M.Sc Biotechnology

PROGRAM EDUCATIONAL OBJECTIVES(PEO)

1. Students will be practitioners and leaders in their chosen field.
2. Students will function in their profession with social awareness and responsibility.
3. Graduates will interact with their peers in other disciplines in their work place and society and contribute to the economic growth of the country.
4. Graduates will be successful in pursuing higher studies in their chosen field.

PROGRAM OUTCOME (PO)

PO-1 Life Sciences knowledge: Successful candidates will acquire current/recent specific knowledge in the respective discipline with proficiency in practical skills and leadership skills for a successful career.

PO-2 Problem analysis: Successful candidates will be able to analyse, design standards, resolve and troubleshoot problems in implementation or standardization of Life sciences protocols.

PO-3 Design/development of solutions: Successful candidates will develop creative and cognitive thinking and cooperate with each other to solve problems in the field of Life sciences.

PO-4 Conduct investigations of complex problems: Successful candidates will acquire capabilities to plan and design protocols and utilize practical skills to validate hypothesis by executing experimental techniques independently coupled with the ability to assimilate, analyse, interpret and accurately evaluate subsequent data.

PO-5 Modern tool usage: Successful candidates will effectively be able to manage resources and time using ICT and other computer enabled devices.

PO-6 Ethics: Successful candidates will be aware of their role and responsibility in handling and use of microbes including genetically modified microorganisms.

PO-7 Communication: Successful candidates will have the ability to understand and communicate all ideas and concepts effectively.

PO-8 Environment sustainability: Successful candidates will get adequate knowledge to use information and implement solutions for environmental protection, safeguards and remediation.

PO-9 Lifelong learning: Successful candidates will carry on to learn, adapt and disseminate knowledge in a world of constantly evolving technology.

PROGRAMME SPECIFIC OUTCOME (PSO)

1. Students will be able to design, conduct experiments, analyze and interpret data for investigating problems in Biotechnology and allied fields and apply the principles of molecular biology methods with emphasis on the application of recombinant DNA technology to animals, plants and microbial organisms.

2. Higher studies (Ph.D) can be pursued in order to attain research positions. various examinations such as CSIR-NET, ARS-NET GATE, ICMR, DBT and many other opens channels for promising career in research.

M.Sc. - BIOTECHNOLOGY
CURRICULUM

Total Number of Credits : 85

Category	Code	Title of the course	Hours per week			Credits
			Lecture	Tutorial	Practical	
	SEMESTER I					
Core	18MBT001	Biochemistry and Enzymology	5	0	0	4
Core	18MBT002	Cell and Developmental Biology	5	0	0	4
Core	18MBT003	Practical I Biochemistry and Enzymology	0	0	5	2
Core	18MBT004	Practical II Cell and Developmental Biology	0	0	5	2
DSE	----------	Discipline Specific Elective I	4	0	0	4
DSE	----------	Discipline Specific Elective II	4	0	0	4
GE	----------	Generic Elective I	2	0	0	2
		Total	20	0	10	22
	SEMESTER II					
Core	18MBT005	Microbiology and Immunology	5	0	0	4
Core	18MBT006	Molecular Genetics	5	0	0	4
Core	18MBT007	Practical III Microbiology and Immunology	0	0	5	2
Core	18MBT008	Practical IV Molecular Genetics	0	0	5	2
Core	18MBT009	Internship	0	0	0	2
DSE	----------	Discipline Specific Elective III	4	0	0	4
DSE	----------	Discipline Specific Elective IV	4	0	0	4
GE	----------	Generic Elective II	2	0	0	2
		Total	20	0	10	24
	SEMESTER III					
Core	18MBT010	Plant and Animal Biotechnology	5	0	0	4
Core	18MBT011	Genetic Engineering and Fermentation Technology	5	0	0	4
Core	18MBT012	Practical V Plant and Animal Biotechnology	0	0	5	2
Core	18MBT013	Practical VI Genetic Engineering and Fermentation Technology	0	0	5	2
DSE	----------	Discipline Specific Elective V	4	0	0	4
DSE	----------	Discipline Specific Elective VI	4	0	0	4
GE	----------	Generic Elective III	2	0	0	2
		Total	20	0	10	22
	SEMESTER IV					
Core	18MBT014	Dissertation/Project	0	0	0	17
		Total	0	0	0	17

List of Discipline Specific Elective Courses

18MBT101	Computational Biology, Biophysics and Biostatistics
18MBT102	Bioinstrumentation
18MBT103	Tissue Engineering and Stem Cell Biology
18MBT104	Environmental and Nano-Biotechnology
18MBT105	Marine and Pharmaceutical Biotechnology
18MBT106	Fermentation Technology
18MBT107	Regulatory affairs, GLP, IPR, Entrepreneurship and Bioethics in Clinical Research
18MBT108	Medical and Herbal Biotechnology
18MBT109	Project Management and Biotech products Entrepreneurship

List of Generic Elective Courses

18MBT151	Medical Transcription and Coding
18MBT152	Biomedical Waste Management
18MBT153	Biotechnology and Human Welfare
18MBT154	Environmental Biotechnology
18MBT155	Entrepreneurship Development

18MBT001 BIOCHEMISTRY AND ENZYMOLOGY 50 0 4

Course Objective:

- To understand of the basics of biomolecules with chemical bondings, bioenergetics and enzyme kinetics, structure of protein and nucleic acids and metabolism of biomolecules

Course Outcome:

- CO-1: To know about basic biochemistry concepts
- CO-2: To know about bimolecules and its function
- CO-3: To understand the various chemical bonding
- CO-4: To clearly explain about bioenergetics reactions
- CO-5: To study about basic characters about enzymes and its types
- CO-6: To be well versed with enzyme reaction
- CO-7: To get knowledge about protein structures
- CO-8: To learn about nucleic acid and its types and functions
- CO-9: Student can able to explain DNA structure
- CO-10: To be well versed with metabolism of biochemical molecules

UNIT I Introduction to Biomolecules 12

Structure of atoms, composition, structure and function of Biomolecules (carbohydrate, lipids, protein, nucleic acids and vitamins).

UNITII Chemical bondings 12

Chemical bonds, stabilizing interactions (van der waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc,.). Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties.

UNIT III Bioenergetics and enzymes 12

Bioenergetics, glycolysis, oxidative phosphorylation , coupled reaction, group transfer, biological energy transducers .principle catalysis, enzyme ,and enzyme kinetics ,enzyme regulation ,mechanism of enzyme catalysis , isoenzymes.

UNIT IV Protein Structures 12

Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motify and folds).conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA.stability of protein and nucleic acid structures.

UNIT V Metabolism 12

Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

Total: 60hrs

TEXT BOOKS

1. Narayanan LM, Meyyan RP, Nallasingam K, Prasanna Kumar S, Arumugam N and Dulsy Fatima, "Biochemiatry", 2014.
2. RaghunathNarverkar, "HandbooksOf Biochemistry", 2008.
3. Trevor Palmer ,"Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", Horwood Publisher, 2001.

REFERENCE BOOKS

1. Lehninger. A.L., D.L. Nelson and M.M. Cox,"Principles of Biochemistry". Worth Publishers, New York.1993.
2. Stryer.L. "Biochemistry". 5th edition. W.H. Freeman and company.2001.
3. Zubay.G. "Biochemistry". Macmillan Publishing Co, New York.1998.

18MBT002 CELL AND DEVELOPMENTAL BIOLOGY 50 0 4

Course Objective:

- To understand of the basics of cell and developmental biology such as cell organelles, cell cylcle cell singnals, fertilization, embryogenesis and developmental differentiation,

Course Outcome:

- CO-1: To know about basic cell biology and developmental biology principles
- CO-2: To know about biomembarne and its fucntions
- CO-3: To learn about the various cell organelles
- CO-4: To clearly explain about nucleic acid functions and structures
- CO-5: To study about cell cycles of mitosis and meiosis
- CO-6: To be well versed with cell signelling and communications
- CO-7: To get knowledge about cancer biology
- CO-8: To Learnt about the cellular function and on-cogenes
- CO-9: To learn different aspects of embryo development
- CO-10: To study about Gametogenesis of Male and female

UNIT I Biomembrane and cell organelles 12

Membrane structure and function**:** structure of models membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, electrical properties of membranes. Structural organization and function of intercellular organelles:nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum **,**cell wall, peroxisomes , plastids , vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

UNITII Nucleic acid, cell cycles and cell signals 12

Organization of genes and chromosomes**:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons. Cell division and cell cycle: mitosis, meiosis, their regulation, steps in cell cycle and their control cycle.Cell signaling**:**Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors signal transduction pathway, second messengers, regulation of signaling pathway, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

UNIT III Cell communication and Cancer biology 12

Cellular communication: regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extra cellular matrix , inegrins , neurotransmission and its regulation. Cancer: genetic rearrangement of progenitor cells,

oncogenes,tumor suppressor genes, cancer and cell cycle, virus- induced cancer, metastasis ,interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNITIV Developmental differentiation 12

Embryonic development, cellular differentiation, organogenesis, metamorphosis, genetic basis of development, stem cells, programmed cell death, aging and senescence.Concepts of development**:** potency, commitment, specification ,induction, competence, determination and differentiation; morphogenetic gradient; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting ;mutants and transgenics in analysis of development.

UNIT V Fertilization and embryogenesis 12

Gametogenesis**:** fertilization and early development: production of gametes, cell surface molecule in sperm egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage blastula formation, embryonic fields, gastrulation and formation of germ layer in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Total: 60hrs

TEXT BOOKS

1. Verma, P.S. and Agarwal, V.K. “Cell Biology”. S. Chand Publication.2008.
2. Arumugam N,“Cell Biology” ,Saras Publication, 2014
3. Arumugam N, R P Meyyan ,“Cell Biology and Molicular Biology”,Saras publication,2014.

REFERENCE BOOKS

1. Lodish, H. Berk, A., Kaiser, Krieger, Scott, Bretscher, Ploegh and Matsudaria, P.“Molecular Cell Biology”. Media connected, 6th edition. W. H. Freeman and company.2008.
4. Cooper, G.M. and Hausman, R.E. “The Cell”. Molecular approach. 4th edition. A.S.M press.2007.
5. Pollard, T.D. and Earnshaw, C. “Cell Biology”. 2nd Edition.2008.
6. Weaver, R.F. “Molecular Biology”. McGraqw Hill International. 2008.
7. Willilams, L and Wilkins. “Cell and Molecualr Biology”. 8th edition. B.I. Publication.2005.

