

**DEPARTMENT OF BIOTECHNOLOGY (2010 – 2011)**

**PERIYAR UNIVERSITY, SALEM- 11**

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

<b>I- SEMESTER</b>		<b>Credits</b>
MBT101	Cell Biology	5
MBT102	Biochemistry and Enzymology	5
MBT103	Plant Cell Biotechnology	5
MBT104	ELECTIVE PAPER (Food Biotechnology/  Marine Biotechnology)	4
MBT 105	Practical I : Cell Biology , Biochemistry and Enzymology	3
MBT 106	Practical II: Plant Cell Biotechnology	3
<b>II - SEMESTER</b>		
MBT201.	Genetics and Molecular Biology	5
MBT202.	Genomics and Genetic Engineering	5
MBT203.	Microbial and Agricultural Biotechnology	5
MBT204.	Practical III: Molecular Biology and Genetic Engineering	3
MBT205.	Practical IV: Microbial and Agricultural Biotechnology	3
MBTEDA206	ED/ Basic Biotechnology	4
MBT207	Human Rights	2
<b>III - SEMESTER</b>		
MBT301.	Immunology and Molecular Medicine	5
MBT302.	Developmental Biology	5
MBT303.	Animal Cell Biotechnology	5
MBTEC, D304.	ELECTIVE PAPER (Environmental Biotechnology/ Bioprocess Technology)	4
MBT305	Practical V: Immunology, Animal and Environmental Biotechnology	3
MBTED306	ED/Herbal Biotechnology	4
<b>IV - SEMESTER</b>		
MBT401.	Bioinformatics and Research Methodology	5
MBT402.	Project Work	9
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<b>Total Credits:</b>		<b>92</b>
<b>Total Hours:</b>		<b>92</b>

**DEPARTMENT OF BIOTECHNOLOGY (2010 – 2011)**  
**PERIYAR UNIVERSITY, SALEM- 11**

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

<b>I- SEMESTER</b>		<b>Credits</b>
MPBT01	Research Methodology	4
MPBT02	Plant and Animal Biotechnology	4
MPBT03	Guide Paper	4
 <b>II – SEMESTER</b>		
	Project	8
	Viva-Voce	4
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		24
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# **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. Membrane transport: passive and facilitated diffusion, active transport, symport, antiport. Intercellular communication- Gap junctions, Tight junction and Desmosomes. Intracellular protein trafficking and targeting.

### **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<sup>+</sup>, 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 cycle: M and S Phase, Mitosis, Cytokinesis, Meiosis. Cell cycle control system: control of cell division and cell growth. Cell death: Apoptosis and necrosis. Oncogenes and tumor suppressor genes.

### **Recommended Books**

- Molecular Biology of the Cell, Fourth Edition.(Bruce Alberts) , Alexander Johnson , Julian Lewis, Martin Raff , Keith Roberts, Peter Walter. Academic Press. New York. (1994)
- Molecular Cell Biology. 6<sup>th</sup> Eds. Lodish , Berk , Baltimore et al . W.H. Freeman & Co.(2000)
- Cell and Molecular Biology: Concepts and Experiments, 5th Eds. Gerald Karp. Wiley (2008)
- The Cell: A molecular approach. 2<sup>nd</sup> Eds. Geoffrey Cooper. Sinauer Associates Inc. (2000)

- Kleinsmith, L. J. & Kish, V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn.,McLaughlin, S., Trost, K., Mac Elree, E. (eds.), Harper Collins Publishers, New York.
- De Robertis and De Robertis. 8<sup>th</sup> Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins (2005)

## **MBT 102: BIOCHEMISTRY AND ENZYMOLOGY**

**Credits: 5**

**Hours: 5/Wk**

### **Unit I**

Water and buffers-Theory. Amino acids: Polar, nonpolar and neutral aminoacids. Vitamins and minerals. Nucleic acids - purines, pyrimidines, DNA, RNA. Biosynthesis of purine and pyrimidine.

### **Unit II**

Carbohydrates: monosaccharides, disaccharides, oligosaccharides and polysaccharides. Glycolysis, TCA, Gluconeogenesis, Glycogenolysis, Oxidative Phosphorylation, ATP synthesis, Photosynthesis.

### **Unit III**

Lipids: classification, fatty acids. Lipid metabolism: Beta oxidation of fatty acids, cholesterol biosynthesis, steroid hormones. Intermediary metabolism. Obesity, Metabolic syndrome and Type II Diabetes.

