SYLLABUS

M.Sc. BIOTECHNOLOGY

(2015-16 Academic year onwards)

DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF LIFE SCIENCES
PONDICHERRY UNIVERSITY

M. Sc. COURSES OFFERED IN THE DEPARTMENT OF BIOTECHNOLOGY

Sl. No.	COURSE TITLE	CREDIT	SEMESTER
1.	BIOT 411 CELL BIOLOGY	3	I
2.	BIOT 413 MICROBIOLOGY	3	I
3.	BIOT 415 TECHNIQUES IN BIOTECHNOLOGY	3	I
4.	BIOT 461 CELL BIOLOGY LAB	1	I
5.	BIOT 462 IMMUNOLOGY LAB	1	I
6.	BIOT 463 MICROBIOLOGY LAB	1	I
7.	BIOT 464 BIOCHEMISTRY LAB	1	I
8.	BIOT 465 TECHNIQUES IN BIOTECHNOLOGY LAB	1	I
9.	BIOT 412 IMMUNOLOGY	3	I
10.	BIOT 414 BIOCHEMISTRY	3	I
11.	BIOT 422 MOLECULAR PLANT-MICROBE INTERACTION	3	I
12.	BIOT 421 MOLECULAR GENETICS	3	II
13.	BIOT 424 IMMUNOTECHNOLOGY	3	II
14.	BIOT 425 MOLECULAR PLANT BREEDING	3	II
15.	BIOT 426 STEM CELL BIOLOGY	3	II
16.	BIOT 471 MOLECULAR GENETICS LAB	1	II
17.	BIOT 474 IMMUNOTECHNOLOGY LAB	1	II
18.	BIOT 475 MOLECULAR PLANT BREEDING LAB	1	II
19.	BIOT 476 STEM CELL BIOLOGY LAB	1	II
20.	BIOT 477 PLANT BIOTECHNOLOGY	3	II
21.	BIOT 478 BIOPROCESS TECHNOLOGY	3	II
22.	BIOT 479 BIOPROCESS TECHNOLOGY LAB	1	II
23.	BIOT 480 MICROBIAL BIOTECHNOLOGY LAB	1	II
24.	BIOT 481 ANIMAL BIOTECHNOLOGY LAB	1	II
25.	BIOT 482 MICROBIAL BIOTECHNOLOGY	3	II
26.	BIOT 484 ANIMAL BIOTECHNOLOGY	3	II
27.	BIOT 501 APPLIED MICROBIOLOGY	3	III
28.	BIOT 552 APPLIED MICROBIOLOGY LAB	1	III
29.	BIOT 511 RECOMBINANT DNA TECHNOLOGY	3	III
30.	BIOT 514 MARINE BIOTECHNOLOGY	3	III
31.	BIOT 561 RECOMBINANT DNA TECHNOLOGY LAB	1	III
32.	BIOT 564 MARINE BIOTECHNOLOGY LAB	1	III
33.	BIOT 566 MEDICAL BIOTECHNOLOGY LAB	1	III
34.	BIOT 575 RADIATION BIOLOGY LAB	1	III
35.	BIOT 574 PROTEOMICS AND GENOMICS LAB	1	III
36.	BIOT 597 CREDIT SEMINAR	1	III
37.	BIOT 598 PROJECT	2	III
38.	BIOT 521 RADIATION BIOLOGY	3	III
39.	BIOT 523 MEDICAL BIOTECHNOLOGY	3	III
40.	BIOT 524 PROTEOMICS AND GENOMICS	3	III
41.	BIOT 525 PHARMACEUTICAL BIOTECHNOLOGY	3	IV
42.	BIOT 526 NANOBIOTECHNOLOGY	3	IV
43.	BIOT 577 NANOBIOTECHNOLOGY LAB	1	IV
44.	BIOT 599 PROJECT	4	IV

Internal test I - IIIrd week of August, February
Internal test II - IIIrd week of September, March
Internal test III - IIIrd week of October, April

M.Sc. Biotechnology – SEMESTER I

COURSES	CREDIT
HARD CORE	
BIOT 411 CELL BIOLOGY	3
BIOT 413 MICROBIOLOGY	3
BIOT 415 TECHNIQUES IN BIOTECHNOLOGY	3
BIOT 461 CELL BIOLOGY LAB	1
BIOT 462 IMMUNOLOGY LAB	1
BIOT 463 MICROBIOLOGY LAB	1
BIOT 464 BIOCHEMISTRY LAB	1
BIOT 465 TECHNIQUES IN BIOTECHNOLOGY LAB	1
SOFT CORE	
BIOT 412 IMMUNOLOGY	3
BIOT 414 BIOCHEMISTRY	3
BIOT 422 MOLECULAR PLANT-MICROBE INTERACTION	3

M.Sc. Biotechnology – SEMESTER II

COURSES	CREDIT
HARD CORE	
BIOT 421 MOLECULAR GENETICS	3
BIOT 424 IMMUNOTECHNOLOGY	3
BIOT 425 MOLECULAR PLANT BREEDING	3
BIOT 471 MOLECULAR GENETICS LAB	1
BIOT 474 IMMUNOTECHNOLOGY LAB	1
BIOT 475 MOLECULAR PLANT BREEDING LAB	1
BIOT 476 STEM CELL BIOLOGY LAB	1
BIOT 477 PLANT BIOTECHNOLOGY	3
BIOT 478 BIOPROCESS TECHNOLOGY	3
BIOT 479 BIOPROCESS TECHNOLOGY LAB	1
BIOT 480 MICROBIAL BIOTECHNOLOGY LAB	1
BIOT 481 ANIMAL BIOTECHNOLOGY LAB	1
SOFT CORE	
BIOT 426 STEM CELL BIOLOGY	3
BIOT 482 MICROBIAL BIOTECHNOLOGY	3
BIOT 484 ANIMAL BIOTECHNOLOGY	3

M.Sc. Biotechnology – SEMESTER III

COURSES	CREDIT
HARD CORE	
BIOT 501 APPLIED MICROBIOLOGY	3
BIOT 552 APPLIED MICROBIOLOGY LAB	1
BIOT 511 RECOMBINANT DNA TECHNOLOGY	3
BIOT 514 MARINE BIOTECHNOLOGY	3
BIOT 561 RECOMBINANT DNA TECHNOLOGY LAB	1
BIOT 564 MARINE BIOTECHNOLOGY LAB	1
BIOT 566 MEDICAL BIOTECHNOLOGY LAB	1
BIOT 575 RADIATION BIOLOGY LAB	1
BIOT 574 PROTEOMICS AND GENOMICS LAB	1
BIOT 597 CREDIT SEMINAR	1
BIOT 598 PROJECT	2
SOFT CORE	
BIOT 521 RADIATION BIOLOGY	3
BIOT 523 MEDICAL BIOTECHNOLOGY	3
BIOT 524 PROTEOMICS AND GENOMICS	3

M.Sc. Biotechnology – SEMESTER IV

COURSES	CREDIT
HARD CORE	
BIOT 599 PROJECT	4
BIOT 577 NANOBIOTECHNOLOGY LAB	1
SOFT CORE	
BIOT 525 PHARMACEUTICAL BIOTECHNOLOGY	3
BIOT 526 NANOBIOTECHNOLOGY	3

BIOT- 411 **CELL BIOLOGY** **CREDIT- 3**

UNIT I **12h**

Basic properties of cell, Different classes of cell: Prokaryotic, animal and plant cell, their characteristics, cell wall, composition, function of bacterial cell wall. Plasma membrane, structure, function, fluid mosaic model, membranes, lipids and proteins transport across the membranes- passive, active; phagocytosis, endocytosis, role of clatherin coated vesicles.

UNIT II **10h**

Endoplasmic reticulum, golgi complex- exocytosis; Lysosomes: phagocytosis, endocytosis; Plant cell vacuoles; Structure of mitochondria and organization of respiratory chain; Structure of chloroplast and photophosphorylation; Structure of nucleus, nucleolus, nuclear membrane, transport across nuclear membrane.

UNIT III **8h**

Molecular aspects of cell division and cell cycle, Regulation of cell cycle events, apoptosis, necrosis.

UNIT IV **8h**

Water, inorganic, organic constituents of cell, minerals, polysaccharides, proteins lipids, nucleic acids, vitamins, enzymes.

UNIT V **10h**

Extracellular matrix, collagen, proteoglycans, fibronectin, laminins, integrins, selectin, cadherins, role of tight junctions and gap junctions, Role of G- proteins coupled receptors, cAMP, Tyrosine kinase in cell signal transductions.

