiculture and 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.

Unit II

Feed and feeding habits: Herbivores, carnivores and omnivores. Feeding adaptations: Methods employed in the study of gut content analysis. Techniques used for studying Age and Growth – use of scales and otoliths, Length weight relationship.

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, 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 seed.

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. Sex chromatin (Barr body).
5. Buffer Preparation; Molarity, Molality and Normality
6. Estimation of DNA.
7. Estimation of RNA.
8. Estimation of protein.
9. Extraction and estimation of starch from potato.
10. Separation of amino acids by paper chromatography/TLC.
11. Analysis of proteins by SDS-PAGE.

MBT 106: PRACTICAL II: 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 PAGE analysis
9. Protoplast isolation and culturing
10. Synthetic seed production (Artificial seed)
11. *Agrobacterium* mediated gene transformation

MBT 201: GENETICS AND MOLECULAR BIOLOGY

Credits: 5
Hours: 5/Wk

Unit I

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

Unit II

Recombination: Plasmids-origin of replication, incompatibility. Mutations and genetic analysis: auxotrophic, conditional lethal and resistant mutants. Isolation, selection and replica plating of mutants. Transformation, Transduction, Conjugation and Transposons.

Unit III

Genome Organization: Prokaryotic and Eukaryotic. DNA: Structure and forms. DNA replication in prokaryotes and eukaryotes- enzymes and steps. DNA Repair Mechanisms: Excision and mismatch repair.

Unit IV

RNA: Types of RNA, RNA polymerase, and Promoters. 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

Basic steps in gene cloning. Type II Restriction endonucleases. Cloning vectors: plasmids (pBR322 and pUC), phage vectors (λ), cosmids. Methods of ligation of insert and vector DNA molecules: cohesive end method, homopolymeric tailing, blunt-end ligation.

Unit-II

Gene transfer methods: calcium phosphate coprecipitation, electroporation, lipofection, viruses, microinjection. Choice of host organisms for cloning. Cloning strategies- genomic cloning, cDNA cloning.

Unit-III

Techniques in genetic engineering: Probes- types. PCR- basic principles and applications. Basic concepts of RT-PCR and real-time qPCR. Applications of genetic engineering in agriculture, environment and medicine. Cloning of insulin gene in bacteria. Hazards and safety aspects of genetic engineering.

Unit-IV

Genome mapping- genetic and physical. Restriction mapping. Genome sequencing methods (DNA Sequencing: Automated sequencing. Next-generation sequencing basic concepts only). (Overview only) shotgun and clone-contig methods. Gene therapy.

Unit-V

Nanobiotechnology- introduction. Nanoparticles- metal, and bimetallic nanoparticles, dendrimers, and fluorescent nanoparticles. Biological synthesis of nanoparticles. Techniques for visualization of biomolecules at nanoscale- FTIR, XRD, EDX, FRET and DLS. Applications of nanotechnology in biology, medicine and environment.

Recommended Books

1. Nicholls DTS. An Introduction to Genetic Engineering. 3rd ed. Cambridge Univ Press. 2008.
2. Glick and Pasternak. Molecular Biotechnology. 4th ed. ASM Press 2009.
3. Reece. Analysis of Genes and Genomes. Wiley 2004.
4. Jain KK. Nanobiotechnology Molecular Diagnostics: Current Techniques and Applications. Taylor & Francis. 2006.
5. vo-Dinh (ed) Nanotechnology in Biology and Medicine: Methods, devices and applications. CRC Press. 2007.

MBT 203: MICROBIOLOGY AND INDUSTRIAL BIOTECHNOLOGY

Credits: 5
Hours: 5/Wk

Unit I

Introduction to bacteria - Cell wall, cell membrane, flagella and cell inclusions. Staining: principle and types. Fungi, Algae and Protozoa. Introduction to bacterial, plant and animal 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, streak, spread and pour-plate methods. Cultivation of anaerobes: Chemoautotrophs and chemoheterotrophs. Culture collection and preservation. Microbial metabolism - an overview. Photosynthesis in microbes. methanogenesis and acetogenesis.

Unit III

Bioprocess engineering: Isolation and screening of industrially important microbes. Bioreactors: Fermentation -Downstream processing: Solid-liquid separation, release of intracellular compartments, concentration of biological products, purification. Industrial production of ethanol, citric acid, 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 energy sources: biogas, energy crops and cellulose.

Unit V

Immobilization of enzymes: Methods, and applications. Use of enzymes in detergents, textiles, leather and food industries. Methods of food preservation: canning and packing. 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.,
- Peppler 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.