### **Unit IV**

Protein structure: peptide linkage, primary, secondary, tertiary and quaternary structures. Purification of proteins, Protein characterization, identification, Protein metabolism and degradation: amino acid oxidation, Urea cycle.

### **Unit V**

Enzymes: Classification-nomenclature-catalysts. Lock and key theory, induced fit theory, active site, substrate specificity, co-enzymes and co-factors. Enzyme kinetics – velocity, substrate concentration, temperature, pH. Michaelis–Menton model, lineweaver-burk plot. Enzyme inhibition.

### **Recommended Books**

- Harper's Illustrated Biochemistry, 27th Edition (2006.) Robert K. Murray, Daryl K. Granner, Victor W. Rodwell. McGraw-Hills.
- Lehninger, Principles of Biochemistry. 4<sup>th</sup> edition. David.L.Nelson and Michael.M.Cox.

- Biochemistry. 5<sup>th</sup> Edition (1999) Lupert Styrer. W.H.Freeman & Co
- Principles of Biochemistry. 4<sup>th</sup> Edition (1995). Geoffrey Zubay.

## **MBT 103: PLANT CELL BIOTECHNOLOGY**

**Credits: 5**  
**Hours: 5/Wk**

### **Unit I**

Plant tissue culture- totipotency, cytodifferentiation, callus culture, cell suspension culture, micropropagation, organogenesis, somatic embryogenesis, protoplast culture, somaclonal variation. Production of haploids (anther and ovule culture and bulbosum technique) and their uses.

### **Unit II**

Plant genome organization-Nuclear, Plastid, and Mitochondrial. Genome walking- Isolation and analysis of gene regulatory sequences. Tools for stress induced gene identification-mRNA differential display and SSH analysis.

### **Unit III**

Molecular markers-RAPD, AFLP, RFLP, SSR, SNP, ISSR and SCAR. Marker-assisted selection by QTL in plants. Computational tools and resources in plant genome informatics.

### **Unit IV**

Plant transformation methods- Agrobacterium-mediated transformation, particle bombardment, electroporation. Confirmation of transgene expression by PCR, RT-PCR, Northern, Southern and Western blot analysis. Vectors for gene transfer (Ti, Ri plasmids, cointegrate, binary vectors, viral vectors). Gene silencing by antisense and RNAi technology in plants, gene regulation by micro RNAs.

## Unit V

Plant genetic manipulation. Biotic stress-herbicide and insecticide, Abiotic stress-salinity and drought. Male sterility and hybrid production. Production of industrial and pharmaceuticals products. Plant breeder's and Farmers' right.

### Recommended Books

- Kalyan Kumar De, 1992, Plant Tissue Culture , New Central Book Agency ,Calcutta
- Robert N. Trigiano, Dennis J. Gray, 1996, Plant Tissue Culture Concept and Laboratory Exercises, CRC Press, London.
- P.S. Srivasta , 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 , 1995 , Experiments in Plant Tissue Culture, Cambridge University Press , USA.
- Singh, S.K. & Srivastava, Seema. 2006Plant Tissue Culture Eastern Book Corporation, India
- Plant Cell And Tissue Culture Narayanaswamy, S. Tata Mcgraw Hill Publishers 1994

**ELECTIVE PAPER**  
**MBTEA 104: FOOD BIOTECHNOLOGY**

**Credits: 4**  
**Hours : 4/Wk**

**Unit I**

Principles and methods of food preservation: freezing, heating, dehydration, canning, fermentation, irradiation etc.

**Unit II**

Technological aspects of industrial production of beer, wine. Enzymes and their applications in food industry: amylase, pectinase, proteases. Production of food flavors.

**Unit III**

Sources and composition of milk, its processing and storage. Milk product processing-cream, butter, cheese, condensed milk, milk powder, ice cream, panner, fermented milk products. yoghurt, cheese.

**Unit IV**

Nutritional and commercial importance of proteins. Production of single cell protein (SCP). Protein concentrates and isolates. Protein hydrolysates. Restructured protein, Non-conventional sources of protein.

**Unit V**

Principles of food processing and packaging, safety, hazards and risks related to food safety. Microbiological consideration in food safety. HACCP as method to prevent food-borne illness.