TEXT BOOKS

1. Lodish, HF. et al., Cell and Molecular Biology, Sixth edition W.H. Freeman & Co Ltd, USA, 2010.
2. Cooper GM. Cell: a Molecular Approach, Fifth edition , ASM and Sinauer Associates, USA, 2011.

REFERENCES

1. Krebs JE et al. Lewin's Gene X, Tenth edition, Jones & Bartlett Publishers, 2009.
2. Voet D, Voet JG. Biochemistry, Biomolecules. 3rd Edition, John Wiley & Sons, 2004.

BIOT- 413 **MICROBIOLOGY** **CREDIT - 3**

UNIT I **10h**

Introduction to microbiology: scope, relevance, discovery and origin of microbial world, theories-spontaneous generation, germ theory of diseases. Interaction of light with objects. Microscopy and applications. Types of microscopy, Bright field, Dark field, Fluorescence, Phase-contrast and Electron Microscopy.

UNIT II **10h**

Eukaryotes: Cell structure and function; Cell wall, cell membrane, endoplasmic reticulum, Mitochondria, Golgi complex, Lysosomes, Peroxisomes, chloroplast and nucleus. Prokaryotes: Cell structure and function; pili, flagella, capsule, cell wall, plasma membrane, mesosomes, endoplasmic reticulum.

UNIT III **10h**

Microbial diversity: Diversity and distribution of microbes. Classification of bacteria and fungi. General characteristics of virus, life cycle and classification of viruses.

UNIT IV **8h**

Microbial nutrition : Heterotrophs, autotrophs; uptake of nutrients, Enrichment culture technique. Transformation of elements: Carbon, Nitrogen, Phosphorous and Sulphur.

UNIT V **10h**

Microbial growth: Kinetics of growth; Batch culture, continuous culture, synchronous culture. Effect of temperature, pH, osmotic pressure, hydrostatic pressure and radiation on microbial growth.

TEXT BOOKS

1. Strelkauskas A, Strelkauskas J, Moszyk-Strelkauskas D. Microbiology: A Clinical Approach Taylor & Francis Publication, 2009.
2. Prescott LM. Prescott, Harley and Klein's Microbiology. Sixth Edition, McGraw-Hill Publications, 2007.
3. Tortora GJ, Funke BR, Case CL. Microbiology: An introduction 8th Edition. San Francisco: Pearson Publishers, 2004.
4. Purohit, SS. Microbiology Fundamentals and applications. Oscar Publications, 2003.

REFERENCES

1. Madigan MT, Martinko, JM, Parker J. Brock Biology of Microorganisms. 10th Edition, Prentice-Hall Publishers, 2003.
2. Alcamo IE., Fundamentals of Microbiology, 6th Edition. Benjamin Cummings Publishing Company, Inc., 2001.

BIOT-415 TECHNIQUES IN BIOTECHNOLOGY CREDIT-3

UNIT I **10h**

Acid, base, buffers: Definition and theories proposed for acids and bases, titration curves of amino acids, Henderson Hasselbalch equation and its application. Determination of pH by hydrogen electrode and glass electrode. Colloidal state and its membrane, definition of colloids, types of colloids, properties of colloids.

UNIT II **8h**

Calorimetry: Principle, Beer and Lamberts, description of the instrument and techniques. Spectrophotometry: Principle and description of the instrument.

UNIT III **10h**

Centrifugation: Principle, types of centrifugation, description of the analytical and ultracentrifuge. Determination of molecular weight by sedimentation velocity method, separation of cell organelles.

UNIT IV **10h**

Electrophoresis: Principle, types of electrophoresis, separation of serum proteins, DNA fragments by (i) moving boundary electrophoresis, (ii) paper electrophoresis, (iii) starch gel electrophoresis, (iv)agar gel electrophoresis, (v) Ag-Ab reaction – Immunoelectrophoresis.

UNIT V **10h**

Chromatography: Principle, types of chromatography: (i) Paper chromatography – separation of amino acids by ascending chromatography, (ii) Adsorption chromatography: Principle and separation of phospholipids, (iii) Ion-exchange chromatography: Principle, different types of resins and separation of amino acids. Affinity chromatography: Principle and separation of enzymes. (iv) Gel filtration chromatography: Principle, estimation of molecular size and weight of biological macromolecules.

TEXT BOOKS

1. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology Cambridge University Press. 2010.

2. Morris and Morris Separation methods in Biochemistry. Pitman London, 1960.

REFERENCES

1. Brawer, I M., Perce, A.M., Experimental techniques in Biochemistry. Prentice Hall Foundation, New York, 1974.

BIOT 461 **CELL BIOLOGY LAB** **CREDIT-1**

16h

1. Osmofragility of RBC and isolation of plasma membrane from erythrocyte
2. Chloroplast isolation from mung beans leaves
3. Extraction and estimation of chlorophyll
4. Extraction of Acid phosphatase from potato to study the effect of pH, temperature,
5. Effect of substrate concentration and inhibitor on on the efficiency of the enzyme.
6. Extraction of tyrosinase from potato
7. Preparation of Competent cell by calcium chloride method and checking its efficiency
8. Preparation of slides from onion root tip for mitosis

BIOT - 462 **IMMUNOLOGY LAB** **CREDIT-1**

16h

1. Immunization and generation of Anti-sera in rabbit against antigen
2. Separation of immunoglobulin G fractions using affinity chromatography
3. Single Diffusion methods of Immunoelectrophoresis
4. Double diffusion method of Immunoelectrophoresis
5. Rocket electrophoresis
6. Titer value determination
7. ELISA for detection of Antigens/Antibodies and Sandwich ELISA
8. Blood group mapping

BIOT- 463 **MICROBIOLOGY LAB** **CREDIT - 1**

16h

1. Microbial isolation techniques. Isolation of bacteria and fungi
2. Establishment of pure cultures - streak, pour and spread plating techniques
3. Identification of microbes. Simple, differential, negative, spore staining methods.
4. Establishment of bacterial growth curve
5. In vitro antibiosis tests
6. Screening of microbes for the production of enzymes and hormones- chitinase, protease, lipase, cellulase, amylase, HCN and IAA.
7. Biochemical and genetic fingerprinting of microbes and Phylogenetic analysis of microbes
8. Microbial preservation techniques- patch plate, slant, water stock, glycerol stock and lyophilisation.

BIOT – 464 **BIOCHEMISTRY LAB** **CREDIT – 1**

1. Laboratory safety guidelines and good laboratory practices.
2. Isolation of Carbohydrates, Protein, Lipids & Nucleic Acids from selective tissues (plant & animals).
3. Estimation of protein
4. Estimation of glucose
5. Estimation of cholesterol
6. Estimation of DNA/RNA
7. Enzyme assay of salivary amylase/LDH
8. Measurement of enzyme activity - Effect of pH, temperature and substrate.
9. Estimation of Vitamins- Vitamin C/Vitamin E.

BIOT-465 TECHNIQUES IN BIOTECHNOLOGY LAB CREDIT- 1

16h

1. Buffers Preparations
2. Spectrophotometry: Visible and UV spectrophotometry
3. Centrifugation: High speed centrifugation, density gradient centrifugation
4. Chromatography Ion – exchange, Adsorption & Gel filtration.
5. Electrophoresis: Agarose and SDS - PAGE
6. FTIR, ESR & NMR
7. Biological applications of radioisotopes: ^{3}H labeling of liver tissue
8. Polymerase Chain Reaction.

BIOT 412 IMMUNOLOGY CREDIT-3

UNIT I **10h**

Introduction to the study of Immunology: Historic perspective, Overview and Concepts, Mile stones in immunology, Discovery of humoral and cellular immunity, Functions of humoral and Cell- Mediated Immune responses

UNIT II **8h**

Components of immunity, Innate and Adaptive immunity, Cells and Tissues of the Immune System: Lymphoid organs, lymphoid cells and other cells involved in immunological responses

UNIT III **10h**

Antigens and Immunogenicity. Nature of Antigens and antibodies. Major histocompatibility antigens. Theories of Antibody formation. Antibody structure, structural basis of Antibody diversity; Immunoglobulins as Antigens, Properties of Immunoglobulins, subtypes

UNIT IV **10 h**

Antigen - Antibody Reaction, Strength of Antigen and Antibody reaction, Cross reactivity, B-cell generation, activation and differentiation. Antibody production, Regulation and Diversity. Precipitation and Agglutination reactions, Immunoelectrophoresis, Radioimmunoassay and ELISA.

UNIT V **10h**

Complement and its role in Immune Responses. Cellular Immunity, Immune tolerance and suppression, Hypersensitivity Reactions, Types of Hypersensitivity, Autoimmunity, Immunization principles and Immune deficiencies.