8. Davide, Sadava,“Organelle structure and function”. Panima publishing.2004.

18MBT003 PRACTICAL I BIOCHEMISTRY AND ENZYMOLOGY 0 0 5 2

Course Objective: To educate and train the students for lab techniques of Biochemistry and Enzymology

Course Outcome:

- CO-1: To be able to use colorimeter for biochemical analysis
- CO-2: Student can understand and able to operate spectrophotometer
- CO-3: To be skilled in chromatography techniques
- CO-4: To be skilled in electrophoresis techniques
- CO-5: Student will be proficient in enzymes assay
- CO-6: To be well versed with enzyme kinetics
- CO-7: To get knowledge about HPLC and use
- CO-8: To Learnt about the GC and its practical application
- CO-9: To be capable of doing Carbohydrate estimation
- CO-10: Tolearn about GLP

List of Experiments **Each Experiment : 5hrs**

Biochemistry and Enzymology

1. Colorimetry.

2. Spectrophotometry.

3. Protein estimations: Lowry and Bradford methods.

4. Gel filtration chromatography.

5. Thin-layer chromatography.

6. Polyacrylamide gel electrophoresis.

7. Plate assay of amylase

8. Plate assay of protease

9. Enzyme kinetics

DemonstrationExperiments.

10. High performance liquid chromatography

11. Gas liquid chromatography.

12. Carbohydrate estimation (Glucose).

Total: 60hrs

TEXT BOOKS

1. Jayaraman J,“Laboratory Manual in Biochemistry” (5th reprint) New Age

International Publishers Mumbai, Chennai, 1996.

2. M. Prakash, C.K. Arora, “Biochemical techniques”,Anmol Publications (I) Ltd New Delhi. 1998.

REFERENCE BOOKS

1. David T. Plummer, “An Introduction to Practical Biochemistry”, 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Robert Weaver, “Molecular Biology”, 5th edition, McGraw-Hill, 2011.
3. Bruce A. White, “Methods in Molecular Biology”, Chapman and Hall, 1997.

18MBT004 PRACTICAL II CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY 0 0 5 2

Course Objective: To educate and train the students for lab techniques of Cell Biology and Developmental Biology

Course Outcome:

- CO-1: To learn basic cell biology lab practices
- CO-2: To be skilled in microscope operation specially compound
- CO-3: To know about various advanced microscopic working principles
- CO-4: To be skilled in RBC and WBC count in blood
- CO-5: To be well versed with microtome tissue sectioning
- CO-6: To be proficient in histochemical analysis
- CO-7: Student can able to observe cell divisionof mitosis and meiosis in cultured cells
- CO-8: To be capable of culturing Drosophila and its observations
- CO-9: To be well versed with embryo development using chick embryo
- CO-10: To learn embryo separation techniques using mouse

List of Experiments

Cell Biology

1. Microscopy: Bright field,
2. Phase contrast and Fluorescence microscopy.
3. Cell counting - RBC and WBC
4. Microtome, Fixation, Embedding, Sectioning, Staining.
5. Histochemical methods for proteins, carbohydrates, lipids and enzymes.
6. Mitosis and Meiosis. Preparation of metaphase chromosomes from cultured cells.
7. Demonstration: Confocal Microscopy,
8. Demonstration: Transmission and scanning electron microscopy

Developmental Biology

9. Culture of Drosophila
10. Culture of Drosophila result analysis
11. Chick embryo development (24hrs, 48hrs, 72hrs and 96hrs)
12. Demonstration on mouse embryo separation

Total: 60hrs

TEXT BOOKS

1. Gunasekar, . P. 1995. “Laboratory Manual in Microbiology”. New Age International

Private Ltd. Publishers, New Delhi, Chennai.

2. Jayaraman J,"Laboratory Manual in Biochemistry" (5th reprint) New Age International Publishers Mumbai, Chennai, 1996.
3. M. Prakash, C.K. Arora, "Biochemical techniques",Anmol Publications (I) Ltd New Delhi. 1998.

REFERENCE BOOKS

1. Ian Freshney R. "Culture of Animal Cells: A Manual of Basic Technique", Wiley-Liss, 2005.
2. David T. Plummer, "An Introduction to Practical Biochemistry", 3rd Edition. Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. Robert Weaver,"Molecular Biology", 5th edition, McGraw-Hill, 2011.
4. Bruce A. White, 1997. Methods in Molecular Biology, Chapman and Hall, London, New York.

18MBT005 MICROBIOLOGY AND IMMUNOLOGY 5 0 0 4

Course Objective: To provide detailed knowledge about taxonomy and diversity of microbes, growth, disease/infectious microbe and aspects of immunotechniques and vaccine technology

Course Outcome:

- CO-1: To know about microbial taxonomy and diversity
- CO-2: To clearly explain Prokaryotic and eukaryotic cells
- CO-3: To learn about the microbial growth pattern
- CO-4: To clearly explain about antimicrobial chemicals and its actions
- CO-5: To study about various microbial diseases
- CO-6: To be well versed with immunology concepts
- CO-7: To get knowledge about various types of antigens
- CO-8: To Learnt about various antibodies
- CO-9: To learn different types of hypersensitivity
- CO-10: To study about vaccine concept and its types

UNIT I General Microbiology 14

Microbial taxonomy and diversity: Bacteria, Archea and their broad classification; Eukaryotic microbes; fungi, yeasts, molds and protozoa; viruses and their classification, molecular approaches to microbial taxonomy,. Prokaryotic and eukaryotic cells. Structure and function; prokaryotic cell wall, cell membrane, mechanism of solute transport across membranes, flagella and pili, capsules, cell inclusion like endospores and gas vesicles.

UNIT II Microbial growth and antimicrobials 12

Microbial growth: Definition of growth ;growth curve ; mathematical expression of exponential growth phase; measurement of growth yields; synchronous growth; continuous culture; effect of environmental factors on growth. Effect of physical and chemical agents; evaluation of effectiveness of antimicrobial agents.

UNIT III Microbial diseases and general immunology 14

Microbial diseases and host pathogen interaction :Normal micro biota ;classification of infected diseases ;reservoirs of infection ;nosocomial infection; emerging infectious diseases; mechanism of microbial pathogenicity; nonspecific defense of host; antigen and antibodies ; humoral and cell mediated immunity; vaccines; Immune deficiency ;human diseases cause by viruses, bacteria, and pathogenic fungi general characteristic of antimicrobial drugs; antibiotics; classification, mode of action and resistance, antifungal and antiviral drugs.

UNIT IV Antigens and antibodies **06**

Antigen and antibodies interactions: Antibody affinity-avidity-specificity-cross reactivity; Antigen processing and presentation through MHC 1 and 2 and BCR.

UNIT V Hypersensitivity and vaccine technology **14**

Generation of T cell clones; HLA typing. Types of hypersensitivity-assessment of delayed hypersensitivity reactions. Antigen isolation, purification and characterization of various antigens and haptens from pathogens and other biological molecules by biophysical, chemical and affinity separation methods. Hybridoma and monoclonal antibody production. Biology and assay of cytokines; vaccine technology including DNA vaccines; Identification of T and B epitopes for vaccine development.

Total: 60hrs

TEXTBOOKS

1. Subhash Chandra Parija, "Textbooks of Microbiology and Immunology", Elsevier; Second edition, 2012.
2. Arumugam N. A.Mani, L.M.Narayanan, DulsyFatima,A.M.Selvaraj, "Immunology & Microbiology", Saras Publication,2015.
3. Arumugam N, "Immunology & Microbiology",Saras Publication, 2007.
4. Ramasamy, P and R.E.B. Hanna, "Immunity and inflammation", University of Madras publications, Pearl Press Ltd., 2002.

REFERENCE BOOKS

1. Pelczar. MJ, Chan ECS, King NR, "Microbiology – concepts and applications", McGraw – Hill, Edd., 27th, Jnc.NY – 2004.
2. Prescott LM, Haley JP, Klecin Da, "Microbiology", WCB Publishers, Sydney – 2002.
3. Ingraham J.L. and C.A.Ingraham, "Essential of diagnostic Microbiology", 2nd edition by Brooks/cole, Thomson Learning, USA-2000.
4. Tak W Mark and Mary Saunders,"The Immune Response Basic and Clinical Principles", 1st edition, AP.2005.
5. Parslow,T.G, D.P. Sites, A.L.Terr, "Medical immunology", 10th edition by McGraw-Hill Publishing, 2001.

6. Zola H, “Monoclonal antibodies”, Bios Scientific Publishers LTD., 2000.
7. GoldsbyR.A., T.J. Kindt and B.A. Osborne, “Kuby Immunology”, Freeman and company, 2000.
8. RoittI, “Immunology”, Blackwell Scientific Publications, 1996.

18MBT006 MOLECULAR GENETICS 50 0 4

Course Objective: To provide fundamental knowledge about Genetics, mutations, DNA repair, RNA and protein synthesis

Course Outcome:

- CO-1: To know about basic principles in genetics
- CO-2: To learn about genome organization in cells
- CO-3: To understand the inheritance of character
- CO-4: To clearly explain about the sex determination
- CO-5: To learn about various types of mutation and it causes and its repair system
- CO-6: To study about DNA repair system after the mutaion
- CO-7: To be well versed with operon system in gene control
- CO-8: To clearly explain about the transcription procedure
- CO-9: To learn about different types of RNA
- CO-10: Student can able to explain translation procedure

UNIT I Introduction and theory 12

Genetics: Principles of Mendalians inheritance, linkage, recombination, genetic mapping; extra chromosomal inheritance; prokaryotic and eukaryotic genome organization, regulation of gene expression, gene mutation and repair, chromosomal aberrations (numerical and structural).

UNIT II Inheritance and Sex determination 12

Development of genetics: gene versus allele concepts(pseudo alleles); quantitative genetics and multiple factors; incomplete dominance, polygenic inheritance, multiple alleles ; linkage and crossing over; methods of gene mapping, including molecular maps(idea of mapping functions)sex chromosomes and sex linked inheritance, sex determination and molecular basis of sex differentiation; mutations.

UNIT III Mutation and DNA repair 12

Microbial genetics: Types of mutation; UV and chemical mutagens ;selection of mutants; Ames test for mutagenesis ;bacterial genetic system transformation,conjugation,transduction,recombination,plasmids,transposons;dna repair; regulation of gene expression; repression and induction; Operon model; bacterial genome with special reference to E.coli ;phage λ and its life cycle RNA phages; RNA viruses; retroviruses; basic concept of microbial genomics.

UNIT IV Transcription 10

Transcription factors and machinery , formation of initiation complex, transcription activators and repressors, RNA polymerase, capping, elongation and termination, RNA processing, RNA editing ,splicing,polyadenylation structure and function of different types of RNA , RNA transport.

UNIT V Translation 14

Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors termination, genetic code, aminoacylation of tRNA ,tRNA-identy,aminoacyltRNAsynthetase, translational proofreading, translation inhibitors ,post-translation modification of proteins, role of chromatin in regulating gene expression and gene silencing.

Total: 60hrs

TEXT BOOKS

1. Phundan Singh, "Molecular genetics", Ibdc Publishers,2010
2. SabyasachiRoychoudhuri, "A Textbooks of Genetics and Molecular Biology", New Central Books Agency; 1 edition, 2011.

REFERENCE BOOKS

1. Sarin,"Genetics", - Tata McGraw hill, 1991.
2. Gardner, Simmons and Snustd,"Principles of Genetics", 1991.
3. HartlD.L.G,"Basic genetics", Jones and publishers, 1991.
4. Date J.W. "Molecular Genetics of Bacteria", Wiley and sons, 1994.