**Recommended Books**

- Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford.
- Joshi, V.K. and Pandey, A. Ed. 1999. Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.
- Salunkhe, O.K. and Kadam, S.S. Eds. 1999. Handbook of World Legumes: Nutritional Chemistry, Processing Technology and Utilization. Volume I to III. CRC Press, Florida.
- Salunkhe, D.K. Chavan, J.K., Adsule, R.N. Kadam, S.S. 1992. World Oilseeds: Chemistry, Technology and Utilization, Van Nostrand Reinhold, New York.
- Dey, S. 1994. Outlines of Dairy Technology. Oxford Univ. Press, New Delhi.
- McCrae, R., Robinson, R.K. and Sadler, M.J. Ed. 1993. Encyclopedia of Food Science, Food Technology and Nutrition Academic Press, London.
- Robinson, R.K. (2 vol. set). 1986. Modern Dairy Technology, Elsevier Applied Science, UK.
- Rosenthal, I. 1991. Milk and Milk Products. VCH, New York.
- Warner, J.M. 1976. Principles of Dairy Processing. Wiley Eastern Ltd, New Delhi.

**ELECTIVE PAPER**  
**MBTEB 104: MARINE BIOTECHNOLOGY**

**Credits: 4**  
**Hours: 4/Wk**

**Unit I**

Marine flora-Phytoplankton, seaweeds, sea grasses and mangroves. Marine fauna– Zooplankton; marine invertebrates (crustaceans & molluscs); Vertebrates and marine mammals (dolphins and whales). Biology of marine organisms- feeding and reproduction.

**Unit II**

Marine natural products- carrageenan, Agar- Agar, Sea weed fertilizer(SLF), bioactive compounds and commercial products from marine organisms- marine copepods as living capsules in aquaculture.

**Unit III**

Sea food spoilage-fish and human pathogens. Marine Pharmacology- marine toxins, antiviral and antimicrobial agents.

**Unit IV**

Marine pollution- pollutants (oil, thermal and radioactive). Biological indicators (microbes, Phyto and Zooplankton). Marine fouling-Macrofoulers, Biofilms, Antifouling methods.

**Unit V**

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.

**Recommended Books**

- Agarwal et. al., Biodiversity and Environment. APH., pp 351.1996.
- Jeffrey S., Levinton CD. Marine Biology: Function, biodiversity, ecology (515pp). 2001.
- Fingerman M., Recent advances in Marine Biotechnology, Science Publishers, 2000.
- Stickney, R.R., 2000. Encyclopedia of Aquaculture. John Wiley Sons Inc. pp. 1063
- Milton fingerman et al., 1999. Recent Advances in Marine Biotechnology Volume 3.
- Sverdrup H.V., Johns M.W., and R.H. Fleming 1969. Oceans – Their Physics, Chemistry and Biology. Prentice-Hall Inc., New Jersey.



## **MBT 105: PRACTICAL I: CELL BIOLOGY, BIOCHEMISTRY and ENZYMOLOGY**

**Credits: 3**  
**Hours: 6/Wk**

1. Stains and staining techniques: vital and differential staining.
2. Mitosis.
3. Meiosis.
4. Sex chromatin (Barr body).
5. Estimation of DNA.
6. Estimation of RNA.
7. Estimation of protein.
8. Extraction and estimation of starch from potato.
9. Separation of amino acids by paper chromatography/TLC.
10. Analysis of proteins by SDS-PAGE.
11. Western blotting analysis
12. Enzyme assay of Peroxidase.

## **MBT 106: PRACTICAL II: PLANT CELL 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

## **MBT 201: GENETICS AND MOLECULAR BIOLOGY**

**Credits: 5**  
**Hours: 5/Wk**

### **Unit I**

Mendelian principles- segregation and independent assortment. Incomplete dominance. 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, Transformation- natural and artificial. Transduction-restricted and aborted transduction. Conjugation - mating types, F-factor, chromosome mapping - zygote induction – Sexduction RTF.

### **Unit III**

DNA and RNA: Types, and structure - Chromatin organization - C-Value paradox- Central dogma concept. DNA replication in prokaryotes and eukaryotes. Regulation of DNA replication. DNA mutagens and repair.

### **Unit IV**

Transcription: Types of RNA, RNA synthesis. Promoters and transcription factors. RNA processing. Translation: genetic code, ORF, protein folding and post translational modification. Protein degradation.

### **Unit V**

Regulation of gene expression in prokaryotes- Lactose and tryptophan. Lytic and lysogenic cycle in viruses. DNA binding motifs –Zinc finger, Homeodomain, Leucine Zipper. DNA methylation.

