PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 011

M.Sc., BIOTECHNOLOGY
CHOICE BASED CREDIT SYSTEM
(University Department)

REGULATIONS / SYLLABUS

(Effective from the Academic Year 2014-2015 and thereafter)

DEPARTMENT OF BIOTECHNOLOGY

PERIYAR UNIVERSITY, SALEM- 11

M.Sc BIOTECHNOLOGY

(CURRICULUM DETAILS)

I- SEMESTER		**Credits**
MBT101	Cell Biology	5
MBT102	Biochemistry and Enzymology	5
MBT103	Plant Cell Biotechnology	5
MBTEA104, B104	ELECTIVE PAPER**:** MBTEA 104 Food Biotechnology/ MBTEB 104 Marine Biotechnology)	4
MBT 105	Practical I : Cell Biology , Biochemistry and Enzymology	3
MBT 106	Practical II: Plant Cell Biotechnology	3
II - SEMESTER		
MBT201.	Genetics and Molecular Biology	5
MBT202.	Genetic Engineering and Nanotechnology	5
MBT203.	Microbial and Agricultural Biotechnology	5
MBT204.	Practical III: Genetic Engineering	3
MBT205.	Practical IV: Microbial and Agricultural Biotechnology	3
MBTEDA206	ED/ Basic Biotechnology	4
MBT207	Human Rights	2
III - SEMESTER		
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 developmental biology and, Animal Biotechnology	3
MBTED306	ED/Herbal Biotechnology	4
IV - SEMESTER		
MBT401.	Bioinformatics and Research Methodology	5
MBT402.	Project Work	9

Total Credits: 92

Total Hours: 92

DEPARTMENT OF BIOTECHNOLOGY

PERIYAR UNIVERSITY, SALEM- 11

M.PHIL BIOTECHNOLOGY
(CURRICULUM DETAILS)

I- SEMESTER		**Credits**
MPBT01	Research Methodology	4
MPBT02	Plant and Animal Biotechnology	4
MPBT03	Guide Paper	4
II – SEMESTER		
	Project	8
	Viva-Voce	4

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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+, cGMP and Nitrous oxide.

Unit IV

Cytoskeleton-Microtubules, Microfilaments, Intermediate filaments, Amyleoid 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. 6th 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. 2nd 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. 8th Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins (2005)

MBT 102: BIOCHEMISTRY AND ENZYMOLOGY

Credits: 5

Hours: 5/Wk

Unit I

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

Unit II

Carbohydrates: mono, di, oligo and polysaccharides. Glycolysis, TCA, Gluconeogenesis, Glycogenolysis, Oxidative Phosphorylation, ATP synthesis, Photosynthesis, Water and buffers-Theory.

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

Amino acids: Polar, nonpolar and neutral aminoacids. Vitamins and minerals. Nucleic acids - purines, pyrimidines, Biosynthesis of purine and pyrimidine. Protein structure: peptide linkage, primary, secondary, tertiary and quartenary structures. Purification of proteins, Protein characterization, identification, Protein metabolism: 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. 4th edition. David.L.Nelson and Michael.M.Cox.
- Biochemistry. 5th Edition (1999) Lupert Styrer. W.H.Freeman & Co
- Principles of Biochemistry. 4th Edition (1995). Geoffrey Zubay.

MBT 103: PLANT CELL BIOTECHNOLOGY

Credits: 5

Unit I **Hours: 5/Wk**

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, somaclonal variation. Molecular markers-RAPD, AFLP, RFLP, SSR, SNP. Production of haploids (bulbosum technique) and their 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, electroporation. Conformation of transgene expression by Molecular Techniques-PCR, Northern, Southern and Western blot analysis, Gene silencing by antisense and RNAi technology in plants.

Unit V

Application of genetic manipulation in crop improvement- herbicide and insecticide. Production of industrial and pharmaceuticals products. IPR, Plant breeders 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, radiation 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.
- MaCrae, 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. 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.
12. Western blotting analysis
13. 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. Another 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 aritificial. Transduction-restricted and aborted transduction. Conjugation - mating types, F-factor, chromosome mapping.

Unit III

DNA and RNA: Types, and structure - Chromatin organization - Central dogma concept. DNA replication in prokaryotes and eukaryotes. Regulation of DNA replication. PCR-Principle, Types of PCR and its application in molecular biology.

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. 6th Edition. Lodish , Berk , Baltimore et al . W.H. Freeman & Co (2000)
- Twyman, R.M.: Advanced Molecular Biology. Garland/bios Scientific Publishers (2000)
- Molecular Biotechnology. 2nd Edition. Sandy B Primrose. Blackwell Scientific Publishers (1991)
- Genomes. 2nd Edition. T.A.Brown. Wiley-Liss (New York). 2002
- Molecular Genetics of Bacteria . 2nd 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. 7th Edition. Blackwell Science

MBT202: GENETIC ENGINEERING AND NANAOTECHNOLOGY

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

Nanotechnology-Introduction, Nanoparticles: Definition, Types of nanoparticles Mechanisms of Nanoparticles synthesis and characterization.

Unit V

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

Recommended Books

- Claudio Nicolini, Nanobiotechnology and Nanobiosciences Pan Stanford Publishing Pte. Ltd, 2009.
- S. David Goodsell, Biotechnology, Lessons from Nature, Wilery-Liss, Inc, 2004.
- Genes VIII.2003. Benjamin Lewin. Benjamin-Cummings Pub Co.
- Principles of Gene Manipulation and Genomics. 7th Edition. by Sandy B. Primrose , Richard M. Twyman , Robert W. Old. Blackwell Science
- Discovering Genomics, Proteomics, and Bioinformatics. 2nd 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. 3rd 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 fluorescence*)
- 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 (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. 6th 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 homeiotic 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 anterio-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. 8th 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 and chemical properties. Equipments required for cell culture.

Unit II

Primary culture, development and maintenance of cell line. 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 and 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. Somatic cell-Nuclear transfer, embryo splitting, nuclear transplantation.

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. 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. (1st 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 Arulpandi, 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 of medicine (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. Kiritikar 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, Assignment /Seminar from leading topics, Journals, 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

Biological Software application-primer designing, Blast analysis, protein 3D structure, SPSS, Graph Pad.

Recommended Books

- Principles and Techniques of Biochemistry and Molecular Biology, 6th edition. Keith Wilson, John Walker. Cambridge University Press. 2005.
- Elements of Statistical Reasoning. 2nd Edition. Edward W. Minium, Robert C. Clarke , Theodore Coladarci. Wiley Higher Education.1999
- Introduction to Bioinformatics: A theoretical and Practical Approach. 1st Edition. : Stephen A. Krawetz, David D. Womble. Humana Press. 2003
- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd 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.