18MBT007 PRACTICAL III MICROBIOLOGY AND IMMUNOLOGY 0 0 5 2

Course objective: To educate and train the students for lab techniques of Microbiology and Immunology.

Course Outcome:

- CO-1: To learn sterilization concepts and its various types
- CO-2: To be skilled in media preparation to cultivate microbes
- CO-3: To be trained to culturing various types of microbes using various method
- CO-4: To be skilled in identifying microbes using various methods
- CO-5: To be well versed with quantification of microbes in different samples
- CO-6: To be proficient in microbiological analysis in food samples
- CO-7: Student can able to observe and isolate microbes I clinical samples and perform antibiotic assay
- CO-8: To be capable of collecting serum and purifying antibodies
- CO-9: To be well versed with immunodiffusion techniques
- CO-10: Student can able to perform ELISA test and identification of immune cells

List of Experiments **Each Experiment: 5hrs**

Microbiology

1. Sterilization techniques (lecture/demonstrations).
   Preparation of culture media (a) broth type of media (b) Agar.
2. Culturing of Microorganisms: Pure culture techniques: Streak plate, pour plate, isolation and preservation of bacterial and fungal culture.
3. Identification of microorganisms. (a) Staining techniques (b) Biochemical testing.
4. Quantization of microorganisms
   a. Counting microscopy (b) Nephelometry/Turbidimetry (c) Total dry weight. (d) Serial dilution plating.
5. Environmental sample analysis-Quantitative estimation of pathogenic and non-pathogenic microbes from sewage and soil samples.
6. Food microbiology (a) milk (b) Fermented Food (c) Salmonella in poultry.
7. Clinical microbiology: Normal mouth flora, blood and urine culture, antibiotic disc test assay

Immunology

8. Immunization Techniques – Collection of Serum
9. Purification of antibodies/immunodiffusion.
10. Agglutination and precipitation.

Enzyme linked immunoabsorbant Assay (ELISA).

11. Immunoelectrophoresis.
12. Mononuclear cell isolation and T-cell identification.

Total: 60hrs

TEXT BOOKS

1. Myers, Mika, Klein, "Microbiology and Immunology Laboratory Manual", Pearson Learning Solutions; 4th edition, 2013.

REFERENCE BOOKS

1. James G. Cappuccino, Natalie Sherman, "Microbiology: A Laboratory Manual" (10th Edition), 2013.
2. Ivan Lefkovits**,** "Immunology Methods Manual: The Comprehensive Sourcebooks of Techniques", 1996.
3. Bruce A. White,"Methods in Molecular Biology", Chapman and Hall, London, New York. 1997.
4. William Wu, Michael J. welshpeterB. KaufmanHelen H. Zhang, Methods in "Gene Biotechnology", CRC Press, New York. 1997.

18MBT008 PRACTICAL IVMOLECULAR GENETICS 0 0 5 2

Course Objective: To educate and train the students for lab techniques of Molecular genetics.

Course Outcome:

- CO-1: To be well versed with DNA isolation from Bacteria
- CO-2: To be skilled in fungal genomic DNA isolation
- CO-3: To be proficient in plant DNA isolation
- CO-4: Student can able to isolate DNA from animal cells and blood cells
- CO-5: To be well versed with DNA purification and quantification
- CO-6: To clearly explain about Southern blotting analysis
- CO-7: Student can able to perform RFLP experiment and its data analysis
- CO-8: To be capable of isolationg RNA fro cells
- CO-9: To clearly explain about Northern blotting analysis
- CO-10: To be skilled in Preparation of non-radioactive probes

List of Experiments Each Experiment:5hrs

Molecular Genetics

1. Isolation of Bacterial genomic DNA
2. Isolation of fungal genomic DNA
3. Isolation of plant genomic DNA
4. Isolation of animal genomic DNA
5. Agarose gel electrophoresis.
6. Isolation of genomic DNA from blood
7. DNA purification and Quantification
8. Southern blotting analysis.(Demo)
9. RFLP analysis.
10. Isolation of RNA.
11. Northern blotting analysis.(Demo)
12. Preparation of non-radioactive probes.

Total: 60 hrs

TEXT BOOKS

1. ChaitanyaK. V. **"**Cell and Molecular Biology : A Lab Manual", PHI, 2013.
2. S.K. Gakhar (Author), Monika Miglani (Author), Ashwani Kumar, "Molecular Biology: A Laboratory Manual", I K International Publishing House Pvt. Ltd, 2013.

REFERENCE BOOKS

1. Michael R. Green, Joseph Sambrook, “Molecular Cloning: A Laboratory Manual” (Fourth Edition), 2014.
2. Bruce A. White, “Methods in Molecular Biology”, Chapman and Hall, London, New York.1997.
3. William Wu, Michael J. Welshpeter B. KaufmanHelen H. Zhang, “Methods in Gene Biotechnology”, CRC Press, New York.1997.
4. Melody S. Clark “Plant Molecular Biology - A Laboratory Manual”, Springer Publication New York.1997.

18MBT009 **INTERNSHIP** **0 0 0 2**

Course objective: Student should go for training in any biotechnological industry or laboratories and learn their laboratory techniques by hands on training. After the training, student should submit detailed reports about the training in an assignment.

Total: 30hrs

18MBT010 PLANT AND ANIMAL BIOTECHNOLOGY 50 0 4

Course Objective: To educate and train the students for lab techniques of Molecular genetics.

Course Outcome:

- CO-1: To be well versed with DNA isolation from Bacteria
- CO-2: To be skilled in fungal genomic DNA isolation
- CO-3: To be proficient in plant DNA isolation
- CO-4: Student can able to isolate DNA from animal cells and blood cells
- CO-5: To be well versed with DNA purification and quantification
- CO-6: To clearly explain about Southern blotting analysis
- CO-7: Student can able to perform RFLP experiment and its data analysis
- CO-8: To be capable of isolationg RNA fro cells
- CO-9: To clearly explain about Northern blotting analysis
- CO-10: To be skilled in Preparation of non-radioactive probes

UNIT I Introduction of Plant Biotechnology and Hormones 12

Plant-genome organization and plant gene structure. Genetics of chloroplast and mitochondria. Nuclear encoded and chloroplast, mitochondria encoded genes for proteins. Seed storage proteins. Auxins, gibberellins, cytokinins, ethylene and abscissic acid. Gene Expression during plant development.

UNIT II Gene regulation and expression 10

Differential regulation and expression, Genetic determinants of nodule formation, functions of rhizobium genes, plant nodule gene expression, and inducible gene expression: use of tissue specific, copper-controllable gene expression in plants .Ti-plasmid based transformation.

UNIT III Plant tissue culture 12

Plant tissue culture – Suspension cultured cells – haploid plants – Cloning of hosts - micropropagation – Somatic embryogenesis – protoplast isolation and applications. Somatic cell hybridization, marker-assisted selection, gene transfer methods viz. direct and vector-mediated, plastid transformation, transgenic plants and their application in agriculture, molecular pharming, plant bodies.

UNIT IV Introduction of Animal Biotechnology 14

Biotechnology for Animal Improvement**:** Conventional methods of animal improvement, predominantly selective breeding and cross-breeding - Artificial insemination - Pregnancy diagnosis - Embryo biotechniques: Augmentation of reproductive efficiency and faster multiplication of superior germ plasm - Super ovulation - *In vitro* maturation of oocytes - *In vitro* fertilization and embryo culture - Embryo preservation.

UNIT V Gene therapy and animal cell culture preservation 12

Gene therapy- AIDS - Oncogenes and anti-oncogenes - phage display technology - Applications of monoclonal antibodies in animal health and reproduction. Cell line preservation and characterization: Cell/embryo cryopreservation - Cell line banking - Cytotoxicity and viability assays – Karyotyping.

Total: 60hrs

TEXTBOOKS

1. Chawla H. S,"Introduction to Plant Biotechnology", Science Publishers,2002
2. Sasidhara R.,"Animal Biotechnology",Neha Publishers & Distributors,2009
3. Yadav, P R,"Text Books Of Animal Biotechnology", Discovery Publishing House Pvt. Ltd. 2009
4. TirvediRC., "Recent Advances in Plant Biotechnology", PANIMA Publishing corporation, 2000.
5. Ignacimuthu. "Applied Plant Biotechnology", Tata McGraw-Hill.1996.

REFERENCE BOOKS

1. Jack G. Chirikjian,"Biotechnology: Plant biotechnology, animal cell culture, immunobiotechnology", Jones & Bartlett Learning, 1995.
2. Grieson and S.N.Covey, Blackio, "Plant Molecular Biology", 1988.
3. Chrispeels M.J. and Sadava, D.F. "Plants, genes and agriculture". Jhones and Barlett.1994.
4. Glyn Stacey. "Medicines from Animal Cell Culture", John Wiley and Sons Ltd.2007.
5. Freshney RI. "Culture of Animal Cells: A Manual of Basic Technique", 2005.
6. Ralf Portner. "Animal Cell Biotechnology: Methods and Protocols", Humana Press Inc., U.S.2007.

18MBT011 GENETIC ENGINEERING AND FERMENTATION TECHNOLOGY 50 0 4

Course Objective: To provide fundamental theoretical knowledge about Genetic Engineering,Cloning Vector, molecular techniques and bioethics.

Course Outcome:

- CO-1: At the end of the course the students will have an understanding of the basics of gene cloning, genetic engineering tools, nucleic acid manipulating enzymes.
- CO-2.: Students will also learn about the cloning in yeast *Saccharomyces cerevisiae*, animal cell cloning vectors
- CO-3: Students will learn about genetic engineering techniques, molecular probes and blotting techniques.
- CO-4: To learn the Polymerase chain reaction (PCR) - Random amplification of polymorphic DNA (RAPD).
- CO-5: Students will be introduced to the basics of fermentation technology,
- CO-6: At the end of the course the student will have an idea about microbial culture selection media formulation and optimization strategies.
- CO-7: Students will learn about Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control. Differention types of reactors.
- CO-8: At the end of the course the student will have an idea aboutclassification, design and operation of fermenters, basic concepts for selection of a reactor, and scale up of bioreactors.
- CO-9: Students will learn about downstream processing. Recovery of particulate matter, product isolation.
- CO-10:Monitoring of bioprocesses – On-line data analysis for measurement of important physio-chemical and biochemical parameter.

UNIT I Introduction of gene cloning 14

Gene cloning – Genetic engineering tools – Nucleic acid manipulating enzymes. Promoters, selectable markers and reporters used in rDNA technology. Ligation, selection of recombinants, cloning vectors for gram-negative bacteria. Cloning in gram-positive bacteria (*Bacillus subtilis*)Fundamental principles of cloning vectors: *E. coli* vectors - Plasmid biology - pBR 322 and its derivatives - gene markers: Phage - filamentous phages - Cosmid - Phagemid - Plant cloning vectors - *Agrobacterium tumefaciens* - Ti plasmid - Cloning in yeast *Saccharomyces cerevisiae* - Animal cell cloning vectors - SV40 - Baculoviruses - mammalian expression vectors - retroviral vectors.