### **Recommended Books**

- Molecular Biology of the Cell, Fourth Edition. Bruce Alberts , Alexander Johnson , Julian Lewis, Martin Raff , Keith Roberts, Peter Walter. Academic Press . New York. (1994)

- Molecular Cell Biology. 6<sup>th</sup> Edition. Lodish , Berk , Baltimore et al . W.H. Freeman & Co (2000)
- Twyman, R.M.: Advanced Molecular Biology. Garland/bios Scientific Publishers (2000)
- Molecular Biotechnology. 2<sup>nd</sup> Edition. Sandy B Primrose. Blackwell Scientific Publishers (1991)
- Genomes. 2<sup>nd</sup> Edition. T.A.Brown. Wiley-Liss (New York). 2002
- Molecular Genetics of Bacteria . 2<sup>nd</sup> Edition. Larry Snyder, Wendy Champness. Amer Society for Microbiology. 2002.
- Benjamin Lewin. Genes VIII.2003. Benjamin-Cummings Pub Co.
- Sandy B. Primrose , Richard M. Twyman , Robert W. Old, 2002. Principles of Gene Manipulation and genomics. 7<sup>th</sup> Edition. Blackwell Science

## **MBT202: GENETIC ENGINEERING**

**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 .Transposons.

### **Unit II**

Genomic mapping: genetic and physical - Restriction mapping, FISH, Sequence tagged site. Sequencing genomes - chain termination, chemical degradation, pyro sequencing. Sequence assembly – shot gun, clone contig methods. Human Genome Project (HGP)- mapping phase- sequencing.

### **Unit III**

Enzyme for Gene manipulation - DNA polymerases, nucleases, DNA ligases. Cutting, joining and introduction of DNA into living cell. Cloning and expression vectors- based on *E.coli* plasmids, M13 bacteriophage- Insertion and replacement vectors - 2µm plasmid, YACs, BACs and P elements.

### **Unit IV**

Construction and application of cDNA and genomic DNA libraries. Gene library Screening– colony hybridization, oligonucleotide and heterologous gene probes. PCR – Principles, types and their applications. Application of rDNA technology- Medicine, Agriculture and Industry.

### **Unit V**

Genetic Engineering-Social, ethical and legal issues - Gene therapy, biowarfare and stems cell research. Biosafety: protocols, risk groups and containments. Intellectual property: Patents, trade mark and copy right. GATT and TRIPs. Patenting genes, transgenic organisms.

## Recommended Books

- Genes VIII.2003. Benjamin Lewin. Benjamin-Cummings Pub Co.
- Principles of Gene Manipulation and Genomics. 7<sup>th</sup> Edition. by Sandy B. Primrose , Richard M. Twyman , Robert W. Old. Blackwell Science
- Discovering Genomics, Proteomics, and Bioinformatics. 2<sup>nd</sup> Edition. by A. Malcolm Campbell, Laurie J. Heyer Pearson Publishers (2006)
- Introduction to Genetic Engineering 2nd Edition. Desmond S. T. Nicholl. Cambridge University Press. 2002.
- Analysis of Genes and Genomes. Richard J. Reece. John Wiley High Education. 2003
- Biotechnology. 3<sup>rd</sup> Edition. Smith, J.E. Cambridge University Press. 2001.
- Recombinant DNA Safety Guidelines, Department of Biotechnology, Ministry of Science and Technology. Government of India.
- Revised Guidelines for research in Transgenic Plants, Department of Biotechnology, Ministry of Science and Technology. Government of India.
- Ethics and Biotechnology by Anthony Oakley Dyson, John Harris. Routledge. 1994.

## **MBT 203: MICROBIAL AND AGRICULTURAL BIOTECHNOLOGY**

**Credits: 5**

**Hours: 5/Wk**

### **Unit I**

Microbes: Classification - viruses, bacteria, fungi, yeast and algae. Factors affecting microbial growth. Collection and maintenance of cultures.

### **Unit II**

Primary and secondary metabolism of microbes. Metabolic diversity among microorganisms- Photosynthesis, methanogenesis and acetogenesis- hydrocarbon transformation.

### **Unit III**

Microbial products: Penicillin, proteases, citric acid, acetic acid, vitamins, glutamic acid and lysine; beer and wine.

### **Unit IV**

Transgenic plants as bioreactors: Metabolic engineering of carbohydrates- starch. Protein factories- industrial and therapeutic proteins. Biopolymers.

### **Unit V**

Growth promoting bacteria: Nitrogen fixation- and nodulation genes. Biocontrol agents- *Trichoderma*, Bt and *Brewaria basiana*. Biofertilizers- nitrogen and phosphate solubilising bacteria.