MBT 204: Recombinant DNA (rDNA) technology

Credits: 5
Hours: 5/Wk

Unit-I

History and recent developments in rDNA technology, Enzymes used in rDNA technology: Restriction enzymes, DNA Ligases, DNA polymerase, Ribonucleases, Reverse transcriptase, Alkaline phosphatase, T4 Polynucleotidekinase, Terminal deoxynucleotidyl transferase, Nucleases-S1 Nuclease and DNAase.

Unit-II

Cloning Vectors- Plasmids and its types, Bacteriophages-Lambda and M13 vectors, Phagemids, Shuttle vectors- YACs, YEps, BACs. Expression vectors- pBR322, pTZ. Animal viruses-SV40, Baculo and their use as vectors.

Units-III

Gene cloning strategies: DNA cloning. Use of adapters & linkers. Construction of genomic DNA and cDNA libraries. Screening and selection of recombinant clones- Colony Hybridization techniques. lacZ complementation (Blue-white selection), Immuno-screening. Preparation of radiolabelled/non-radiolabelled DNA & RNA probes.

Unit-IV

PCR –types and its applications. DNA fingerprinting, Chromosome walking. Medical and forensic applications of rDNA technology- DNA Profiling, Diagnosis of inherited disorders and infectious diseases by PCR. Gene therapy for ADA and cystic fibrosis. CRISPR-Cas9 gene editing technology.

Unit- V

Biotechnological applications of rDNA technology: Gene transfer techniques. Synthesis and purification of recombinant proteins from cloned genes. Production of enzymes. Therapeutic products for use in human health care- insulin, growth hormones, Hepatitis B vaccine. Safety regulations in rDNA technology.

Recommended Books

1. Principles of Gene Manipulation and Genomics (2009) by S. B. Primrose and R. M. Twyman, John Wiley & Sons.
2. Gene Cloning (2007) by Julia Lodge, Pete Lund and Steve Minchin, Taylor and Francis.
3. An introduction to Genetic Engineering (2004) by Desmond S.T. Nicholl, Cambridge University Press.
4. Gene Cloning and DNA Analysis. An Introduction (2010) by T. A. Brown, Blackwell Scientific Publications.
5. Next-Generation Genome Sequencing (2008) by Michal Janitz, Wiley-Blackwell Publications.
6. Recombinant DNA (1992) by J.D. Watson, M. Gilman, J. Witowski and Mark Zoller, Scientific American Books.
7. From Genes to Clones: Introduction to gene technology (1987). Winnacker, E.L.
8. Molecular cloning: A Laboratory Manual (2001). Sambrook, J., Russell, D.W., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
9. Comprehensive Biotechnology (Vol.1-4) (2004) by Moo-Young, Robinson Howell.
10. Next-Generation Genome Sequencing (2008) by Michal Janitz, Wiley Blackwell.

MBT 205: PRACTICAL III: MOLECULAR BIOLOGY GENETIC ENGINEERING AND rDNA TECHNOLOGY

Credits: 3

Hours: 6/Wk

1. Isolation of genomic DNA
2. DNA fingerprinting by RAPD
3. Restriction analysis of genomic DNA
4. Southern blotting analysis
5. Determination of molecular size of DNA
6. Amplification of gene by PCR.
7. Isolation of RNA and AGE analysis
8. cDNA synthesis by RT-PCR
9. Isolation of plasmids and Electrophoretic analysis
10. Ligation of DNA into plasmid vectors
11. Transformation of plasmids
12. Selection of recombinant clones by blue – White screening.
13. Identification of gene by Colony PCR.

**MBT 206: PRACTICAL IV: GENETICS, MICROBIOLOGY AND INDUSTRIAL
BIOTECHNOLOGY**

Credits: 3

Hours: 6/Wk

1. Preparation of different media & Sterilization methods.
2. Enumeration of microorganisms in soil & water.
3. Gram staining and streaking methods.
4. Isolation of microbes from spoiled vegetables.
5. Isolation of amylase producing microorganisms.
6. Microbial production of citric acid using *Aspergillus niger*.
7. Isolation of antibiotic producing microbes and cross streak assay (antibiotic resistance).
8. Antibiotic Sensitivity Test by Kirby-Bauer Disk Diffusion method.
9. Wine production (using Yeast).
10. Culturing and selection of Auxotrophs
11. Isolation of nitrogen fixing bacteria.
12. Isolation of carotenoid producing bacteria.

EXTRA DEPARTMENTAL SUPPORTIVE COURSE (EDS)

MBTEDA 207: BASIC BIOTECHNOLOGY

Credits : 3

Hours : 3/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: Insulin Production.

Unit III

Biotechnological tools: Plant and animal tissue culture. Transgenic plants and animals. Bioethics and biosafety. Development of recombinant vaccines.