UNIT II Genetic engineering techniques 14

Electrophoresis of DNA - molecular probes - hybridization techniques - Autoradiography - DNA fingerprinting - Restriction fragment length polymorphism (RFLP) - Blotting techniques. Polymerase chain reaction (PCR) - Random amplification of polymorphic DNA (RAPD) - gene

transfer technologies.Nucleic acid hybridization techniques; molecular probes (types of probes and its construction);probe labeling – nick translation, end labeling and random primer labeling , polymerase chain reaction and its variants; DNA fingerprinting;DNA sequencing (Maxam and Gilbert sequencing Sanger's dideoxy sequencing, Pyrosequencing, PCR based sequencing and hybridization sequencing) ; site directed mutagenesis; DNA microarray; chromosome walking and jumping.

UNIT III Introduction to fermentation technology 10

Introduction to fermentation technology; interaction between chemical engineering, microbiology and biochemistry. History of fermentation .introduction to fermentation processes, microbial culture selection for fermentation processes. Media formulation and process optimization.

UNITIV Bioreactors and its design 10

Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control. Differention types of reactors, continuous and Fed-batch cultures Garden's fermentation classification, design and operation of fermenters, basic concepts for selection of a reactor, packed bed reactor, fluidized bed reactor, trickle bed reactor, bubble column reactor and scale up of bioreactors.

UNIT V Downstream process and Monitoring 12

Downstream processing. Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two – phase separation, solvent extraction, chromatography and electrophoresis.Monitoring of bioprocesses – On-line data analysis for measurement of important physio-chemical and biochemical parameter. Computer based data acquisition, monitoring and control-LABVIEW software.

Total: 60hrs

TEXTBOOKS

1. Anil Kumar Srivastava,"Genetic Engineering And Biotechnology", Neha Publishers & Distributors, 2010.
2. Balasubramanianet.al.,"Concepts in Biotechnology", University of Madras Publications, Pearl press.2005.
3. Kalaiselvan P T, I Arul Pandi, Bioprocess Technology (Volume 1), MJP PUBLISHERS; 1st edition 2007.

4. Stanbury F, A Whitaker, Principles Of Fermentation Technology, Elsevier; 2 edition,2008
5. Mukhopadhyay, S.N. processes biotechnology fundamentals, Viva Bookss Pvt. Ltd. 2001.

REFERENCE BOOKS

1. Sandy B. Primrose , Richard Twyman, "Principles of Gene Manipulation and Genomics", Oxford; Seventh edition, 2006.
2. Brown TA, "Gene cloning and DNA analysis", 4th edition, Blackwell science,Japan. 2001.
3. Keith Wilson and john Walker, Practical Biochemistry-principles and Techniques, Cambridge, 5^{th} Ed. 2000.
4. Coulson and Richardson JF, chemical engineering-volume 3 (Chemical and biochemical reactors and process controls ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian BooksPvt.Ltd. 1998.
5. Bailey and oils, Biochemical Engineering Fundamentals, McGraw-Hill, 1990.

18MBT012 PRACTICAL V PLANTAND ANIMAL BIOTECHNOLOGY 0 0 5 2

Course Objective: To educate and train the students for lab techniques of plant tissue culture and its manipulation.

Course Outcome:

- CO-1: Students will receive hands on training in cell and tissue culture
- CO-2:To understand the maintenance of culture lines
- CO-3: Students will also learn techniques callus propagation of plants.
- CO-4: Students would have been trained in Preparation of tissue culture medium
- CO-5: To know about membrane filtration
- CO-6 : To Learn the preparation of single cell suspension from spleen
- CO-7: Cryopreservation techniques for cell culturewill also be learned by the students.
- CO-8: Students will be given practical training in the cell counting and viability assays.
- CO -9: To introduce the students to the organized preparation of the scientific reports for the experiments.
- CO -10: To learn Cytological examination of callus tissue

List of Experiments: Each experiments: 5hrs

Plant Biotechnology

1. Hands on training in cell and tissue culture and maintenance of culture lines
2. Preparation of media, surface sterilization.
3. Callus propagation of plants.
4. Protoplast isolation and culture.
5. Anther culture, production of haploids.
6. Cytological examination of callus tissue

Animal Biotechnology

7. Preparation of tissue culture medium and membrane filtration
8. Preparation of single cell suspension from spleen
9. Trypsinization of monolayer cell and Passage
10. Cryopreservation techniques for cell culture
11. Cell counting and viability
12. Role of serum in cell culture

Total:60hrs

TEXTBOOKS

1. ChawlaH.S.,“Plant biotechnology,Laboratory Manual for Plant Biotechnology”, oxford & IBH Publishing Co. Pvt.Ltd.2004.

2. Ritu Mahajan, Jitendra Sharma, R.K. Maharajan, “Practical Manual of Biotechnology”, Vayu Education of India, 2010.

REFERENCE BOOKS

1. Michael R. Green, Joseph Sambrook, “Molecular Cloning: A Laboratory Manual” (Fourth Edition), 2014.
2. Ian Freshney R. “Culture of Animal Cells: A Manual of Basic Technique”, Wiley-Liss, 2005.
3. William Wu, Michael J. welshpeter B. KaufmanHelen H. Zhang, 1997. “Methods in Gene Biotechnology”, CRC Press, New York.
4. Melody S. Clark 1997. “Plant Molecular Biology - A Laboratory Manual”, Springer Publication New York.
5. Bruce A. White, 1997. “Methods in Molecular Biology”, Chapman and Hall, London, New York.
6. Melody S. Clark 1997. “Plant Molecular Biology - A Laboratory Manual”, Springer Publication New York.

18MBT013 PRACTICAL VI GENETIC ENGINEERING AND FERMENTATION TECHNOLOGY 0 0 5 2

Course Objective: To educate and train the students for lab techniques of genetic engineering and gene cloning.

Course Outcome:

- CO – 1: Students will receive hands on training in isolation of Bacterial Culture
- CO – 2: Students will also learn techniques of preparation of plasmid DNA, genomoic DNA.
- CO – 3: Students would have been trained in PCR.
- CO – 4: To learn Agarose gel electrophoresis
- CO – 5: Students will be given practical training in Purification and Quantization of nucleic acids.
- CO – 6 : To learn Estimation of Preparation of Competent cells,
- CO – 7 : To understand construction of plasmid vectors
- CO – 8: To know about Selection of transformed colonies and preservation
- CO - 9: To introduce the students to the organized preparation of the scientific reports for the experiments.
- CO – 10: To learn DNA sequence

List of Experiments: Each experiment: 5hrs

1. Bacterial culture and antibiotic selection media.
2. Isolation of Plasmid DNA, genomic DNA
3. Purification and Quantification of nucleic acids.
4. Preparation of Competent cells, construction of plasmid vectors
5. Transformation, selection of transformed colonies and preservation
6. PCR
7. Manual DNA sequencing (Demo)

Fermentation Technology

1. Growth of microorganism's estimation of Monod parameters.
2. Temperature effect on growth-estimation of energy of activation and Arrhenius Constantfor micro-organisms.
3. Batch, fed batch and continuous cultures a) Estimation of Monod parameters. b) Pure andmixed cultures. c) Production of secondary metabolites in synthetic and complex Industrialmedia. Identification of growth factors transient pulse experiment.
4. Screening of process variables single dimensional research, Blackettsurman design,

design experts etc.

5. Study of rheology of fermentation, broth and power determination.

Total :60hrs

TEXT BOOKS

1. P.Gunasekar, 1995. Laboratory Manual in Microbiology. New Age International Private Ltd. Publishers, New Delhi, Chennai.
2. Dube,R.C. Practical Microbiology,S. Chand & Company,2009.
3. Kulandaivelu S. S. Janarthanan, Practical Manual on Fermentation Technology, I K International Publishing House Pvt. Ltd; First Edition edition 2012.

REFERENCE BOOKS

1. Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual (Fourth Edition), 2014.
2. James G. CappucinoNatalie Sherman 1999. Microbiology - A Laboratory Manual 4th Edition - Wesley California, England.1999.
3. William Wu, Michael J. welshpeter B. KaufmanHelen H. Zhang, Methods in Gene Biotechnology, CRC Press, New York. 1997.
4. Melody S. Clark, Plant Molecular Biology - A Laboratory Manual, Springer Publication New York. 1997.
5. Bruce A. White, Methods in Molecular Biology, Chapman and Hall, London, New York. 1997.
6. Brain M, LM. Harvey, Practical Fermentation Technology, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, 2008.
7. James G. CappucinoNatalie Sherman, Microbiology - A Laboratory Manual 4th Edition - Wesley California, England. 1999.
8. Harold, J. Benson, Microbiological Applications-Laboratory Manual in GeneralMicrobiology, McGraw Hill, New York, San Fransis. 1998.

18MBT014 DISSERTATION/PROJECT 0 0 0 17

Course objective: Student should do research on their own interest or research guide interest on any biotechnology topic for 6 month in the university or any industries or laboratories. After the research,he/she should submit the detailed reports about the research in a dissertation and should present in anexternal examiner.

Total: 15 Weeks (30h/Week)

Syllabus

Discipline Specific Elective Courses

18MBT101 COMPUTATIONAL BIOLOGY, BIOPHYSICS AND BIOSTATISTICS

4 0 0 4

Course objective: To provide fundamental theoretical knowledge about Computational Biology, Biophysics and Biostatistics.

Course Outcome:

- CO-1: Imparting knowledge on fundamentals of bioinformatics and its application
- CO-2: To learn about few packages widely used in Bioinformatics
- CO-3: To do programming for bioinformatics using Rasmol and Clustalin
- CO-4: To learn SQl commands in operating PERL and Bio-PERL
- CO-5: To learn Basics on UNIX and LINUX
- CO-6: To apply basic commands in developing web resources for industrial application
- CO-7: To apply statistics and interpretation in Biological studies
- CO-8: To learn different statistical parameters in application in biology
- CO-9: To learn about the physical structure of protein
- CO-10: To learn about the physical properties of biomolecules in sedimentation, viscosity and their thermodynamics

UNITI Introduction about Bioinformatics 10

Fundamentals of bioinformatics: definition , nucleic acid and protein sequence database, sequence analysis, sequence alignment hidden mark, types of alignment, BLAST,FASTA, inter pro-log models.

UNITII Bioprogramming 10

Bioprogramming: Rasmol, clustalin, biological databases, nucleotide sequence database, protein sequence database, EMDL, DDBJ, introduction to PERL and bio-PERL, introduction to SQL commands.

UNITIII Importance of bioinformatics 10

Basic UNIX, LINUX commands web resources in bioinformatics in industrial application and importance of bioinformatics.

UNITIV Statistical methods 12

Statistical methods: Measure of central tendency and dispersal; probability distribution (binomial, poisson and normal); sampling distribution ; difference between parametric and non- parametric statistics; confidence interval; errors; levels of significance; regression and correlation ;t-test;analysis of variance;X2 test; basic introduction to muetrovarite statistics.

UNITV Biophysics 12

Biophysics: Introduction to biophysics, classification and conformation of proteins primary, secondary, tertiary and quaternary structure, Ramachandran plot, peptide-peptide bond isomerization, protein-DNA interaction, glycol and lipo proteins. Nucleic acid hybridization, laws of thermodynamics, chemical equilibrium, x-ray diffraction, sedimentation and viscosity.