### **Recommended Books**

- Michael T. Madigan John M. Martin & Jack Parker, 1984, Biology of Microorganisms Prentice Hall International, Inc., London.
- Edward A. Birge ,1992, Modern Microbiology . Principles and application. Wm.C. Brown Publishers , Inc. U.S.A.
- Gerard J. Tortora, Berdell R. Funke, Christine & L. Case ,2001, Microbiology –An Introduction. Benjamin Cummings, U.S.A.
- Danial Lim , 1998, Microbiology, McGraw-Hill Companies , New York.
- Stephen A. Hill ,1984, Methods in Virology. Blackwell Scientific Publication, London

## **MBT 204: PRACTICAL III: 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: MICROBIAL AND AGRICULTURAL BIOTECHNOLOGY**

**Credits: 3**  
**Hours: 6/Wk**

- Gram staining and streaking methods
- Isolation of microbes from spoiled vegetables
- Isolation of amylase producing microorganisms
- Microbial production of citric acid using *Aspergillus niger*
- Isolation of antibiotic producing microbes and cross streak assay (antibiotic resistance)
- Wine production (using Yeast)
- Isolation of nitrogen fixing bacteria
- Isolation of carotenoid producing bacteria
- Isolation of microbial insecticides (*Trichoderma*, *Bacillus thuringiensis*, *Pseudomonas fluorescens* )
- Industrial visit-Biofertilizers/Dairy plant/Fermentation

**EXTRA DEPARTMENTAL SUPPORTIVE COURSE (EDS)**  
**MBTEDA 206: BASIC BIOTECHNOLOGY**

**Credits : 4**

**Hours :**

**4/Wk**

**Unit I**

Introduction and scope of biotechnology. Prokaryotic and eukaryotic cell. Mendelian principles 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**

Application of Biotechnology in Agriculture- GM crops, Terminator technology. Medicine- Biochips- cancer ovary. Stem cell lines, Insulin Production. Industry: Biofuel, Biopolymer.

**Unit V**

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

**Recommended Books**

- J.E. Smith, 1996. Biotechnology, Cambridge University Press.
- P.K.Gupta, 1998. Elements of Biotechnology, Rastogi Publications.

- E.D.P. DeRobertis and E.M.F. De Robertis, 2005. Cell and Molecular Biology, CBS Publishers, India
- R.Sasidhara, 2008. Animal Biotechnology, M.P.J. Publishers, Chennai.
- C.B.Nirmala, G.Rajalakshmi and C.Karthik, 2008. Plant Biotechnology, M.P.J. Publishers, Chennai.
- P.T.Kalaichelvan and Arul pandi, 2008. Bioprocess technology, M.P.J. Publishers, Chennai.
- D. Hames and N.Hooper, 2008. Instant notes in Biochemistry, Taylor & Francis, UK
- W.M.Becker, L.J. Kleinsmith and J.Hardin, 2007. The World of Cell. 6<sup>th</sup> Edition, Pearson Press.

## **MBT 301: IMMUNOLOGY AND MOLECULAR MEDICINE**

**Credits: 5**  
**Hours: 5/Wk**

### **Unit I**

Introduction to Immunology, Innate and adaptive immunity, cells and organs of immune system, Antigen - Antibody reactions, immunogenicity and antigenicity, epitopes, antibody-structure, classes and biological activity.

### **Unit II**

Multigene organization of Ig genes, mechanism variable region gene rearrangements, generation of antigenic diversity, class switching among constant region genes, expression of Ig genes and regulation of Ig gene transcription.

### **Unit III**

Antigen processing and presentation. Structure of T- cell receptor and TCR gene. Organization and TCR genes, T-cell: activation, maturation and differentiation. 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 reactions type: I, II, III and IV.

### **Unit V**

Transplantation Immunology: Graft rejection, Primary and acquired immunodeficiencies. Cancer – Induction, tumor antigens, and cancer immunotherapy. Immune response to infective disease- Viral, Bacterial and Parasitic. Vaccines- Active and passive immunization, subunit and DNA vaccines.

### **Recommended Books**

- Immunology. Thomas J. Kindt, Barbara A. Osborne, Janis Kuby, Richard A. Goldsby, Janis Kuby. W H Freeman & Co. 2006.
- Immunobiology: The Immune System in Health and Disease . Charles Janeway, Paul Travers, Mark Walport, Mark Shlomchik, Mark J. Shlomchik. Garland Pub. 2004.
- Abul K Abbas, Andrew K. Lichtman & Jordan S. Pober (Eds.), 1997. Cellular and Molecular Immunology, 3rd 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 and egg. Spermatogenesis, Oogenesis, and their gene action. Sea Urchin – External fertilization, Prevention of polyspermy and egg activation. Mammalian fertilization- Acrosome reaction, 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 in its season and developmental symbiosis. Biology of aging.