TEXT BOOKS

1. Tizard, Ian R. Immunology an introduction, Fourth Ed, Saunders college publishing, New Delhi, 2010 Coico R, Sunshine G. Immunology: A short course, Sixth Edition, Wiley-Blackwell publishers, Canada 2009.
2. Coleman, Lombard and Sicard. Fundamental Immunology, McGraw-Hill Science publishers 1999. Kindt TJ, Goldsby RA, Osborne BA. Kuby Immunology, Sixth Ed, W.H. Freeman and company, New York, 2007.
3. Delves PJ, Martin SJ, Burton DR, Roitt IM. Essential immunology, Twelfth Edition, Wiley-Blackwell publishers, USA, 2011.

REFERENCES

1. Elgert KD. Immunology: Understanding the immune system, Wiley-Blackwell publishers, Canada, 2009.
2. Hudson, L. and Hay, F.C. Practical Immunology, Black Well publishers 1989.
3. Dixon, F.J. Advances in Immunology, Academic Press 1986.

BIOT – 414 **BIOCHEMISTRY** **CREDIT-3**

UNIT I **7h**

Historical Basis and overview of Biochemistry, Biochemical basis of life, Biomolecules-Classification, Structure, Function and Significance of macromolecules – Carbohydrates, Proteins, Lipids and Nucleic Acids.

UNIT II **8h**

Enzymes- Nomenclature and classification of enzymes- protein & non-protein enzymes (ribozymes, DNAzymes); Mechanisms of enzyme action- specificity of enzyme action, single and multienzymes, isoenzymes, coenzymes and cofactors; Factors affecting enzyme activity-Michaelis Menten Equation, Lineweaver Burk Equation; Enzyme kinetics- single and multisubstrates; Enzyme inhibition- competitive, noncompetitive, uncompetitive and allosteric inhibition; Enzyme Regulation; Biological role of enzymes.

UNIT III **8h**

Introduction to Metabolism- Anabolic and catobolic reactions, Integrated approach to metabolism; Metabolism of Carbohydrates, glycogen & starch – Glycolysis and gluconeogenesis, Energetics and ATP production, glucose homeostasis and its regulation. TCA cycle and its regulation, its role in energy generation and biosynthetic intermediates, HMP pathway and its significance. Synthesis and breakdown of glycogen and its regulation. Metabolic disorders associated with carbohydrate metabolism

UNIT IV **8h**

Lipid Metabolism- Metabolism of Fatty acids - α, β, ω oxidation, fatty acid biosynthesis, saturated and unsaturated, endogenous synthesis of triacylglycerols, phospholipids, cerebrosides, gangliosides. Synthesis and degradation of cholesterol. Transport and storage of cholesterol. Arachidonic acid metabolism-Significance and synthesis of prostaglandins, leucotrienes and thromboxanes. Metabolic disorders associated with lipid metabolism

UNIT V **9h**

Metabolism of proteins and nucleic acids- disposal of ammonia, urea cycle, non protein amino acids and amines and their role in cell function; Metabolism of essential and non-essential animoacids; Purine and Pyrimidine biosynthesis and degradation, salvage pathways, regulation. Metabolic disorders associated with aminoacid and nucleotide metabolism.

TEXT BOOKS:

1. Lehninger's Principles of Biochemistry by David L. Nelson and Michael M. Cox, Macmillan worth publisher, 6th Edition 2013.
2. Murray, R.K., Granner, B.K., Mayes. P.A., Rodwell, V.W., Harper's Biochemistry Prentice Hall International, 29th edition, 2012.

REFERENCES:

1. Voet and Voet's Biochemistry, D.Voet and J.Voet 4th edition, 2011, John Wiley and Sons Inc., 2005.
2. Biochemistry 6th edition by Jeremy M Berg, Lubert Stryer, John L.Tymoczko, 2010

BIOT- 422 MOLECULAR PLANT-MICROBE INTERACTION CREDIT -3

UNIT I **10h**

Introduction to Molecular Plant Pathology-Concepts and Definitions.An over view of plant-pathogen interaction. Molecular Biology of disease resistance. Plant chemicals involved in resistance.Gene-for-gene interaction-Resistance genes-Avirulence genes. Systemic Aquired Resistance (SAR). SAR-maker proteins. Biosynthesis and mode of action of Salicylic acid.

UNIT II **10h**

Defense related pathways. Octodecanoid pathway. Lipoxygenase pathway, Shikimic Acid pathway, Cyanogenesis, Anthocyanin biosynthetic pathway, Hypersensitive Reaction, Reactive Oxygen species and their role in resistance. Pathogenesis Related (PR) proteins. Resistance gene dependent plant defense. Role of sinapoyl CoA and feruloyl CoA in resistance.

UNIT III **10h**

Pathogen and Diversity: Bacteria, Fungi, Viruses and Nematodes. Baterial, fungal and viral diseases. Specific symptoms associated with phytopathogens. Virulence mechanisms of bacterial and fungal pathogens.

UNIT IV **10h**

Molecular Diagnosis: Molecular tools for the detection of plant pathogens. Introduction-molecular probes- different molecular methods (immunological assays and nucleic acid hybridization an amplification techniques) for the identification of pathogens. Use of PCR in the detection and characterization of phytopathogens.

UNIT V **8h**

Modern biotechnological strategies for disease management: Plant growth-promoting rhizobacteria (PGPR). Taxonomy and diversity of fluorescent pesudomonads. Mechanisms of plant growth promotion and antagonism.

TEXT BOOKS

1. Jones R, Ougham H, Thomas H, Waaland S. The Molecular Life of Plants. First Edition. Wiley-Blackwell publications, 2012.
2. Chrispeels MJ, Sadava DE. Plants, Genes and Crop Biotechnology, Second Edition, Jones and Bartlett Publishers, 2003.
3. Ronald PC. Plant- Pathogen Interactions. Methods and Protocols. Humana Press, 2007.
4. Gurr SJ, Mcpherson MJ, Bowles DJ. Molecular Plant Pathology. Oxford University Press, 1998.

REFERENCES

1. Prell HH. Plant fungal pathogen interactions. Springer Publications, New York, 2001.
2. The Plant Cell (Special Edition: Plant Microbe Interaction) Vol.8, 1996.
3. Singh RP and. Singh US. Molecular methods in Plant Pathology; Boca Raton, Fla. Lewis Publishers, 1995.
4. Marshell G and Walters D. Molecular Biology in Crop Protection. Kluwer Academic Publishers, 1994.

BIOT – 421 MOLECULAR GENETICS CREDIT- 3

UNIT I **10h**

Experimental evidences for DNA as the genetic material. Molecular nature of the gene. Organisation of Prokaryotic and Eukaryotic genome, Non-Mendelian inheritance, Sex linked inheritance.

UNIT II **10h**

DNA Replication: conservative, semi conservative, rolling circle, Cairn's model of replication. Mechanism of replication: Okazaki fragments, role of different enzymes and accessory proteins. Specific examples of replication – single stranded phage, double stranded, SV40, ØX174.

UNIT III **10h**

Mutation and Mutagenesis: Types of mutations- Induced mutations, Reverse mutations, suppressor mutations, spontaneous mutations. Chemical mutagens – nitrous acid, hydroxylamine, alkylating agents, intercalaters. Physical mutation by radiations. Mechanism of DNA repair process: Photo reactivation, excision repair, recombinational repair, SOS repair.

UNIT IV **10h**

Genetics of Bacteria and viruses: Transformation, Conjugation, F+, Hfr, Transduction-generalized and specialized. Gene Expression: DNA transcription in prokaryotic and eukaryotic systems, Types of RNA and their functions, Role of RNA polymerases and other factors involved in transcription machinery, molecular mechanism of translation, post translational modifications.

UNIT V **8h**

Regulation of gene expression: operon concept, regulatory gene, operator an promoter regions, lac and trp operons as examples for inducible and repressible operons, effect of glucose, CAP, cAMP.

TEXT BOOKS

1. Stickberger MW et al. Genetics, 2008, Third edition, Macmillan and Company.
2. Tropp BE. Freidfelder's Molecular Biology. Molecular Biology, Genes to Proteins. Fourth Edition, Jones & Bartlett Pub, 2012.

REFERENCE BOOKS

1. Watson JD et al. Molecular Biology of the Gene, Sixth edition, Benjamin Cummings. 2007.
2. Krebs JE et al. Lewin's Gene X, Tenth edition, Jones & Bartlett Publishers, 2009
3. Basic Genetics by Daniel L. Hartl, David Freifelder, Leon A. Snyder Jones & Bartlett Pub. 1988.
4. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A., and A.M. Weiner. Molecular Biology of the Gene, Volume I & II (4th Edition). Benjamin Cummings Publications, 1987.