TOTAL :54hrs

TEXTBOOKS

1. Roy, R.N. A Text Books of Biophysics ,New Central Books Agency (P)Ltd, 2009.
2. Mariappan, P. Biostatistics: An Introduction [Kindle Edition], Pearson; 1 edition, 2013.
3. Vashisth,A.K,Textbooks Of Biostatistics,Neha Publishers & Distributors, 2008.
4. Joao Meidanis, Carlos Setubal,Computational Molecular Biology,Cengage Learning 2007.

REFERENCE BOOKS

1. Lesk, Introduction to Bioinformatics, OUP. Bios Scientific Publishers Ltd.2001.
2. Cynthia Gibas and Per Jambeck, Developing Bioinformatics Computer Skills, SPD.2001
3. Atwood, Introduction to Bioinformatics, Pearson Education.1999.
4. Tisdall, Beginning Perl for Bioinformatics, SPD. 1999.
5. Baxevanis, A.D., Quellette, B.F.F., Bioinformatics: A practical guide to the analysis of genes and proteins, John Wiley and Sons. 2004.
6. Cotterill Rodney. M.J., Biophysics: an introduction. John Wiley, New York.
7. Harbor Laboratory Press, New York.2002,
8. Mount David.W., Bioinformatics: sequence and genome analysis. Cold Spring C. 2001,
9. Tanford, C., Physical chemistry of Macromolecules, John Wiley and Sons. Biophysical Chemistry, Cantor, W.H. Freeman. 2010.

18MBT102 BIOINSTRUMENTATION 4 0 0 4

Course Objective: To provide fundamental theoretical knowledge to the students about Bioinstruments and biomethods, its principle and operation methods.

Course Outcome:

- CO-1: Learning Basics of Microscopy, its operation and maintenance
- CO-2: To learn advanced microscopes like SEM, TEM, STEM, FESEM etc and image processing for microcopical studies.
- CO-3: To learn about the analysis of biomolecules using spectroscopy
- CO-4: Applications of NMR and ESR in determination of biomolecules
- CO-5: To learn Immunology and antigen antibody reactions
- CO-6: Learn to detect molecules in living cells using FISH and GISH
- CO-7: Applying radio-isotopes in detection and measurement of biomolecules
- CO-8: To learn biological imaging of tissues using radio-isotopes
- CO-9: To learn isolation and purification of genetic materials
- CO-10: To learn sequencing genomes and RFLP,RAPD and AFLP techniques

UNIT I Microscope 12

Microscopic Techniques: Visualization of cell and sub cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission electron microscope, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing method in microscopy.

UNIT II Spectroscopy 10

Biophysical method : Analysis of biomolecules using UV/visible, fluorescence, circular dichroism , NMR and ESR spectroscopy ,structure determination using x-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

UNIT III Immunotechniques 10

Histochemical and immunotechniques: Antibody generation, detection of molecules using ELISA, RIA , western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecule in living cells, in situ localization by techniques such as FISH and GISH.

UNITIV Radioisotopes techniques 10

Radio labeling techniques: Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioisotopes material, safety guide lines.

UNIT V DNA technology 12

Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, analysis of RNA , DNA and proteins by one and two dimensional gel electroporesis , isoelectric focusing gels; isolation of specific nucleic acid sequences; generation of genomic and cDNAliberies in plasmid, phage, cosmid .BAC and YAC vectors ;protein sequencing methods, strategies for genome sequencing; RFLP,RAPD and AFLP techniques.

TOTAL : 54hrs

TEXTBOOKS

1. VeerakumariL.,Bioinstrumentation,Mjp Publishers; 1 edition, 2011.
2. Webster, Bioinstrumentation ,Wiley India Private Limited , 2007.

REFERENCE BOOKS

1. John G Webster, Bioinstrumentation. John Wiley & Sons, New York, 2004. Physical John
2. Robyt F., Bernard J. White, Biochemical Technique: Theory and Practice, - Waveland PrInc; Reprint edition, 1990.
3. Wilson,K., Walker, J. E. J. Wood, K., Walker, J, Principles and techniques of practical biochemistry (5th Ed.): Cambridge University Press, Cambridge, 2000.
4. Michael R. Green, Joseph Sambrook, Molecular Cloning: A Laboratory Manual (Fourth Edition), 2014.

18MBT103 TISSUE ENGINEERING AND STEM CELL BIOLOGY 4 0 0 4

Course Objective: To provide fundamental theoretical knowledge to the students about Tissue Engineering in animal cell and Stem Cell Biology.

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of the fundamentals of tissue engineering, tissue moprphogenesis.
- CO – 2: Students will also learn about theBiomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies; Bioreactor modulation of Tissue formation.
- CO – 3: Students will learn about Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell.
- CO – 4: Stem cell – Definition, characterizationwill also be learned by the students.
- CO – 5: Students will be introduced to the types of stem cells: Adult stem cell from amniotic fluid, cord blood and tooth primordial. Neural stem cells and its applications.
- CO – 6: At the end of the course the student will have an idea aboutRas/ Raf pathways
- CO – 7: Students will learn about therapeutics applications of embryonic stem cells
- CO - 8 : Bone marrow stem cells, Adipose derived stem cells
- CO – 9 : Hematopoietic stem cells in heart regeneration and neural defects.
- CO – 10: At the end of the course the student will have an idea about the controversy surrounding human embryonic stem cell research.

UNIT I Basic biology of tissue engineering 10

Basic biology of tissue engineering; the basis of growth and differentiation – morphogenesis and tissue engineering. In vitro control of tissue developmental – Growth factors; Role of basic fibroblast growth factors and angiogenesis. Biomaterials in tissue engineering. Cell-Based Therapies, Tissue Morphogenesis.

UNIT II Biomaterials and bioreactors 12

Biomaterials Scaffolds, Scaffold Fabrication and Tailoring, Bioreactor technologies;Bioreactor modulation of Tissue formation, Bioreactor cultivation of functional tissues and its applications. Bio artificial pancreas, renal replacement devices. Structural tissue engineering – Bone regeneration through cellular engineering-Brain implants –Neural stem cell – Periodontal applications – Artificial womb.Synthetic

UNIT III Introduction to stem cell 10

Stem cell – Definition, characterization, Pluripotent stem cells, Self renewal and differentiation, hierarchy, Stem cell niche, Niche specification -0 Drosophila germ line stem cells. Types of stem cells: Adult stem cell from amniotic fluid, cord blood and tooth primordial. Neural stem cells and its applications.

UNIT IV Cell signals and its pathways 10

Characteristics of stem cell – cell cycle, Ras/ Raf pathways, P13K cell signaling, p53 check points, Role of LIF pathways in cell cycle control. Stem cell communications – gap junctions, cell fusions, HOX genes, upstream transcriptional factors, Tran differentiation, cell fusion.

UNIT V Applications of stem cells 12

Therapeutics applications of embryonic stem cells, Bone marrow stem cells, Adipose derived stem cells and Hematopoietic stem cells in heart regeneration and neural defects. Ethics in human stem cell research; Controversy surrounding human embryonic stem cell research, societal implications: women, low-income, Different religious views, Current Ethical Guidelines in India, Ethical views of other countries and how this affects advancement of science Policy.

Total :54hrs

TEXT BOOKS

1. Jonathan Slack ,Stem cells- A Very Short Introduction, Oxford, 2012.
2. Bernhard O. Palsson ,Sangeeta N. Bhatia, Tissue Engineering, Prentice Hall; 1 edition, 2003.

REFERENCE BOOKS

1. Robert P. Lanaza, Robert Langer and Joseph Vacanti. Principles of tissue engineering. Second edition Academic Press. 2002.
2. Micklem.H.S.,LoutitJohn.F., Tissue grafting and radiation, Academic Press, New York.2004.
3. Penson, Balducci.D.,Tissue cultures in biological research, Elsevier, Amsterdam.2004.
4. Robert Lanza, John earhart, Brigid Hogan, Douglas Melton, Roger Pedersen, E. Donnall Thomas, James Thomson and Sir Ian Wilmut, Essentials of Stem Cell Biology (Second Edition, 2009.
5. Robert Lanza. “Essential of Stem Cell Biology” Academic Press, 2005.
6. James Thomson et al; “Handbooks of Stem Cells’ Embryonic / Adult and Fetal Stem Cells” Vol I and II; Academic Press (2004).

18MBT104 ENVIRONMENTAL AND NANO-BIOTECHNOLOGY 4 0 0 4

Course Objective: To provide fundamental theoretical knowledge about Environmental and Nano Biotechnology and its application.

Course Outcome:

- CO–1: At the end of the course the students will have an understanding of the fundamentals and scope of environmental biotechnology.
- CO – 2 : To learn the Biodegradation
- CO –3: Students will also learn about theBioenergy
- CO – 4: Students will learn about Microbial reactors, genetically modified microbes
- CO – 5 : Students will understand the energy from waste
- CO – 6: To understand the Biogas technology plant design
- CO – 7: Students will be introduced to the impact of nanotechnology in different fields.
- CO–8:Students will understand Nanometer, Nanotubes, Biosensors, Nanorods,Nanofibres.
- CO – 9 : Students will receive the knowledge about Application of nanobiotechnology in health and life sciences
- CO – 10: At the end of the course the student will have an idea aboutBiological nanostructures.

UNITI Introduction of environmental biotechnology 10

The scope of environmental biotechnology; Biodegradation of macromolecules; biodegradation of genobiotics; Vermicomposting. Heavy metal pollution; bioremediation of metal contaminated soils; spilled oils and grease deposits and synthetic pesticides. Biosensors to detect environmental pollutants. Microorganisms and organic pollutants; Extremophiles. Fermentation technology (bioreactors).

UNITII Fermentation and Bioremediation I 10

Bioenergy, ethanol fermentation .liquid waste treatment; biofilters, activated sludge systems; membrane bioreactors. Biotechnological approaches for solid waste management, phytotechnology-terrestrial phytosystems, metals phytoremediation, phytotechnology-aquatic phytosystem, nutrient film techniques and algal treatment systems.

UNIT III Fermentation and Bioremediation II 12

Microbial reactors, genetically modified microbes& their uses in environmental management recycling & up gradation technology, production of products, energy from waste. Biogas technology plant design, construction, operation, biogas form organic wastes, waterweeds, landfills, microbiology of anaerobic fermentation. Biotransformation, bioconversion ,bioremediation, phytoremediation technology ,fermentation technology, development of stress

tolerant plants, Environmental problems & environmental monitoring through microorganism, microbiology of water , air ,soil, microbes as pathological agents in plants , animals and man. Impacts of large scale exploitation of solar, wind, hydro and ocean energy.

UNIT IV Introduction to nanotechnology 12

History of nanotechnology and future of nanotechnology. Impact of nanotechnology in different fields. Nanometer, Nanotubes, Biosensors, Nanorods, Nanofibres, Fullerenes and Nanostructures. Nanostructured materials, synthesis of nanostructured material and properties of nanomaterials. Quantum dots, carbon nanotubes and their properties. Nanocomposites and Nanomachines. Nanowires, Nanoparticles and characterization of nanoparticles.