### **Recommended Books**

- Principles of Development, Second Edition. Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith. Oxford University Press. 2002.
- Developmental Biology. 8<sup>th</sup> Edition. Scott F Gilbert. Sinauer Associates Inc.2006.

- From embryology to Evo-Devo : a history of developmental evolution. Edited by Manfred D. Laubichler and Jane Maienschein. Cambridge, Mass : MIT Press, c2007.

### **MBT 303: ANIMAL CELL BIOTECHNOLOGY**

**Credits: 5**

**Hours: 5/Wk**

#### **Unit I**

Animal cell and tissue culture. Culture media- Types, Physical, chemical and metabolic functions. Equipments required for cell culture.

#### **Unit II**

Primary culture, development and maintenance of cell line, and clonal propagation. Disaggregation (enzymatic and mechanical) of tissue. Manipulation of cells (electroporation, liposome mediated transformation, microinjection). Scaling –up of cell lines. Cell growth, characterization, cell viability and death. cytotoxicity of cultured cells.

#### **Unit III**

Tissue culture (slide and flask cultures). Organ culture, whole embryo culture, tissue engineering. *In Vitro* fertilization, embryo transfer and super ovulation. Gene transfer- Lipofection, sperm-mediated transfer. Transgenic animals - mouse and fish.

#### **Unit IV**

Stem cells-Embryonic stem cells versus adult embryonic cells-applications. Transfection using egg and cultured stem cells. Cell culture based vaccines-recombinant and DNA vaccines.

#### **Unit V**

Molecular cloning vectors-Shuttle vectors, viral vectors for animals: retrovirus, SV40, Baculovirus. Somatic cell-Nuclear transfer, embryo splitting, nuclear transplantation. DNA fingerprinting and microsatellites.

#### **Recommended Books**

- Freshney, I.R. Culture of Animal cells: a manual of basic technique. John-Wiley& Sons, New Jersey.2006.
- Bosch,T.C.G. Stem cells- From Hydra to Man. Springer India. 2008.

- Nigel Jenkins. Animal Cell Biotechnology – Methods and protocols. Humana Press Inc, New Jersey. 2005.
- M .M. Ranga, 2000 ,Animal Biotechnology, Agrobios (India),

## 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, green house effect and climate change. 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, thyroid hormone disruptors.

#### Unit IV

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

#### Unit V

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

#### Recommended Books

- Environmental Biotechnology: Concepts and Applications. Wiley (2005). Hans-Joachim Jördening, Josef Winter.
- Biodiversity and Environmental Biotechnology. (1<sup>st</sup> edition) Scientific Publishers (India) (2007) S.K. Dwivedi, M.C. Kalita, Padmanabh Dwivedi
- Toxicogenomics: Principles and Applications. Edited by Hisham K. Hamadeh and Cynthia A. Afshari. Hoboken, NJ:Wiley-Liss, 2004
- Environmental Biology. P.D.Sharma. (1994) Rastogi Publishers.
- Introduction to Environmental Biotechnology. A.K.Chatterjee (2002). Printice- Hall, India.



## **ELECTIVE PAPER**

### **MBTED 304: BIOPROCESS TECHNOLOGY**

**Credits: 4**  
**Hours: 4/Wk**

#### **Unit I**

Industrially important microbes: Isolation, screening and maintenance. Microbial growth, strains improvement for increased yield and other desirable characteristics.

#### **Unit II**

Fermentation process- batch, Fed-batch and continuous. Bioreactor designs. Air and media sterilization, Aeration & agitation. Measurement and control of bioprocess parameters- Scale up and scale down process.

#### **Unit III**

Down stream processing: Precipitation, filtration, flocculation and centrifugation. Cell disruption methods - physical and chemical. Chromatography and separation, drying and crystallization.

#### **Unit IV**

Industrial bioprocess-Anaerobic (ethanol, lactic acid) aerobic process (citric acid, Streptomycin and single cell protein).

#### **Unit V**

Production, recovery and scaling up of enzymes and their role in food and other industries; Immobilization of enzymes and their industrial applications.

#### **Recommended Books**

- Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, Prentice Hall, Engelwood Cliffs, 2002.
- Kalaichelvan and Arulpani, Bioprocess Technology. MJP. Publishers 2008.
- Doran. Bioprocess Engineering Principle. Elsevier. 2007.
- Stanbury, RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
- Comprehensive Biotechnology. The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4 (2004). Edited by M. M. Young, Reed Elsevier India Private Ltd, India
- Biotechnology: The Biological Principles (1990) Edited by M D Trevan, S Boffey, K H Goulding, and P Stanbury, Tata McGraw-Hill Publishing company Ltd, New Delhi, India.