BIOT - 424 IMMUNOTECHNOLOGY CREDITS-3

UNIT I **10h**

Introduction Scope of Immunotechnology, Preparation and purification of Antigens, Extraction of antigens from pathogens, parasites and other biological materials. Antigen fractionation and purification. Preparation of synthetic antigens, Recombinant antigens

UNIT II

8h

Production, purification and characterization of antibodies. Different kinds of Immunization procedures. Purification of Immunoglobulins, Characterization of Immunoglobulins

UNIT III **10h**

Hybridoma and monoclonal antibody (MAb) techniques, Production of murine hybridoma, Production of MAbs in cultures and animal (Ascites), Purification of MCAbs. Characterization of MAbs/ and Labelling of antibodies

UNIT IV **10h**

Cellular immunological methods, Markers of immunocompetant cells, Separation and purification of immunocompetant cells. Flow cytometry and FACS, Functional tests for immunocompetant cells and Histocompatibility testing

UNIT V **10h**

Immunological assays - Agglutination tests, Complement fixation tests, In vivo tests/, Neutralization tests, Radioimmunoassays, Enzyme immunoassays, Immunoblotting, Immunohistochemistry and immunohistopathology and Immunofluorescenece techniques

TEXT BOOKS

1. Hannigan BM, Moore CBT, Quinn DG. Immunology, Second edition, Viva books Publishers, New Delhi, 2010.
2. Chakrawarty AK. Immunology and Immunotechnology. Second edition, Oxford University press. India, 2008.
3. Kindt TJ, Goldsby RA, Osborne BA. Kuby Immunology, Sixth Ed, W.H. Freeman and company, New York, 2007.
4. Pandian MR, Senthil Kumar B. Immunology and Immunotechnology, First Edition, Panima Publishers, New Delhi, 2007.
5. Weir DM, Herzenberg LA, and Blackwell C. Handbook of Experimental Immunology, Black well Science Oxford 1989.

REFERENCES

1. Benny K. C. Lo Editor. Antibody Engineering: Methods and Protocols (Methods in Molecular Biology) Humana Press, 2003.
2. Rose et al., Manual of Clinical laboratory Immunology, 6th Ed ASM Publications, 2002.

BIOT -425 MOLECULAR PLANT BREEDING CREDIT- 3

UNIT I **10h**

Plant breeding- History; Genetic resources- centres of diversity and origin of crop plants, Law of homologous variation, genetics resources

UNIT II **10h**

Mode of reproduction in plant: Principles and methods of breeding self, cross pollinated and vegetatively propagated plants, Heterosis breeding, Polyploidy and haploids in breeding, Wide hybridization, Mutation breeding, Breeding crops to contain useful and adaptive traits; seed production and variety development and its conservation.

UNIT III **8h**

Plant genome mapping: Types of mapping population; RFLP and AFLP mapping. Marker assisted breeding using RFLP, AFLP, RAPD, SNP and CAPS marker.

UNIT IV **10h**

Plant tissue culture and somatic cell genetics – role of growth regulators, Micropropagation, Germplasm storage *in vitro*; Embryo rescue, Haploids and triploids, Secondary products, Protoplast culture and fusion, Cybrids, Somaclonal variation, Mutant selection *in vitro* and by transposon tagging.

UNIT V **10h**

Plant genetic engineering using recombinant DNA techniques: Genetic engineering for abiotic stress, quality improvement; Strategies for Marker Gene Removal from Transgenic plants; Transgene silencing, Strategies to avoid gene silencing and improve gene expression in transgenic plants, Description and uses of antisence RNA, ribozymes in plants; Ethics and plant genetic engineering.

TEXT BOOKS

1. Acquaah, G. Principles of Plant Genetics and Breeding, John Wiley sons, 2012.
2. Bhojwani SS, Razdan MK. Plant Tissue culture. Theory and Practice. Elsevier B. V. Publications, 2009.
3. Sleper, DA and Poehlman, JM. Breeding field crops, Wiley-Blackwell, NJ. 2006

REFERENCES

1. Sambrook, J and Russell, D, Molecular Cloning: A Laboratory Manual, Third Edition, Cold Spring Harbor Laboratory Press, NY, 2001
2. Allard RW, Principles of Plant Breeding. 2nd Edition, John Wiley & Sons, NJ, 1999.

BIOT- 426 **STEM CELL BIOLOGY** **CREDIT – 3**

UNIT I **10h**

Introduction to stem cells – Definition, History, Types and Sources of stem cells. Capacity of stem cells- Totipotent, Pluripotent, Multipotent, Unipotent. Embryonic stem cells and Adult Stem cells- Mesenchymal stem cell, Neuronal stem cell, Gut Epithelial Stem cells, Hematopoietic stem cells; Bone marrow, Peripheral blood and Cord blood stem cells, Cancer stem cells. Stem cell niche/microenvironment. Stem cell cryopreservation.

UNIT II **10h**

Properties- Self-renewal and Differentiation. Regulation of stem cell: Cell cycle regulation, Gene expression, Chromatin modifications, Epigenetic regulation (DNA and Histone Methylation and Histone Acetylation, etc.), and miRNA roles. Cross talk between miRNAs and epigenetic regulators during stem cell differentiation.

UNIT III **10h**

Identification of stem cell using specific markers. Isolation of stem cells -Fluorescence based cell sorting. Culture and genetic manipulation of stem cells. Expansion of stem cells using molecular and biochemical approaches. Cloning and nuclear transfer technology. Genetic reprogramming and Induced Pluripotent Cells (iPCs). *In vitro* functional assays- Cobblestone Area-Forming Cell (CAFC), Colony Forming Cell (CFC), *In vivo* serial transplantation assay.

UNIT IV **10h**

Stem cells and aging. Correlation between stem cells and cancer stem cells, Clinical applications of stem cells. Stem cell therapy and Regenerative medicine. Bone marrow and cord blood stem cell transplantation. Repair of damaged tissues and organs. Use of stem cells in heart and retinal diseases. Stem cell transplantation. Future prospects of stem cells.

UNIT V **8h**

Ethical issues associated with stem cell research. Implication of human embryonic stem cell research, societal implications: religious vs. scientific views. Ethical guidelines for stem cell research (National & International).

TEXT BOOK

1. Yanhong Shi, Dennis O.Clegg. Stem Cell Research and Therapeutics. Springer edition. 2010.
2. C. S. Potten. Stem Cells. Academic Press. 2008.

REFERENCES

1. Julie Audet, William L. Stanford. Stem Cells in Regenerative Medicine. Methods and protocols. (Springer edition). 2009.
2. Robert Lanza, Irina Klimanskaya. Essential Stem Cell Methods. (Elsevier- First edition). 2009.

BIOT – 471 MOLECULAR GENETICS LAB CREDIT- 1

16h

1. UV mutagenesis and percent survival and Photoreactivation of UV irradiated *E. coli.*
2. Development of auxotrophic mutants employing EMS
3. Screening of multiple antibiotic resistant mutants of E. coli
4. Plasmid curing in bacteria
5. Replica plating technique
6. Determination of purity and estimation of DNA
7. Transfection by single burst experiment
8. Blue and white colony selection employing X-gal-IPTG

BIOT 474 IMMUNOTECHNOLOGY LAB CREDIT-1

16h

1. Preparation of antigens from pathogens and parasites.
2. Slide and Tube agglutination reaction.
3. Immunofluorescence technique.
4. Culturing of Leucocytes.
5. SDS-PAGE and Immunoblotting.
6. Rapid detection of HBV/ HCV candidate antigens and Diagnostic PCR.
7. Separation of CD cells using Flow cytometry.
8. Isolation and identification of lymphocytes.

BIOT- 475 MOLECULAR PLANT BREEDING LAB CREDIT- 1

16hr

1. General Breeding Techniques: Emasculation, pollination and tagging.
2. Selection of parents for wide hybridization and embryo rescue.
3. Tissue culture techniques: Preparation of various tissue culture media.
4. Tissue culture of various explants.
5. Isolation and culture of protoplasts and microspores.
6. Application of RFLP technique in plant breeding.
7. Demonstration of AFLP technique in plant breeding.
8. Detection of multiple genes by employing SNP primers.

BIOT- 476 **STEM CELL BIOLOGY LAB** **CREDIT – 1**

1. Isolation of mononuclear cells from blood sample.
2. Isolation of Hematopoietic stem cells (CD34+) from peripheral and cord blood.
3. Isolation of Mesenchymal stem cell from cord blood.
4. Identification of CD34+ cells using Fluorescence Activated Cell Sorter.
5. Maintenance of Hematopoietic stem cells.
6. Culture of hematopoietic CD34+ cells.
7. Nuclear transfection of CD34+ cells.
8. Functional assays of Hematopoietic stem cells (CAFC & CFC).