UNIT V Applications of bionanotechnology 10

Introduction to nanobiotechnology. Nanobiotechnology and future perspectives. Biological nanostructures. Nanolithography. Application of nanobiotechnology in health and life sciences. Microbial nanoparticles, DNA - Protein nano structures. Self- assembly of nanomolecules. Drug nano particles. Bioincompatibility and drug delivery.

TOTAL :54hrs

TEXT BOOK

1. Mohapatra,P.K., Textbooks of Environmental Biotechnology, I K International Publishing House Pvt. Ltd, 2006.
2. Alan Scragg, Environmental Biotechnology, Oxford; Second edition, 2007.
3. ManasiKarkare, Nanotechnology: Fundamentals and Applications,I K International Publishing House Pvt. Ltd ,2008.
4. Charles Poole , Frank Owens, Introduction to Nanotechnology ,Wiley 2007.

REFERENCE BOOK

1. Manahan, S.E. Environmental science and technology .lewis ,New York, 1997.
2. Metcalf and Eddy (eds). Wastewater engineering: treatment and reuse, Tata McGraw-Hill , New Delhi.2003.
3. Nelson, G.C. genetically modified organism in agriculture: economics and politics academic press.2001.
4. Evans,G.M and Furlong J.C. Environmental biotechnology: theory and application.John Wiely and Sons.2003 .
5. Thomas,J.A. and Fuchs R. biotechnology and safety assessment, 2002.
6. Claudia Nicolini. NanobiotechnologyNanobiosciences. Pan Stanford Publishing Pte. Ltd, 2009.
7. Niemeyer, C.M. and Mirkin, C.A. Nanobiotechnology concepts, application and perspectives. WILEY-VCH, VerlagGmb H & Co.2004.

18MBT105 MARINE AND PHARMACEUTICAL BIOTECHNOLOGY 4 0 0 4

Course Objective: To provide knowledge about marine micro and macro organisms and its medically important products.

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of the fundamentals of marine recourses.
- CO - 2: To understand the biotechnology aspects with Marine organisms.
- CO – 3: Students will also learn about different varieties of marine plan and their utilization.
- CO – 4. To understand the Marine Animals as a source of Biotechnological application
- CO – 5: Students will learn about the commercial production of different bioactive compounds from marine resources.
- CO – 6: Students will be introduced toPharmaceutical biotechnology.
- CO – 7: To learn pharmacokinetic concepts.
- CO – 8: To know the Peptide and protein drugs.
- CO – 9: To learn Elimination of protein Therapeutics and Distribution of therapeutics,
- CO–10:Student will receive knowledge of Protein binding of proteins therapeutics, Heterogeneity of protein therapeuticswill also be learnt by the students.

UNIT I Introduction to marine biotechnology 10

Introduction to marine biotechnology. Marine plant-phytoplankton, sea grasses, mangroves and marine fungi. Marine animal resources. Marine microorganisms and their utilization.

UNIT II Marine products 10

Bioactive compounds from marine resources. Marine natural products and their commercial production. Marine microalgal biotechnology.

UNIT III Introduction to Pharmaceutical biotechnology 10

Introduction to Pharmaceutical biotechnology, Introduction to pharmacokinetic concepts, biological /research advances and approved biological for pharmaceutical uses and introduction to pharmacogenomics.

UNITIV Therapeutics enzymes and antibiotics 12

Enzymes in therapeutics, clinical analysis and Pharma industry. Screening of antibiotics procedures, inoculums and medium for commercial production of penicillin and cephalosporin, fermentation process, isolation and purification.

UNIT V Pharmacokinetics and Phermacodynamics 12

Pharmacokinetics and Phermacodynamics - Peptide and protein drugs. Elimination of protein Therapeutics and Distribution of therapeutics, Protein binding of proteins therapeutics, Heterogeneity of protein therapeutics. Chemical modification of protein therapeutics and immunogenicity.

TOTAL : 54hrs

TEXTBOOKS

1. Sambamurthy K, AshutoshKar , Pharmaceutical Biotechnology, New Age InternationalPvt Ltd Publishers, 2006.
2. ChandrakantKokate , Pramod H.J , SS Jalalpure , Textbooks of Pharmaceutical Biotechnology [Kindle Edition],Elsevier; First edition, 2011.
3. David H. Attaway, Oskar R. Zaborsky,Pharmaceutical and Bioactive Natural Products (Marine Biotechnology) 3rd Edition.1993.

REFERENCESBOOKS

1. Daniel Figeys (Ed.) Industrial proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley and Sons, 2005.
2. Kayser, O. R.H. Muller.. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH.2004.
3. HeonrichKlefenz. Industrial Pharmaceutical Biotechnology.2002.
4. Garywalsh. Biopharmaceutical, biochemistry and biotechnology.2003.
5. Thomas Lengauer, Bioinformatics - from Genomes to drugs. Vol.I and II. Wiley - VCH.2002.

18MBT106 FERMENTATION TECHNOLOGY 4 0 0 4

Course Objective: To provide knowledge about fermentation technological process for industrial important.

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of the fundamentals of fermentation technology, interaction between chemical engineering, microbiology and biochemistry.
- CO – 2: Students will also learn about different Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control.
- CO – 3 : Student will known about the Different types of reactors, continuous and Fed-batch cultures.
- CO – 4: Students will learn about the production of industrial starters: isolation, maintenance and development of microorganisms.
- CO – 5 : To understand the Starter utilization and immobilization of biocatalysts.
- CO – 6: Students will be introduced toDownstream processing, Recovery of particulate matter, product isolation, distillation.
- CO – 7: Students will knowing the Monitoring of bioprocesses
- CO – 8: To learn On-line data analysis for measurement of important physio-chemical and biochemical parameter.
- CO – 9: To learn Computer based data acquisition,
- CO – 10: To understand Monitoring and control-LABVIEW software will also be learnt by the students.

UNIT I Introduction to fermentation technology 12

Introduction to fermentation technology; interaction between chemical engineering, microbiology and biochemistry. History of fermentation .introduction to fermentation processes, microbial culture selection for fermentation processes. Media formulation and process optimization.

UNITII Bioreactors and its design 12

Bioreactors: Functions, design, aeration and agitation, sterilization instrumentation and control. Differention types of reactors, continuous and Fed-batch cultures Garden's fermentation classification, design and operation of fermenters, basic concepts for selection of a reactor, packed bed reactor, fluidized bed reactor, trickle bed reactor, bubble column reactor and scale up of bioreactors.

UNIT III Industrial microbes 10

Production of industrial starters: isolation, maintenance and development of microorganisms. Starter utilization, immobilization of biocatalysts: kinetics effects, inactivation kinetics biocatalysts in non-conventional media (biphasic, organic, ionic liquids, supercritical fluids).

UNIT IV Downstream process 10

Downstream processing. Recovery of particulate matter, product isolation, distillation, centrifugation, whole broth processing, filtration, aqueous two – phase separation, solvent extraction, chromatography and electrophoresis.

UNIT V Monitoring data and analysis 10

Monitoring of bioprocesses – On-line data analysis for measurement of important physio-chemical and biochemical parameter. Computer based data acquisition, monitoring and control-LABVIEW software.

TOTAL : 54hrs

TEXT BOOKS

1. Kalaiselvan P T, I Arul Pandi, Bioprocess Technology (Volume 1), MJP PUBLISHERS; 1st edition 2007.
2. Stanbury F, A Whitaker, Principles Of Fermentation Technology, Elsevier; 2 edition,2008
3. Mukhopadhyay, S.N. processes biotechnology fundamentals, Viva Bookss Pvt. Ltd. 2001.

REFERENCE BOOKS

1. Keith Wilson and john Walker, Practical Biochemistry-principles and Techniques, Cambridge, 5th Ed. 2000.
2. Coulson and Richardson JF, chemical engineering-volume 3 (Chemical and biochemical reactors and process controls ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian BookssPvt.Ltd. 1998.
3. Bailey and oils, Biochemical Engineering Fundamentals, McGraw-Hill, 1990.
4. Ho, W.S.W. and K.K. Sirkar, Membrane Handbooks, Van Nostrand Reinhold, N.Y. (1992)

18MBT107 REGULATORY AFFAIRS, GLP, IPR, ENTREPRENEURSHIP AND BIOETHICS IN CLINICAL RESEARCH 4 0 0 4

Course Objective: To provide detailed knowledge about Regulatory affairs, GLP, IPR, Entrepreneurship and Bioethics in Clinical Research

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of the overview of regulation affairs.
- CO – 2: Students will also learn aboutdrug act, schedules to drugs and perenealties for offence regarding sale of drugs. schedule Y clinical trials.
- CO – 3: Students will learn about the regulatory authorities in India, Indian FDA, DCGI, ICMR, GEAC, AERB, DGFT, DTAM, DBT guidelines and provisions.
- CO – 4: To understand the Indian regulatory approval process.
- CO – 5: Students will be introduced toIPR, laws of IPR, patents.
- CO – 6: To learn the Bioethics, ethical issues in preclinical (animal) studies, & clinical studies
- CO – 7: Students will knowing the Ethical principles, Institutional Review Board, special issues in research.
- CO – 8:To learn Ethical guidelines-ICMR,
- CO – 9: To understand Institutional Ethics committees, Institutional review board, ethics-sops ethical issues based on methodology of clinical research.
- CO –10: The ethics of clinical research in developing countries will also be learnt by the students.

UNIT I Introduction to regulation affairs 10

Overview of regulation affairs. the rights and obligation of a medical professional of patient and code of medical ethics.

UNIT II Drug regulations 10

Introduction to drug act, schedules to drugs and perenealties for offence regarding sale of drugs. schedule Y clinical trials. Amendments of schedule Y.

UNIT III Regulatory authorities 12

Regulatory authorities in India, Indian FDA, DCGI, ICMR, GEAC, AERB, DGFT, DTAM, DBT guidelines and provisions. Indian regulatory approval process. ICH and process of harmonization. Categories of ICH guidelines, quality, safety, and efficacy guidelines. Introduction to food & drug administration (FDA).

UNIT IV Intellectual property rights 10

IPR, laws of IPR, parents. The WHO, TRIPS agreement, copyrights, IP protection. Impact of IP technology transfer contracts & agreements.

UNIT V Bioethics 12

Introduction to bioethics, ethical issues in preclinical (animal) studies, & clinical studies- Ethical principles, Institutional Review Board, special issues in research. Ethical guidelines-ICMR, Institutional Ethics committees, Institutional review board, ethics-sops ethical issues based on methodology of clinical research. The ethics of clinical research in developing countries.

TOTAL : 54hrs

TEXT BOOKS

1. UdupaN, Krishnamurthy Bhat , A Concise Textbook of Drug Regulatory Affairs,Manipal University Press (MUP); First Edition edition, 2015.
2. DeepaGoel (Author), ShominiParashar, IPR, Biosafety and Bioethics, Pearson; 1 edition, 2013.
3. Ajit N Babu ,Wolter Kluwer; Clinical Research Methodology and Evidence-Based Medicine, Second edition, 2014.
4. Kanosia, Clinical Research: Pharmacovigilence& Ethics CreateSpace Independent Publishing Platform, 2015.