**MBT 305: PRACTICAL V: IMMUNOLOGY, DEVELOPMENTAL BIOLOGY AND  
ANIMAL CELL 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
- Typsinization of monolayer and sub culturing
- Measurement of doubling time
- Cryopreservation and thawing
- Cell counting and viability
- Acrosome reaction
- Invitro fertilization (IVF)

## EXTRA DEPARTMENTAL SUPPORTIVE COURSE (EDS)

### MBTEDB 306: HERBAL BIOTECHNOLOGY

Credits : 4

Hours : 4/Wk

#### Unit I

Medicinal plants in the traditional system (Ayurveda, Siddha, Unani, Homeopathy etc.). Plant tissue culture ,molecular markers (RAPD, RFLP, AFLP) used for authentication of diversity in medicinal plants.

#### Unit II

Plant diseases- Blast, blight, tikka, smelt, wilt. Control measures. Herbicides.

#### Unit III

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

#### Unit IV

Parasitic diseases- Malaria, filarial, metabolites as potential insecticides. Control of malarial parasite and vector.

#### Unit V

Herbs for human diseases - diabetic, cancer, diaharea, skin and HIV

#### Recommended Books

- K.R. Kiritkar and B.D. Basu, 1980. Indian medicinal plants Vol. I-V, CSIR Publications, New Delhi
- K. Janardhan Reddy, 2007. Advances in medicinal plants, University Press
- P.D. Sharma, 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 RESEARCH METHODOLOGY**

**Credits: 5**

**Hours: 5/Wk**

### **Unit I**

Bioinformatics- Nucleotide and Protein sequence analysis. Database similarity searching: BLASTN and BLASTP. Gene discovery using EST sequence database. Gene sequence submission format-FASTA.

### **Unit II**

Sequence Alignment- Pairwise and multiple. Sequences retrieval from database - NCBI, EMBL and DDBJ. Protein sequence analysis - SwissProt and PDB.

### **Unit III**

Research - Planning and selection of research problems, Experimental design. Review of literature. Report writing - Bibliography, Manuscript preparation for publication.

### **Unit IV**

Measures of central tendency (mean, median and mode), Dispersion (standard deviation), Hypothesis testing; statistical error, correlation and regression analysis. Parametric (Student's t-test, ANOVA); Non-parametric tests (Chi-square test).

### **Unit V**

Principles and applications - UV-Vis spectrophotometer, Atomic Absorption spectrophotometer. HPLC, Gas-chromatography, Agarose gel electrophoresis, PAGE and gel documentation. Centrifugation.

### **Recommended Books**

- Principles and Techniques of Biochemistry and Molecular Biology, 6th edition. Keith Wilson, John Walker. Cambridge University Press. 2005.
- Elements of Statistical Reasoning. 2<sup>nd</sup> Edition. Edward W. Minium, Robert C. Clarke , Theodore Coladarci. Wiley Higher Education. 1999
- Introduction to Bioinformatics: A theoretical and Practical Approach. 1<sup>st</sup> Edition. : Stephen A. Krawetz, David D. Womble. Humana Press. 2003
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3<sup>rd</sup> Edition. Andreas D. Baxevanis , B. F. Francis Ouellette . Wiley, John & Sons. 2004.
- Sokal, R.R. and F.J. Rohlf (1969) Biometry: The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company San Francisco, USA, pp.776
- Zar, J.H. (1996). Biostatistical analysis. Prentice Hall, Upper saddle River, New Jersey, USA.

## **M.Phil BIOTECHNOLOGY SYLLABUS**

### **MPBT01: PAPER I. RESEARCH METHODOLOGY**

**Credits: 4**

**Hours: 4/Wk**

#### **Unit I**

Basic and applied research, Research/Experimental design, Literature collection. components, Format of thesis and dissertation,. Preparation of Research report – Thesis - dissertation -Manuscript/research article – monograph/review.

#### **Unit II**

Microscopy- Fluorescence, Scanning and Transmission Electron microscopy, Affinity chromatography, HPLC, UV-Visible spectrophotometer, ICP, NMR, GC-MS and Microarray technique. Autoradiography and Liquid Scintillation Counter.

#### **Unit III**

Centrifugation, SDS-PAGE, Agarose gel electrophoresis, Capillary Electrophoresis, 2D-Electrophoresis and Gel Documentation. Histochemical and Immunotechniques: Antibody generation, detection of molecules using ELISA, Western blot and Immunoprecipitation.