BIOT- 477 **PLANT BIOTECHNOLOGY** **CREDIT-3**

UNIT I **10h**

Genome organization and protein targeting: General organization of nuclear, mitochondrial and chloroplast gene. Targeting of proteins synthesized in cytoplasm to chloroplast, mitochondria and within the endomembrane system of plants.

UNIT II **10h**

Structure and expression of gene: Tissue specific genes, structure and organization of nuclear genes concerning storage proteins, phytochrome, microbial infection and other stresses. Maize transposable elements, organization and function of transposons.

UNIT III **10h**

Development of plant transformation cassettes: Structure and function of Ti plasmid of *Agrobacterium*, Mechanism of T-DNA transfer to plants. Ti plasmid vectors for plant transformation. Promoter and marker genes in plant transformation. Criticisms regarding the use of different promoters and markers.

UNIT IV **10h**

Gene transfer and tissue culture techniques: Physical, chemical and biological methods for plant gene transfer. Shoot-tip culture, Rapid clonal propagation, somoclonal variation and synthetic or artificial seeds, cytoplasmic male sterility.

UNIT V **8h**

Transgenic plants for virus resistance, herbicide tolerance, delay of fruit ripening, resistance to insect, fungi and bacteria. Production of antibodies, viral antigens and peptide hormones in plants.

TEXT BOOKS

1. Pierce, Benjamin A. Genetics / Conceptual approach. 4th ed. New york, W.H. Freemam & Company, 2012.
2. Jones R, Ougham H, Thomas H, Waaland S. The Molecular Life of Plants. First Edition. Wiley-Blackwell publications, 2012.
3. Hughes MA. Harlow. Plant Molecular Genetics. Addison Wesley Longman, England 1996.
4. Kirsi-Marja, Wolfgang Barz. Marcel Dekker., Eds., Plant Biotechnology and Transgenic Plants. 2002.

REFERENCES

1. Stewart CN Jr. Plant Biotechnology and Genetics: Principles, Techniques and Applications. First edition, Wiley-Interscience, 2008.
2. Lea, PJ, Leegood, RC., Eds. Plant Biochemistry and Molecular Biology, John-Wiley and Sons, Chichester and New York, 1993.
3. Trigiano RN, Gray DJ., Eds. Plant Development and Biotechnology. CRC press, 2004.

BIOT-478 BIOPROCESS TECHNOLOGY CREDIT- 3

UNIT I **10h**

Types, cells, production strains, preservation- history, industrial applications, chemical technology vis a vis biotechnology, commercial evolution, potential

UNIT II **10h**

Mechanism of enzyme reactions, Michaelis Menten kinetics, inhibition, factors affecting rate, parameter estimations, growth characteristics of microbial cells, Monod model, batch culture.

UNIT III **10h**

Agitation and mixing, transport in cells, transfer resistances, mass transfer coefficients, enhancement of oxygen transfer, heat transfer correlations, batch and continuous sterilization

UNIT IV **10h**

Ideal bioreactors, Batch, fed batch, CSTR, PFR, Multiphase bioreactors, packed bed, bubble column fluidized trickle bed, immobilization. Aseptic, septic and anaerobic fermentors.

UNIT V **8h**

Filteration, centrifugation, sedimentation, extraction, sorption, reverse osmosis, ultrafilteration, electrophoresis, waste water treatment.

TEXT BOOKS

1. Shuler M, Kargi F. Bioprocess Engineering. Prentice Hall (I) Ltd, Publishers, New Delhi, India, 2002.
2. Doran PM. Bioprocess Engineering Principles, Academic Press, 2012.

REFERENCES

1. Bailey JE, Ollis DF. Biochemical Engineering Fundamentals, Second Edition, McGraw-Hill Publication Company, 1986.

BIOT 479 BIOPROCESS TECHNOLOGY LAB CREDIT-1

1. Laboratory fermentor sterilization and operations
2. Isolation of beneficial bacteria and establishment of pure culture
3. Optimisation of growth of isolate using batch culture
4. Immobilisation of isolate using alginate and acrylamide method.
5. Standardisation of conditions for upscaling of culture using fermentor
6. Effective sterilisation of media in fermentor and upscaling of isolate culture.
7. Sterilization and safe disposal of culture
8. Determination of COD
9. Effective filter sterilisation of solution in lab conditions.
10. Visit to fermentation industry.

BIOT -480 MICROBIAL BIOTECHNOLOGY LAB CREDIT - 1

16h

1. Production of *Taq* polymerase using recombinant *E. coli.*
2. Mushroom cultivation.
3. Different methods of antimicrobial susceptibility testing.
4. Isolation of antagonistic bacteria for growth suppression of pathogens.
5. Detection of antimicrobial phenazines and phloroglucinols genes by PCR.
6. Microbial bioconversion of agricultural wastes using bacteria and fungi.
7. Microbial dégradation agricultural pollutants, fungicides and insecticides.
8. Cultivation and mass multiplication of azolla and Microbial degradation of hydrocarbons.

BIOT - 481 ANIMAL BIOTECHNOLOGY LAB CREDIT – 1

16h

1. Animal Cell Culture.
2. Silk worm rearing.-Protein profile of silk gland and haemolymph of larval forms of Silk worm.
3. Morphology of male gametes of different animals-bull, goat and sheep.
4. Cryopreservation of gametes of bull.
5. Invitro fertilization of fish and frog.
6. Gene transfer in animal cells –Electroporation.
7. Biopesticide effect on Mosquitoes and caterpillar larvae.
8. PCR detection of disease of animals-blue tongue disease in cattle.
9. Immunization and generation of Anti-sera in rabbit against bacterial antigen.
10. RFLP in cattle, goat, sheep and cat.

BIOT -482 MICROBIAL BIOTECHNOLOGY CREDIT - 3

UNIT I **10h**

General concepts of microbial biotechnology. Microorganisms as factories for the production of novel compounds. Genetic engineering of microbes to improve production of antibiotics, amino acids, lipids, enzymes, steroids and secondary metabolites. Biopolymers and bioplastics

UNIT II **10h**

Definition, Concepts- history, biotechnological potentials of microalgae – food – feed – colourant – fuel and pharmaceutically valuable compounds. Cultivation methods of algae with reference to *Dunaliella* and *Phormidium valderianum.* Production of microbial biofertilizers – cyanobacteria, *Rhizobium, Azotobacter, Azospirillum, Phosphobacteria* and VAM.

UNIT III **10h**

Biological pest control, scheme for selection of microbial antagonist for biological control of insects, bacterial, fungal and viral diseases. Mode of action of biological control involved in different biocontrol agents. Genetics of antimicrobial metabolite production in biocontrol bacteria. Risks associated with GMOs, Potential impacts on the environment and human health.

UNIT IV **8h**

Bioconversion of cellulosic and non-cellulosic wastes. Mechanism of novel carboxylase genes involved in bioconversion. Agrobyproducts. Bioremediation of wood, fuels lubricants, rubber, plastics.

UNIT V **10h**

Waste utilization: Waste water treatment - Aerobic and Anaerobic processes, Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries. Sewage disposal, compost making, methane generation. Microbiology of degradation of xenobiotics in environment: Ecological considerations, decay behavior, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides.

TEXT BOOKS

1. Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2009.
2. Singh, BD. Biotechnology Expanding Horizons. Kalyani publishers, New Delhi., 2012.
3. Das, HK. 2010. Textbook of Biotechnology, 4th Edition Wiley- Blackwell India, 2010.
4. Glazer AN, Nikaido H. Microbial Biotechnology: Fundamentals of Applied Microbiology, 2007.

REFERENCE

1. Gerald (Ed.) Reed. Prescott and Dunn's Industrial Microbiology, Fourth Edition, CBS Publishers and Distributors, 2004.
2. Walker, JM. and Rapley R. Molecular Biology and Biotechnology 5th edition. RSC Publishing, Cambridge, U.K. 2009.
3. Saikia, R. Microbial Biotechnology. New India Publishing Agency. New Delhi. India. 2008.

BIOT- 484 ANIMAL BIOTECHNOLOGY CREDIT - 3

UNIT I **10h**

Animal Cell culture –primary and established cell line cultures, functions of different constituents of culture media, serum and protein free media and their applications, scaling up of animal cell culture, cell synchronization, cell cloning and micro manipulation. Applications of animal cell culture. Stem cell culture and their applications .Cell culture based vaccines .Organ and histotypic culture. Apoptosis.