REFERENCE BOOKS

1. Douglas J. Pisano, David S. Mantus, FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics, CRC Press, 2008.
2. Stephen F. Amato, Robert M. Ezzell, B Amato, Regulatory Affairs for Biomaterials and Medical Devices (Woodhead Publishing Series in Biomaterials), 2014.
3. Ezekiel J. Emanuel, Christine C. Grady, Robert A. Crouch, Reidar K. Lie, The Oxford Textbook of Clinical Research Ethics, OUP USA; Reprint edition, 2011.

18MBT108 MEDICAL AND HERBAL BIOTECHNOLOGY 4 0 0 4

Course Objective: To provide detailed knowledge about medicinal and herbal biotechnology and its products.

Course Outcome:

- CO –1: At the end of the course the students will have an understanding of medical biotechnology and its scope.
- CO – 2: Students will also learn about the disease diagnosis, therapy –ELISA, hybridoma, proteomics.
- CO – 3: Students will learn about diagnostic kit development for microanalysis.
- CO – 4: Medical coding and transcription. Importance of ICD9 and ICD10 will also be learned by the students.
- CO – 5: Students will be introduced to the basics of Stem Cell Biology, Fate Mapping of Stem Cells, Stem Cell Pattern: Stem Cell Pattern of Cell type switching in *Schizosaccharomycespombe.*
- CO – 6: The student will have an idea about*in vivo* Stem Cell System,Embryonic Stem Cells, Trophoblast Stem Cells, Hematopoietic Stem Cells, Mesenchymal Stem Cells.
- CO – 7: Students will learn about important medicinal herbs in treating diseases and phytochemistry of medicinal plants.
- CO – 8: To learn about methods of analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).
- CO – 9: Students will learn about Biotechnological methods of plant propagation. - Micropropagation – Somatic Embryogenesis and somoclonal variation.Herbal gardening and maintenance.
- CO – 10: To understand the Alternative method of secondary metabolite production

UNIT I Introduction to medical biotechnology 10

Introduction to medical biotechnology and its scope. Disease Diagnosis and Therapy- ELISA and hybridoma technology,- DNA vaccine, - Gene Therapy,- Toxic genomics. DNA, RNA, Protein in Drug Development. Diagnosis of disease by Proteomics. Separation and identification techniques for protein analysis. Development of antibody based protein assay for diagnosis.

UNIT II Diagnosis and medical coding 10

Diagnosis and Kit Development- Use of enzymes in clinical diagnosis, Use of biosensors for rapid clinical analysis.- Diagnostic kit development for microanalysis. Introductions to medical coding and transcription. Importance of ICD9 and ICD10.

UNIT III Introduction to Stem Cell Biology 12

Introductionto Stem Cell Biology, Fate Mapping of Stem Cells, Stem Cell Pattern: Stem Cell Pattern of Celltype switching in *Schizosaccharomycespombe.* The Notch/LIN-12 Communication

System, Cell Cycle Control,Checkpoints, and Senescence of Dividing SomaticCells. Drosophila Ovary: An In Vivo Stem Cell System, Male Germ-line Stem Cells,Primordial Germ Cells as Stem Cells, Embryonic Stem Cells, Trophoblast Stem Cells, Hematopoietic Stem Cells, Mesenchymal Stem Cells , Adult Bone Marrow stem cells, Epidermal Stem Cells: Liver Stem Cells, Pancreatic Stem Cells, Stem Cells in the Epithelium of the Small Intestine and Colon

UNIT IV Introduction to Herbal medicine 12

Study of on history and scope of herbals. Important medicinal herbs in treating diseases. . Phytochemistry of medicinal plants- alkaloids- flavones- flavanoids and xanthones - furocoumarins - glycosides - naphthoquinones - phenols and acylphloroglucinols - resins, oleoresins and gum resins. Saponins - swsquiterpene - sterols and steroid like compounds - tannins and terpenes. Introduction to analysis and quality controls of herbal products (TLC, HPLC, IR, NMR, and mass spectroscopy).

UNIT V Herbal biotechnology 12

Biotechnological methods of plant propagation.- Micropropagation– Somatic Embryogenesis and somoclonal variation.Herbal gardening and maintenance- Standardization of cultivation protocols of selected medicinal plants; *in vitro* production of secondary metabolites.Polyhouse technology. Important diseases of medicinal plants and their management. Alternative method of secondary metabolite production - Organ culture, Cell culture, Biotransformation (Microbial and Plant cells) - Scale up - Enhancement of productformation by elicitation.

Total : 56hrs

TEXT BOOKS

1. Trivedi P. C., Herbal Drugs and Biotechnology ,Pointer Publishers , 2009.
2. KhadabadiS. S., B. A. Baviskar S. L. Deore ,Pharmacognosy and Phytochemistry: A Comprehensive Approach (Pharmacognosy),PharmaMed Press; 1 edition2014.
3. PrathibhaNallari ,V.VenugopalRao,Medical Biotechnology, Oxford University Press ,2010.
4. Agrawal S.S. and M. Paridhavi, Herbal Drug Technology, University press 2007.
5. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University,Press, 1996.

REFERENCE BOOKS

1. Anderson, F.J Illustrated History of the Herbals. New York: Columbia University press. 2009.
2. Daniel Figeys (Ed.) Industrial proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley and Sons, 2005.
3. Kayser, O,R.H. Muller. Pharmaceutical Biotechnology - Drug Discovery and clinical applications. Wiley - VCH.2004.
4. HeonrichKlefenz, Industrial Pharmaceutical Biotechnology.2002.
5. Garywalsh. Biopharmaceutical, biochemistry and biotechnology.2003.
6. Robert Lanza. “Essential of Stem Cell Biology” Academic Press, 2005.
7. James Thomson et al; “Handbooks of Stem Cells’ Embryonic / Adult and Fetal Stem Cells” Vol I and II; Academic Press (2004).

18MBT109 PROJECT MANAGEMENT AND BIOTECH PRODUCTS ENTREPRENEURSHIP 4 0 0 4

Course Objective: To provide detailed knowledge about Project Management and Biotech products Entrepreneurship that's motivate the students in industrial firm.

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of project management – frame work; concept of a project, capital expenditure.
- CO – 2: Students will also learn about resource allocation: elementary investment strategy, portfolio planning tools, strategic position & action evaluation.
- CO – 3: Students will learn aboutscouting for project idea, preliminary screening and project rating index.
- CO – 4:Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedulewillalsobe learned by the students.
- CO – 5: Students will be introduced to thetriple constraints in project management,
- CO – 6: At the end of the course the student will have an idea about project management &clinical trials, role of project management in clinical trials.
- CO – 7: Students will learn about Business plan preparation- sources of product for business.
- CO – 8: At the end of the course the student will have an idea about matching the entrepreneur with the project- Feasibility report preparation and evaluation criteria. .
- CO – 9: Students will learn aboutIntroduction& stages of business development-start-up phase, growth phase, maturity phase, decline phase.
- CO–10: Outsourcing in clinical research, reasons for outsourcing to contract research organization will also be learnt by the students.

UNIT I Introduction to Project management 10

Project management – frame work; concept of a project, capital expenditure, Importance& difficulties, Phase of capital budgeting, feasibility study: overview. Resource allocation: elementary investment strategy, portfolio planning tools, strategic position & action evaluation.

UNIT II Project formulations 12

Financial identification& formulation- scouting for project idea, preliminary screening and project rating index. Market & demands analysis- market survey, characterization of market, forecasting & planning, profit potential of industries; porter model. Technical analysis- analysis of inputs, technology, product mix, capacities, location, civil works, charts, lay outs, work schedule.

UNITIII Project management plans 12

The triple constraints in project management, project management activities, project management objective, project management documents, project control variables, project management &

clinical trials, role of project management in clinical trials, major roles of a project manager in a CRO , ensuring project success.

UNIT IV Business plan 10

Business plan preparation- sources of product for business -pre feasibility study-criteria for selection of products- ownership-capital- budgeting project profile preparation- matching entrepreneur with the project- Feasibility report preparation and evaluation criteria.

UNIT V Business development and biotech companies 12

Introduction & stages of business development-start-up phase, growth phase, maturity phase, decline phase. Outsourcing in clinical research, reasons for outsourcing to contract research organization, the India advantage, scope and future of CRO , list of clinical research organization in India , list of it companies offering service in clinical research. role of business development manager.

Total : 56hrs

TEXT BOOKS

1. Hisrich “Entrepreneurship”, Tata McGraw Hill, New Delhi, 2001.
2. Khanka S.S., Entrepreneurship development”, S. Chand and company limited, New Delhi, 2001
3. Craig Shimasaki, Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies [Kindle Edition]Academic Press; 1 edition, 2014.

REFERENCE BOOKS

1. Kumawat, H. S.. Modern Entrepreneur And Entrepreneurship Theory Process PracticeNeha Publishers & Distributors, 2013.
2. Erik Larson (Author), Clifford Gray, Project Management: The Managerial Process with MS Project (The Mcgraw-Hill Series Operations and Decision Sciences) 6th Edition, 2013.
3. Meri Williams, The Principles of Project Management, SitePoint; 1 edition, 2008.

Syllabus

Generic Elective Courses

18MBT151 MEDICAL TRANSCRIPTION AND CODING 20 0 2

Course Objective: The paper designed to introduce and provide basics in Transcription and Coding to students.

Course Outcome:

- CO – 1 : To educate basics in Medical Coding and transcription
- CO – 2: At the end of the course the students will have an understanding of the basics in Medical Coding and transcription and ICT principles.
- CO –-3: To learn the importance of Reimbursement
- CO – 4: Students will also learn about importance and its applications in Healthcare Industry.
- CO – 5: To learn billing System.
- CO – 6: Students will learn about different approaches in medical transcription.
- CO – 7:Students will also learn about evaluation & management of coding
- CO – 8: Students will be introduced to the CPT codes used in medical coding
- CO – 9: To Understand the Absence of Code
- CO – 10. Student will receive knowledge about Emergency Department Services;

UNIT I Introduction to medical coding 6

Professional Overview; Specific Responsibilities, Medical Diagnosis, Standardization in Coding; Relative Value Units (RVUs); HIPAA Background and Explanation.

UNIT II ICD-9-CM coding and structure 6

ICD-9-CM: Overview; ICD-9-CM: General Structure; ICD-9-CM: Basic Operating Guidelines; V Codes; Categories of V Codes; Tips for Improving ICD-9-CM coding Accuracy.

UNIT III Reimbursement and Billing system 6

Reimbursement: Introduction; Reimbursement: Overview; Healthcare Industry Billing/Reimbursement Climate; Top Ten Coding and Billing Errors; Step to Avoid Coding Billing Errors; More Efficient Billing Systems.

UNIT IV CPT Medical Coding 6

CPT Medical Coding: Three Categories of CPT Codes; CPT Codes: Category I; General Guidelines for Using the CPT Manual; Coding Multi-Disciplinary Approach; Absence of Codes; Correlation between Coding and Time; Troublesome Modifiers: -25 & -59.