#### **Unit IV**

Principles and techniques of Southern and Northern hybridization. Principles and applications of PCR, RT-PCR, and qPCR. Automated DNA sequencing. Fermentor-Types, design, downstream process.

#### **Unit V**

Measures of Mean, Median and Mode: Standard Deviation and Standard Error. Regression and Correlation coefficient analysis; Student's t-test; Analysis of Variance (ANOVA); Chi-Square test. Bioinformatics: BLAST N & P, Gene discovery using EST. Genbank Database- NCBI, EMBL & DDBJ. Protein sequence Database- Swis Port & PDB.

## Reference Books

- Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
- Prem S. Mann, 2004. Introductory Statistics. Fifth Edition. John Wiley and Sons (ASIA) Pvt. Ltd.
- S. C. Rastogi, N. Mendiratta, and P. Rastogi. Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery.
- Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
- Protein Purification by Robert Scopes, Springer Verlag Publication, 1982
- Tools in Biochemistry David Cooper
- Methods of Protein and Nucleic acid Research, Osterman Vol I – III
- Joseph Sambrook & David W. Russell, Molecular Cloning – A laboratory Manual (Third Edition) – Cold Spring Harbor laboratory Press, Cold Spring Harbor, New York.
- M. Prakash, C.K. Arora, Laboratory Instrumentation, – Anmol Publications Pvt Ltd.,
- Charles N. Rely, Donald T. Sawyer, Robert E. Krieger Huntington Experiments of Instrumental methods, A Laboratory Manual, New York.
- Hobart, H. Willard, Lynne L. Meritt J.R. John Dean, Instrumental Methods of Analysis, East West Press Pvt Ltd.
- Gelvin, Plant Molecular Biology, A Laboratory Manual, Kluwer Academic Press.
- P.N. Arora and P.K. Malhotra, Biostatistics
- Norman T.S. Bailey, Statistical Methods in Biology. Cambridge University Press, UK

## **MPBT02: PAPER II. PLANT AND ANIMAL BIOTECHNOLOGY**

**Credits: 4**

**Hours: 4/Wk**

### **Unit I**

Plant tissue culture - Nutritional requirements, plant growth hormones, genetic variation and chromosome stability. Protoplast isolation, culture and Somatic hybridization. Production of haploid plants. Germplasm conservation.

### **Unit II**

Transformation, Transgenic plants - Pest and Disease resistance. Recombinant proteins and edible vaccines. Molecular Markers- RAPD, RFLP, AFLP, SNPs. Production of secondary metabolites.

### **Unit III**

Development of cell line, Separation of viable and non - viable cells. Cell cultures, cytotoxicity of cultured cells. Tissue culture techniques. Recombinant subunit and DNA vaccines. Monoclonal antibody production. Nucleic acid probes and hybridization. Tissue typing.

### **Unit IV**

Embryo transfer technology. *In-vitro* fertilization. Transfer of genes: micro injection, electroporation and liposome mediated transformation. Stem cells – Embryonic and adult. Molecular pharming: Production of pharmaceuticals and biomolecules – Hormones and Steroids.

### **Unit V**

Intellectual Property rights (IPR), General agreement on tariff and trade (GATT), Trade related intellectual property (TRIP), Patents for plants, animals, transgenic organisms and DNA sequences. Plant breeder's and farmer's rights. Biosafety and ethical issues.

## Recommended Books

- Ralf Pörtner, 2007. Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). 2<sup>nd</sup> Edition. Humana Press.
- R.Spier and J.Griffiths, 1994. Animal Cell Biotechnology.. Academic Press.
- D.C. Darling and S.J. Morgan, 1994. Animal Cells Culture and media, BIOS Scientific Publishers Limited.
- Jennie P. Mather and David Barnes, 1998. Methods in Cell Biology, Volume 57: Animal Cell Culture Methods Academic Press.
- Ann Harris, 1996. Epithelial Cell Culture, Cambridge University Press.
- M .M. Ranga, 2000.Animal Biotechnology ,Agrobios (India),
- Kalyan Kumar De, 1992. Plant Tissue Culture , New Central Book Agency ,Calcutta
- Robert N. Trigiano, Dennis J. Gray, 1996. Plant Tissue Culture Concept and Laboratory Exercises , CRC Press , London.
- P.S. Srivasta, 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 , 1995. Experiments in Plant Tissue Culture, Cambridge University Press , USA.
- Singh, S.K. & Srivastava, Seema. 2006.Plant Tissue Culture Eastern Book Corporation, India
- Narayanaswamy, S, 1994. Plant Cell And Tissue Culture Tata McGraw Hill Publishers