Unit IV

Applications of Biotechnology in Agriculture-GM crops, Stem cells-Embryonic and adult, 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

Immunity: innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs. Cells of the immune system- lymphocytes, mononuclear phagocytes-dendritic cells, granulocytes, NK cells and mast cells. Antigens- antigenicity, epitopes, haptens. Immunoglobulins- structure, classification and functions.

Unit-II

T-cell and B-cell receptors, Antigen recognition- processing and presentation to T-cells. Complement activation. Organization and expression of immunoglobulin genes. Generation of antibody diversity.

Unit-III

Immunization practices: active and passive immunization. Vaccines-killed, and attenuated. Recombinant vaccines: DNA vaccines, synthetic peptide vaccines. Production of applications of polyclonal and monoclonal antibodies.

Unit-IV

Transplantation types: MHC antigens in transplantation. Immunodeficiency disorders: AIDS: The HIV genome and life cycle. Autoimmunity and hypersensitivity (elementary details only). Cancer immunotherapy

Unit-V

Agglutination and precipitation techniques: Immuno-electrophoresis, RIA, Immunoblotting, Immunohistochemistry, immunofluorescence. ELISA-principle and applications. Flow cytometry

Recommended Books

1. Goldsby et al. Kuby Immunology. WH Freeman & Co. 7th ed 2013.
2. Abbas et al. Cellular and Molecular Immunology. Elsevier 2011.
3. Janeway, C. (Ed), Paul Travers. Immunobiology 8th ed. Garland Publ. 2016.
4. Coico and Sunshine. Immunology: A short course. 7th ed. Wiley, 2015.

MBT 302: ANIMAL BIOTECHNOLOGY AND DEVELOPMENTAL BIOLOGY

Credits: 5

Hours: 5/Wk

Unit I

Animal cell culture: types of media, sterilization, disaggregation of tissue (mechanical and enzymatic), subculture and contamination. Primary and secondary culture, cancer cell lines. Cell viability and cytotoxicity. Organ culture: advantages and applications.

Unit II

Stem cells: Types -embryonic and adult, isolation, identification, expansion, differentiation and uses. Methods for producing transgenic animals: Lipofection, sperm-mediated transfer, and microinjections. Transgenic cattle, sheep. Production of recombinant vaccines for foot and mouth diseases and DNA vaccines.

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. Somatic cell-Nuclear transfer, embryo splitting, nuclear transplantation.

Unit IV

Types of cell specification and morphogens gradients. Ultrastructure of sperm, egg, pollen and ovule. Spermatogenesis and Oogenesis vis-a-vis their gene action. Gametogenesis in plant. Mammalian fertilization: Acrosome reaction and Capacitation. Transcription of Lampbrush Chromosomes.

Unit V

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

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.
- 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: BIOINFORMATICS, BIOSTATISTICS AND BIOINSTRUMENTATION

Credits: 5

Hours: 5/Wk

Unit I

Biological databases: primary, secondary and organism-specific. Database similarity searching: BLAST, FASTA. Multiple sequence alignments: CLUSTAL. Molecular Phylogenetics. Protein structure database

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

Beer and Lambert's Law, Principle, instrumentation and applications of UV-visible spectrophotometry and Atomic absorption spectroscopy. Autoradiography. Liquid scintillation counter. Applications of radioisotopes in biology.

Unit IV

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

Unit V

Principles and applications of gel filtration 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.

ELECTIVE PAPER

MBTEC 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.

ELECTIVE PAPER

MBTED 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.

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

Credits: 3

Hours: 6/Wk

1. Blood Typing and analysis: ABO grouping, Rh factor, WBC, TLC, Platelets counts.
2. Preparation of antigen, serum and antiserum
3. Antigen- antibody interaction: Flocculation, Precipitation and agglutination reaction.
4. ELISA
5. Preparation of culture media and sterilization
6. Preparation of single cell suspension from spleen
7. Trypsinization of monolayer and sub culturing
8. Cryopreservation and thawing
9. Cell counting and viability
10. Acrosome reaction

EXTRA DEPARTMENTAL SUPPORTIVE COURSE (EDS)

MBTEDB 306: HERBAL BIOTECHNOLOGY

Credits : 3

Hours : 3/Wk

Unit I

Traditional system of medicine: Ayurveda, Siddha, Unani, and Homeopathy. Plant tissue culture and molecular markers: RAPD, RFLP and AFLP for authentication of medicinal plants.

Unit II

Viral diseases: TMV, Bacterial diseases: (Blast, blight), fungal diseases (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

MBT307: MOOC Course II

MBT401: Project Work

Credits: 10