UNIT V Services and Evaluation & Management 6

Prolonged Services; Critical Care Services; Emergency Department Services; Cautionary CPT Coding Areas; Reasonable and Necessary; Documentation; Changes/Revisions to CPT Codes;

National Correct Coding Initiative (NCCI); Evaluation & Management (E/M) Coding:- Evaluation and Management (E/M).

Total :30hrs

TEXT BOOKS

1. Marcy O. Diehl, Medical Transcription : Techniques and Procedures, 2007
2. Buck MS CPC CCS-P, Carol J. ,Step-by-Step Medical Coding, Edition, 1e Saunders , 2015

REFERENCE BOOKS

1.Linda Campbell, Medical Transcription Fundamentals and Practice, Prentice Hall- Gale. 1993.

2.Sally Crenshaw Pitman, John H. Dirckx, Ellen B. Drake. Medical Transcription: Fundamentals and Practice (3rd Edition), Prentice Hall.2007.

3. Cynthia DestafanoBsbaRt(r), Fran M. FedermanMsed. Essentials of Medical Transcription: A Modular Approach, Saunders Publishers.2004.
4. Cindy Destafano, Fran M. Federman, Cynthia Destafano. Advanced Medical Transcription: A Modular Approach [with Cdrom], W.b. Saunders Company Publishers.2003.

18MBT152 BIOMEDICAL WASTE MANAGEMENT 2 0 0 2

Course Objective: This course aims to provide knowledge about source, types, handling, collection, and disposal and also it is ensure the proper and safe management of biomedical waste.

Course Outcome:

- CO – 1: At the end of the course the students will have an understanding of the basics, the Scope and importance of biomedical wastes
- CO – 2 : students will learn about types of wastes and composition.
- CO – 3: Students will also learn about Potential health hazards of biomedical wastes.
- CO – 4 : To learn Direct and Indirect hazards
- CO – 5: Students will learn about different approaches and understand the principles and methods of disposal of biomedical wastes.
- CO – 6: To understand the secured land fill
- CO – 7: Students will also learn about the different technologies of treatment and management of biomedical wastes.
- CO – 8: To learn Conventional treatment technologies
- CO –9: Students will understand the rules, policies and guidelines of biomedical wastes.
- CO – 10. To understand the WHO guidelines for biomedical wastes

UNIT I Introduction to biomedical waste 8

Introduction, Definition, Scope and importance of biomedical waste. Categories of biomedical wastes(Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste , Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).

UNIT II Health impacts biomedical waste 6

Health impacts of biomedical wastes. Direct and Indirect hazards. Potential health hazards of BMW. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (protective devices)

UNIT III Handling of biomedical waste 6

Biomedical waste – Handling rules, segregation, collection, transportation, disposal-color coding and type of container for disposal of biomedical wastes. Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).

UNIT IV Treatment and management of biomedical waste 6

Treatment and management of biomedical wastes-on site - pre treatments, treatment-in-site and off-site (common treatment facilities).Liquid waste treatment by different technologies. Conventional treatment technologies (wet thermal and incineration)

UNIT V Legislation policies and rules of biomedical wastes 4

Environment and legislation policies and rules for handling and management of biomedical wastes. CPCB guidelines .WHO guidelines for biomedical wastes.

Total : 30hrs

TEXT BOOKS

1. Sharma – Holistic approach to Hospital Waste Management published by Dept. of
2. Bhide A. D.andB.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
3. GoelS. L, Hospital Management, 2009.
4. RadhakrishnanR , Biomedical Waste Management ,Neha Publishers &Distributors,2007.
5. BeheraP K, Sustainable Bio-Medical Waste Management (2 Vols.)Dominant Publishers And Distributors 1993

REFERENCE BOOKS

1. Hosetti,B. B.Prospects and perspective of solid waste management, 2006.
2. Glynn Henry J and Gary. W. Heinke, "Environmental Science and Engineering", PreticeHall of India, 2004.
3. BhideA. D and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
4. Glynn Henry J and Gary. W. Heinke, "Environmental Science and Engineering", Pretice Hall of India, 2004.

18MBT153 BIOTECHNOLOGY AND HUMAN WELFARE 2 0 0 2

Course Objective: This course has been designed to introduce the various techniques in modern era of biotechnology. It focuses on industrial biotechnology, agriculture and medical biotechnology and moleculartechniques for forensic science.

Course Outcome:

- CO – 1: At the end of the course the students will be educated about the products of industrial biotechnology.
- CO –2: Students will also gain knowledge relevant to the applications of agriculture biotechnology.
- CO –3: Students learn about interaction between plants and microbes.
- CO–4: Students will learn about the various techniques involved in environmental biotechnology.
- CO–5: To know about the degradation of hydrocarbons and agricultural wastes
- CO – 6:Students will also learn about the molecular techniques of forensic science
- CO – 7: To learn various methods of DNA finger printing
- CO – 8: Students will understand about health care products
- CO – 9: Students will receive knowledge about human genome project.
- Co – 10: To learn recombinant live vaccines

UNIT I Industrial Biotechnology 4

Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

UNIT II Agricultural Biotechnology 6

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III Environmental Biotechnology 8

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT IV Biotechnology in Forensic science 6

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT V Biotechnology in medicine 6

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

Total : 30hrs

TEXT BOOKS

1. Patnaik, "Textbooks of Biotechnology", McGraw Hill Education (India) Private Limited.2012.
2. Satyanarayana, U, "A Textbooks of Biotechnology", Bookss and Allied (p) Limited, 2013.
3. Sateesh MK,"Bioethics and Biosafety", I. K. International Pvt Ltd, 2010.
4. Sree Krishna V,"Bioethics and Biosafety in Biotechnology",New age international publishers, 2007.
5. Purohit S.S. "Agricultural Biotechnology", 3rdeds, Agrobios, 2010.
6. Kumaresan V," Biotechnology P, Saras Publication, 2015
7. Kumaresan V, N Arumugam, Environmental Biotechnology ,Saras,2014
8. SandhyaJadhav ,A Text Book of Environmental Biology and Biotechnology 2nd Edition Vision, Publications 2012

REFERENCE BOOKS

1. Ellyn Daugherty,"Biotechnology: Science for The New Millennium", EMC Publishing, 2006,
2. Clark DP and Pazdernik NJ. "Biotechnology-Applying the Genetic Revolution". Elsevier Academic Press, USA.2009.
3. Alan Scragg,"Environmental Biotechnology", Oxford; Second edition, 2007.

18MBT154 ENVIRONMENTAL BIOTECHNOLOGY 2 0 0 2

Course Objective: The topic represents a stand-alone, progressive topic leading the student through the key aspects of environmental microbiology prior to its subsequent application within environmental biotechnology.

Course Outcome:

- CO – 1: At the end of the course the students will understand the importance of conventional fuels and their environmental impacts
- CO – 2: Students will also gain knowledge relevant to the applications of Bioremediation to the environment.
- CO – 3: To understand the degradation of lignin and cellulose using microbes.
- CO – 4: To learn water contaminated with oil spills
- CO – 5: Students will learn about the various techniques involved in Phyto-remediation
- CO – 6: To know about the pesticides and other toxic chemicals by micro-organisms.
- CO– 7: Students learnt about the various methods in waste water treatment.
- CO – 8: To understand the Algal and fungal biofertilizers
- CO – 9:Students will alsogain the knowledge about Bioleaching
- CO – 10:To learn the importance of Genetically modified microorganisms.

UNIT I Biofuels 6

Conventional fuels and their environmental impact – Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol

UNIT II Bioremediation 6

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes.

UNIT III Phyto-remediation 6

Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms-degradation aromatic and chlorinates hydrocarbons and petroleum products.

UNIT IV Waste water treatment and biofertilizer **6**

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)

UNIT V Biomining **6**

Biomining, Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).Environmental significance of genetically modified microbes, plants and animals.

Total : 30hrs

TEXT BOOKS

1. Pradipta Kumar Mohapatra,"Environmental Biotechnology", I.K. International Publishing House; 1st Ed. Edition,2007.
2. Satyanarayana, U, "A Textbook of Biotechnology", Books and Allied (p) Limited, 2013.
3. Purohit S.S. "Agricultural Biotechnology", 3rd edition, Agrobios, 2010.

REFERENCE BOOKS

1. Alan Scragg,"Environmental Biotechnology", Oxford; Second edition, 2007.
2. Hans-Joachim Jordening and Jesef Winter, "Environmental Biotechnology – Concepts and Applications",Wiley VCH, 2004.
3. Metcalf and Eddy, "Waste Water Engineering", 4th edition, Tata McGraw hill,2003
4. Alicia L. Ragout De Spencer, JohnF.T. Spencer."Environmental Microbiology: Methods and Protocols", Humana Press, 2004.
5. Milton Wainwright, "AnIntroduction to Environmental Biotechnology", Springer, 1999.

18MBT155 ENTREPRENEURSHIP DEVELOPMENT 2 0 0 2

Course Objective: Formulate strategies that reflect the interdisciplinary nature of the biotechnology industry in the areas of science, regulation and enterprise.Create marketing strategies that achieve organizational goals and objectives. Formulate product launch strategies in the biotechnological products approval and marketing process.

Course Outcome:

- CO – 1: To learn the Entrepreneurship
- CO – 2: Students will alsodevelop achievement motivation and entrepreneurial skill.
- CO – 3: Students will learn about Project formulation
- CO –4: To understand the various financial and funding strategies for enterprise under various economic situations.
- CO – 5 : Students gain knowledge about Indirect raw material s and its management
- CO – 6 : To learn how to move for loans for Entrepreneurship
- CO –7:Students will also gain the knowledge about various strategies of marketing management.
- CO –8: Students will gain the knowledge about marketing strategies of import and export of biotechnology products.
- CO – 9: To understand the Institutional support for exports
- CO – 10: To learn the Project Report on a selected product should be prepared.

UNIT I Introduction 6

Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship.

UNIT II Establishing an enterprise 6

Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

UNIT III Financing the enterprise 6

Importance of finance / loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capital its sources and how to move for loans, Inventory direct and indirect raw material s and its management.

UNIT IV Marketing Management 6

Meaning and Importance, Marketing-mix, product management – Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management.

UNIT V Entrepreneurship and international business 6

Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports. Project Report on a selected product should be prepared and submitted.

Total : 30hrs

TEXT BOOKS

1. Gupta CB, Khanka SS. "Entrepreneurship and Small Business Management", Sultan Chand &Sons, 2000.
2. Naidu N.V.R., T. Krishna Rao, "Management and Entrepreneurship", I K International Publishing House Pvt. Ltd, 2008
3. Janakiram B., "Management and Entrepreneurship",Excel Books, 2009.

REFERENCE BOOKS

1. Jack M. Kaplan (Author), Anthony C. Warren, "Patterns of Entrepreneurship Management", John Wiley & Sons; 4th Edition edition, 2013.
2. Holt DH. "Entrepreneurship" New Venture Creation. Prentice-Hall, 1998.