UNIT II **10h**

Reproductive Biotechnology- cryopreservation of gametes and embryos in mammals. In- vitro fertilization, embryo splicing and embryo transfer. Production of transgenics -birds, mammals and knockout mice. Application of transgenic animals –models for diseases, oncogenes , drug screening and gene farming

UNIT III **10h**

Integrated insect pest management using biocides, hormone analogues, pheromones and genetic manipulations. Biotechnology of silk worms-Life cycle, culture of silk worm, diseases of silk worm ,improvement of silk production and quality, Biology of viral vectors-SV40,adeno virus, retro virus, vaccinia virus papiloma virus, and baculoviruses. Insect as a bioreactor.

UNIT IV **10h**

RFLP and its applications in domestic animals. Biotechnological approaches to vaccine production Development of animal vaccines for –Reinderpest, foot and mouth disease, blue tongue disease, rabbies and anthrax . Peptide vaccines, fusion protein vaccines, synthetic peptide vaccines, anti-idotype antibody vaccines. Ethical issues in animal biotechnology. Management aspects of biotechnology and genetic engineering.

UNIT V **8h**

Biotechnology in animal production-manipulation of growth using hormones and probiotics, manipulation of lactation, manipulation of wool growth in sheep and rabbits

TEXT BOOKS

1. Pörtner R. Animal Cell Biotechnology: Methods and Protocols, Second Edition, Humana Press, 2007.
2. Babink LA and Phillips JP. Animal Biotechnology, Comprehensive Biotechnology First Supplement, Pregamon press, Oxford, 1989.
3. Rossant, J. and Pederson RA. Experimental approaches to Mammalian Embryonic Development, Cambridge University Press, Cambridge, 1996.
4. Freshney RI. Animal cell culture – A practical approach. IRL press, 1992

REFERENCES

1. Freshney RI. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 6th Edition, Wiley and Blackwell publications, 2010
2. Ian Gordon. Reproductive Technologies in farm animals, First edition, CABI Inter., 2004.
3. Lewis R. Human Genetics: Concept and Applications. McGraw Hill Company. 2003.
4. Barrer JSF, Hammond K, McClintock AE. Eds., Future Developments in the Genetic Improvements of Animals. Academic Press, 1992.

BIOT -501 APPLIED MICROBIOLOGY CREDIT-3

UNIT I **10h**

History and development-Growth phase, Isolation, Preservation Screening of microbes used in Industry: Strain improvement by mutation, selection and enrichment. Bioreactors-types. Air lift, cavitator, acetator, fluid Bed reactors.

UNIT II **10h**

Production of beverage and industrial alcohols, wine, beer. Production of organic acids -lactic acid, acetone-butanol, citric acid and acetic acid. Production of microbial biomass –SCP.

UNIT III **10h**

Industrial Production of antibiotics- Penicillin, erythromycin and streptomycin; Bacterial production of enzymes-protease,cellulase,amylase. glucose isomerase, etc, Immobilization of enzymes and development of biosensors.

UNIT IV **10h**

Role of Microorganisms in cheese production –cheddar cheese, blue cheese, Swiss cheese, camembert cheese, yogurt, buttermilk , sour cream, koumiss,kefir manufacturing. Leather processing.

UNIT V **8h**

Production of therapeutic and diagnostic proteins –Interferon, somatotropin cytokines, insulin, growth factors, steroids. Microbial leaching of ores.

TEXT BOOKS

1. Gerald (Ed.) Reed. Prescott and Dunn's Industrial Microbiology, Fourth Edition, CBS Publishers and Distributors, 2004.
2. Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2009
3. Alani, DI. Murray MY. Perspectives in Biotechnology and applied Microbiology. Elsevier Publication. 1986.
4. Ketchun PA. Applied Microbiology, Microbiology- Concepts and applications. Cassida Jr. Tata McGraw hill Publications, 1994.

REFERENCES

1.Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2006

2.Staneberry et al. Fermentation Technology, 1998.

BIOT -552 APPLIED MICROBIOLOGY LAB CREDIT-1

16h

1. Estimation of Microbial biomass.
2. Red and White wine fermentation/Alcohol production from molasses using yeast.
3. Production of amylase using bacillus under submerged conditions.
4. Production of protease using Protease vulgaris under submerged conditions.
5. Production of protease using rice bran / Cottage cheese production.
6. Production of penicillin-G.
7. Mass culture of LAB in fermentor.
8. Industrial visit to brewery and distillery.

BIOT –511 RECOMBINANT DNA TECHNOLOGY CREDIT- 3

UNIT I **10h**

Vectors for cloning: Plasmids, phages, ssDNA phages, cosmids,YACs. Enzymes used in gene manipulation-restriction enzymes, DNA polymerases, reverse transcriptase, ligases, polynucleotide kinase, alkaline phosphatase and nucleases.

UNIT II **8h**

Transfer of DNA into cells: transformation, transduction, electroporation, microinjection. Agrobacterium mediated gene transfer.

UNIT III **10h**

Cloning strategies: Genomic libraries, cDNA Cloning subcloning, shot gun cloning. Cloning in *E. coli, Bacilli* and *yeast*. Yeast two hybrid system. cDNA phage display library. Recombinant clones: Detection of recombinant DNA and its Products.

UNIT IV **10h**

Site-directed mutagenesis of cloned genes. DNA sequencing: Oxy, deoxy chemical methods, Pyrosequencing, Nanosequencing. PCR: Design of PCR primers, RT-PCR, RACE, AP-PCR, PAF. Antisense and ribosome technology: siRNA, miRNA, Ras, Dicer. Applications of PCR.

UNIT V **10h**

Applications of genetic engineering in medicine, agriculture, veterinary and industry. Safety aspects of recombinant DNA technology; Intellectual property rights (IPR) and patents. DNA forensics. Somatic cell gene therapy.

TEXT BOOKS

1. Primrose SB & Twyman R. Eds. Principles of Gene Manipulation and Genomics. Seventh edition, Wiley-Blackwell; 2006.
2. Lodish H et al. Ed., Molecular Cell Biology, Sixth edition, W. H. Freeman & Co. 2007.

REFERENCE BOOKS

1. Sambrook J et al. (Eds.) Molecular Cloning: A Laboratory Manual, Fourth edition, Cold Spring Harbor Laboratory Press. 2012.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and P. Walter. Molecular Biology of the Cell, Fourth Edition. Garland & Co. 2002.

BIOT -514 MARINE BIOTECHNOLOGY CREDIT- 3

UNIT I **10 h**

Biotechnology in Marine Sciences. Aquaculture: culture of shrimp, crab, edible mollusc ,oysters and pearl oysters, Culture of milkfish, mullets and eel. Culture of live feed organisms- brine shrimp, rotifers, marine algae.

UNIT II **10 h**

Marine hydrocolloids-agar,agarose, carageenan, alginates, chitosans and chitin. Marine enzymes - Applications of enzyme for fish processing. Marine Lipids- application of lipases for modification of fats and oils. Marine flavourants. Bioconversion of organic materials and fish ensilage,

UNIT III **10h**

Aquaculture biotechnology- hormonal manipulation of sex, chromosomal manipulation of sex fish, cryopreservation of fish gametes and embryo. Diseases of cultured shrimp, fish. Diagnostics and their application to aquaculture.

UNIT IV **10h**

Production of transgenic fishes.-growth hormone, antifreeze protein, disease resistant fish, Cloning and expression of GnRH, application of hormones in induced breeding in aquaculture. Antifreeze protein and its applications.

UNIT V **8h**

Pharmaceuticals from marine realms, type of drugs and their medical applications. Biofouling and their control. Control of oil spills and bioremediation Role of halophiles.

TEXT BOOKS

1. Pillay TVR, Kutty MN. Aquaculture: Principles and Practices. 2nd Edition., John Wiley & Sons, 2005.
2. Le Gal Y, Ulber R. Marine Biotechnology I and II. illustrated edition Springer publication, 2005.
3. Zhanjiang (John) Liu. Aquaculture Genome Technologies. First Edition, Blackwell publications, 2008.
4. Dunham RA. Aquaculture and Fisheries Biotechnology – Genetic Approaches. First edition, CABI Publishing, 2004.

REFERENCES

1. Proksch P, Müller WEG. Frontiers in Marine Biotechnology. First Edition, Garland Science Taylor & Francis group publications, 2006.
2. Voigt MN, Richard Botta J., Eds. Advances in Fisheries Technology and biotechnology for increased profitability. Technomic Publishing Co. Inc.,1990
3. Colwell RR. Biotechnology in the Marine Science- Proceedings of the First Annual MIT Sea Grant Lecture and Seminar - 1982.
4. Le Gal Y and Halvorson HO. New Developments in Marine Biotechnology Plenum press 1998.

BIOT – 561 RECOMBINANT DNA TECHNOLOGY LAB CREDIT- 1

16h

1. Plasmid DNA extraction from *E. coli.*
2. Genomic DNA extraction from *Bacillus thuringiensis.*
3. Agarose gel Electrophoresis and elution of DNA.
4. Restriction mapping of genomic and plasmid DNA.
5. Preparation of competent cells.
6. $CaCl_2$ mediated transformation and electroporation.
7. SDS-PAGE analysis and Western Blot analysis.
8. Multiplex PCR for detection of cry genes in *Bacillus.*

BIOT 564 MARINE BIOTECHNOLOGY LAB CREDIT- 1

16h

1. Estimation of water quality parameters: dissolved oxygen, salinity, ammonia in sea water.
2. Antagonistic test with probiotics and fish pathogens.
3. Identification and partial characterization of fish and shrimp pathogens.
4. Ploidy detection using karyotyping.
5. PCR diagnosis of white spot syndrome virus, monodon baculovirus, hamotopoetic necrosis virus and Immunodiagnosis of fish pathogen (Western blot)
6. Enrichment of live feed organisms –Artemia, Rotifers.
7. Induction of breeding in fish using ovaprim-invitro fertilization and rearing of Fry.
8. Extraction of hydrocolloids from sea weeds/ Field visit to shrimp hatchery, farms & salt pans.

BIOT -566 MEDICAL BIOTECHNOLOGY LAB CREDITS - 1

16h

1. Identification and characterization of selected medically important pathogens – *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus pneumoniae*.
2. Culturing of single cell protein (SCP) (Spirullina).
3. Ammonium sulfate precipitation of cystic sacrosis antigen.
4. Quality control of antibodies – HPLC.
5. Role of bioinformatics in drug development.
6. Computer assisted drug designing and computer based ligand and Receptor interaction.
7. Segregation techniques used for obtaining blood products.
8. Genetic and biochemical analysis of novel molecule.

BIOT 575 RADIATION BIOLOGY LAB CREDIT- 1

16h

1. Fricke's dosimetry for calculating dose rate of gamma-rays.
2. Biophysical analysis of gamma-irradiated DNA.
3. Agarose gel electrophoresis of the gamma-irradiation of plasmid DNA.
4. Determination of death rate of gamma-irradiated of bacterial cells.
5. Identification of albino mutants consequent to gamma –irradiation of seeds.
6. Effect of electron scavengers on the post- irradiation treatment of the seeds.
7. Identification of chromosomal aberrations in root tips of rice seedlings subsequent to gamma-irradiation and comparison of Superoxide dismutase activity in gamma-irradiated rice seedlings.
8. Determination of total peroxide obtained after various treatments of gamma-irradiated seeds.

BIOT- 574 PROTEOMICS AND GENOMICS LAB CREDIT- 1

16h

1. One and two dimensional separation of protein.
2. Scanning and image analysis of 2-D gels and Spectral analysis of proteins.
3. Computer assisted demonstration of microarray technology: DNA and protein
4. Liposome preparation.
5. Identification of cystic fibrosis gene from Human genome and fatty acyl desaturase gene in *Arabidopsis* genome.
6. Characterization of the protein coded by gene sequence above (in Expt 4) using NCBI software online.
7. Primer designing methods: degenerate and general oligonucleotide primers.
8. Protein-protein interaction: immunoneutralization (Antigen-antibody precipitation).

BIOT – 521 RADIATION BIOLOGY CREDIT- 3

UNIT I **10h**

Physics of ionizing interaction:α, ß, γ, n; Free radical production, LET, absorption and dosimetry; Units of radiation measurement, radiation level and limits. Direct and indirect effects of radiations, Irradiation products of water, G-values and Fricke's dosimetry

UNIT II **10h**

Cell survival curves, Target theory, RBE, Dose response relationship models. Laws of Bergoneau and Tribondeau, Application of radiation therapy/ differential response; Mitotic cycle and radiosensetivity, Dose rate effects; fracticnation; oxygen-effect, Radioprotectors, radiation hormesis mechanism.

UNIT III **10h**

Acute radiation effects of whole body irradiation, late somatic effects; effect on immune response, LD50, radiation syndromes: bone marrow, gastrointestinal and cerebrovascular.acute radiation syndrome, Leukemia and other cancers, cataracts, life shortenings, risk estimates, oncogenes and mechanism of life shortening, Risk estimates, oncogenes and mechanism of carcinogenis, probability of causation, epidemiological populations

UNIT IV **10h**

Radiation damage to DNA, RNA and proteins. DNA strand breaks, Chromosomal aberrations. Methods of detecting damage for both ionizing and UV light. Virus as probe for DNA repair, Role of defective DNA repair mechanism in human disease.

UNIT V **8h**

Genetic effects, radiation carcinogenesis, Differential response, reoxygenation, Tumor kinetics, fractionation, sensitizers and radioprotectants, hyperthermia. Ultrasound, optical radiations, radiofrequency and microwave radiations.

TEXT BOOKS

1. Hall EJ. Radiation Biology for Radiologist, Seventh Edition, J B Lippincott Company, United Kingdom, 2012.

REFERENCES

1. Perez CA, Brady LW, Halperin EC, Schmidt-Ullrich RK. Principles and Practice of Radiation Oncology. Fourth Edition, Lippincott Williams & Wilkins (LWW) Publications, 2004.

2. Friedberg EC, Walker GG, Siede W. DNA repair and mutagenesis. ASM press, Washington, DC 1995.

BIOT- 523 MEDICAL BIOTECHNOLOGY CREDITS - 3

UNIT I **10h**

Introduction, worldwide market in medical biotechnology, revolution in diagnosis, changing approaches of therapy, FDA – Organization chart and regulatory measures for drug discovery: Investigational new drug. Drug discovery: Overview, rational drug design, combinatorial chemistry in drug development, computer assisted drug design, role of bioinformatics in genome – based therapy, antisense DNA technology for drug designing.

UNIT II **10h**

Genetically modified food – advantages and disadvantages, production of single cell proteins, biotechnological approaches to obtain blood products: Tissue plasminogen activator and erythropoietin, Vaccine technology: Subunit vaccines, drawbacks of existing vaccines, criteria for successful vaccine, peptide vaccine, minicells as vaccines, impact of genetic engineering on vaccine production, viral vector vaccines and AIDS vaccine chiral technology: Principle and applications.

UNIT III **8h**

Stem cells in therapy: Therapeutic proteins, interleukins, interferons – principle, production and applications, Gene Therapy: Basic approaches to gene therapy, vectors used in gene therapy, applications of gene therapy in cancer, genetic disorders and AIDS

UNIT IV **10h**

Neutraceuticals, fast-based nutraceuticals technology of typical food/ food products (bread, cheese, idli, agro-products (oilseeds) and Food derived bioactive peptides. Biosensors in clinical diagnosis, Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing. Nanotechnology in diagnosis.

UNIT V **10h**

Clinical trials – Phase –I Phase II and II trail norms – ICMR guidelines for design and conducting clinical trials, licensing procedure in India, intellectual Property Rights and patents in biotechnology.

TEXT BOOKS

1. Pongracz J, Keen M. Medical Biotechnology. First Edition, Churchill Livingstone, Elsevier Publication, UK, 2009.
2. Trivedi PC. Medical Biotechnology, First Edition, Aavishkar Publisher Distrib., Jaipur, India, 2008.
3. Albert Sasson. Medical Biotechnology: Achievements, Prospects and Perceptions. United Nations University Press, 2005.
4. Kun LY. Microbial Biotechnology – Principles and applications. World Science publications, 2004

REFERENCE

1. Marks AR & Neiil US. Textbook of Molecular Medicine - Science in Medicine, Jones and Bartlett Learning, New Delhi; 2010.
2. Glazer AN, Nikaido H. Microbial Biotechnology – Fundamentals of Applied Microbiology WH Freeman, New York 1994.
3. Vyas. Methods in Biotechnology and Bioengineering, CBS publications, 2003.
4. Marshak et al., Stem cell Biology. CSHL publications, 2002.

BIOT -524 **PROTEOMICS AND GENOMICS** **CREDIT- 3**

UNIT I **10h**

Whole genome analysis: Prokaryotes and Eukaryotes, Foundations of genomics. Mapping of genome – linkage mapping, High resolution physical mapping – Marker associated and clone assisted genome mapping: Genome library construction – YAC, BAC and PAC libraries of genome.

UNIT II **10h**

Genome sequencing – Hierarchical and shot gun sequencing methods – variation in sequencing methods – Pyroseqencing – Automation in genome sequencing – Sequence analysis – Databanks – Data mining.

UNIT III **10h**

Annotation of genome – experimental and computational approaches – Functional genomics – Experimental and computational approaches – Gene knockouts, yeast two hybrid system – gene expression profiling – microarrays – cDNA and Oligo arrays – DNA chips – Application of DNA arrays – SNPs.

UNIT IV **8h**

Genomics verses Proteomics – Tools for proteomics – 2D Electrophoresis – Protein digestion techniques and mass spectrometry – MALDI TOF – Analysis of proteins.

UNIT V **10h**

Proteome analysis – Algorithms for proteomics – Protein expression profiling – protein arrays – Protein-Protein interactions – Protein microarrays. Advantages and disadvantages of DNA and protein microarrays.

TEXT BOOKS

1. Twyman, RM, Primrose SB. Principle of Genome analysis and Genomics. 3rd Edition, Wiley-Blackwell publications, Australia 2007.
2. Westermeier, Reiner. Proteomics in Practices. 3rd edition, Weinheim, Wiley, 2002.
3. Simpson RJ. Purifying Proteins for Proteomics / A Laboratory Manual, First edition. Cold Spring Harbor Laboratory Press, 2004.
4. Brown TA. Introduction to Genetics: A Molecular Approach. First Edition, Garland Science, Taylor & Francis group. 2012.

REFERENCES

1. Veenstra, TW and Tates III, JR, 2006. Proteomics for biological discovery, Wiley Publications, 2006.
2. Durbin R, Eddy SR, Krogh A, Mitchison G. Biological Sequence Analysis, Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press, 2000.

BIOT 525 PHARMACEUTICAL BIOTECHNOLOGY CREDIT-3

UNIT I **9 h**

Introduction to Pharmacology- History, nature and source of drugs, Classification of drugs, Dosage forms (liquid & solid dosage forms, Topical applications and aerosols), routes of drug administration- types, advantages and disadvantages, site of action of drugs, Combined effect of drugs, Factors modifying drug action, tolerance and dependence, Pharmacogenetics, Mechanism of action of drugs, drug interactions, Adverse Drug Reactions

UNIT II **9 h**

Principles of Basic and Clinical pharmacokinetics- Models of pharmacokinetics, Transmembrane transport of drugs. Drug absorption pathway; Bioavailability of drugs-definition, factors influencing bioavailability;, Fate of Drug - Drug metabolizing enzymes (hepatic drug enzymes and cytochrome P450), Excretion of drug- types, models of elimination and mechanism. Biological half life of Drugs, Bioassays and Therapeutic Drug Monitoring, Drug accumulation in continuous medication. Application of drug plasma concentration monitoring

UNIT III **8h**

Hit to Lead Optimisation by Preclinical Studies & Clinical Trials- Approaches to screen lead molecules- Irrational Approach, Rational approach, Anti sense Approach, High Throughput Screening, Sources of lead-molecules, including natural products, synthetic libraries, and *in silico* structure-based molecules, Prodrugs, Chiral Drugs, Vaccines, Antibodies, Cytokines, Hormones, gene therapy. Preclinical Toxicology- acute, subacute and chronic toxicity Animal tests, Prodrugs, Formulations and Drug Delivery Systems. Clinical Trials-Ethical consideration, Regulatory requirements for Clinical Trials, Phases of Clinical Trials

UNIT IV **7 h**

Good Practices, Regulatory Authorities & Regulatory Applications-Overview, Policies and Procedures: The Process of Drug Discovery, Drug Development Process, Role of Regulatory Authorities, USFDA, WHO, JMHLW, CSDA, European Union, Japan, China and DCGI Regulations, Drugs and Cosmetics Act, India. Schedule- Y, Schedule-M and Schedule-T, GMP Inspection, Structure of Pharmaceutical Industry, Manufacture of Small Molecules APIs, Manufacture of Large Molecules APIs, Finished Dosage Forms; IPR and patenting.

UNIT V **7 h**

Future Directions of Drug Development in the Pharma Industry- Novel Drug delivery systems, Drug targeting- Target Identification, Methods used to identify potential drug targets, Target Validation, Drug Interaction with targets or receptors; In silico models in drug discovery and development, Molecular modeling in silico, Computer models to predict ADMET, The 'omics' era in drug development: Proteomics, Genomics, Metalobomics, Pharmacogenomics- The promise of personalized medicine., ICMR guidelines for drug discovery & development.

TEXT BOOKS

1.R.S.Satoskar & Bhandarkar Pharmacology and Pharmacotherapeutics Revised 23rd Edition 2013 Bombay Popular Prakasam Publishers
2.Rang H & MM Dale. Pharmacology, Fifth Edition, Churchill-Livingstone, 2003.

REFERENCE

1. Goodman and Gilman's The Pharmacological Basis of Therapeutics 12TH Edition, 2013, MacMillan Publishing Company
2. Ho et al., Biotechnology and Biopharmaceuticals Transferring Proteins and Genes. 2003
3. Essentials of Medical Pharmacology, KD Tripathi, 6th Ed Jaypee Publications 2010
4. Delivery Technologies for Biopharmaceuticals Ed. Lene Jorgensin & Hanne Morck Nielson Wiley Publications 2009
5. Natural Product Chemistry for Drug Discovery Ed Antony D. Buss & Mark S. Butler RSC Publishing 2010.

BIQT- 526 NANOBIOTECHNOLOGY CREDIT-3

UNIT I **10h**

Introduction to Nanobiotechnology: Definition and concepts, biological, microbial and nano world. Nanomaterials: nanoparticles, nanowires, nanoclusters, nanotubes, nanocomposites, nanovesicles, nanospheres and nanocapsules. Biomolecules as nanomaterials: lipids as nanobridges, proteins as nanomolecules, polysaccharides and nucleic acids in nanotechnology.

UNIT II **10h**

Biological synthesis of nanomaterials: Synthesis of nanomaterials using plants, extracellular synthesis of nanoparticles by bacteria, extracellular and intracellular synthesis of nanoparticles by fungi. Production of bacterial magnetosomes, hybrid nano-conjugates and DNA-oligomers. Optimization of parameters for biological synthesis of nanoparticles. Advantages and limitations of biological synthesis of nanomaterials.

UNIT III **10h**

Characterization of nanomaterials: Confirmation of synthesis and characterization by UV-Vis spectroscopy, X-ray diffraction (XRD), Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Selected-area electron diffraction (SAED), Energy dispersive x-ray analysis (EDAX) AFM, Infrared (IR) and Thermo gravimetric analysis (TGA) analysis.

UNIT IV **10h**

Applications of nanomaterials in medicine, agriculture and environment: Medical applications-Nanomedicines, drug delivery, nanoparticles for pathogen detection, nanodevices, diagnosis and imaging. Nano-based antimicrobial agents and cosmetics. Agricultural applications-Nanofertilizers, Nanopesticides, Nanopigments, Food processing and Smart packing. Nanoparticles for compound and gene delivery. Environmental applications: Antimicrobial nanoparticles in textile industry, Nanopaints and Nanofilters. Nanocatalysts for degradation of pollutants.

UNIT V **10h**

Impact, ethical issues, challenges, patent issues in nanotechnology. Health and environment risk assessments. Nanoeconomy and commercialization. Impact of nanotechnology on society.

TEXT BOOKS

1. D. E. Reisner, Joseph D. Bronzino. Bionanotechnology: Global Prospects. CRC Press (2008)
2. E. Papazoglou and A. Parthasarathy. Bionanotechnology. Morgan & Claypool publishers (2007).
3. E. Gazit. Plenty of room for Biology at the Bottom: An Introduction to Bionanotechnology. Imperial College Press (2006).

REFERENCE BOOKS

1. C. M. Niemeyer, C. A. Mirkin, - Nanobiotechnology: Concepts, Application and Perspectives, Wiley – VCH, (2004).
2. T. Pradeep, - Nano: The Essentials, McGraw – Hill education, (2007).
3. D. S. Goodsell, - Bionanotechnology, John Wiley & Sons, (2004).

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1. Synthesis of nanoparticles using fungus/bacterium/plant extract.
2. Characterization of nanoparticles using UV-vis spectroscopy/X-ray diffraction (XRD), Transmission electron microscopy (TEM)/Scanning electron microscopy (SEM)/Selected-area electron diffraction (SAED)/Energy dispersive x-ray analysis (EDAX) .
3. Production of nanocomposites.
4. Analysis of intracellularly synthesized mycogenic nanoparticles in the mycelia by Inductively coupled plasma-optical emission spectroscopy (ICP-OES).
5. Analysis of surface-coating molecules in the biologically synthesized nanoparticles using Infrared (IR) and Thermogravimetric analysis (TGA).
6. Antimicrobial activity of nanaoparticles – Agar-diffusion assay, Viable cell count, Cell membrane integrity and Flowcytometry.
7. Cytotoxicity assessment of nanoparticles-Peripheral blood mononuclear (PBMC) culture.
8. Biogenic nanoparticles as catalysts for the degradation of pollutants.