M.Sc. BIOTECHNOLOGY

Choice and Credit based semester system
(Effective from the academic year 2009-2010)
SCHEME OF INSTRUCTION AND EXAMINATION

Paper No	Title of the Paper	Periods/ Week	Duration of Exam (hrs)	Max.* Marks	Credits
I Semester:					
BT 1.1	Cell Biology	4	3	100	4
BT 1.2	Biomolecules	4	3	100	4
BT 1.3	Microbial Physiology & Genetics	4	3	100	4
BT 1.4	Analytical Tools and Techniques in Biotechnology	4	3	100	4
BT 1.5	Lab-I: Cell Biology and Microbiology	12	6	100	4
BT 1.6	Lab-II: Biochemical Analysis and Techniques	12	6	100	4
	Total marks and credits for I semester			**600**	**24**
II Semester:					
BT 2.1	Enzymology and Metabolism	4	3	100	4
BT 2.2	Molecular Biology	4	3	100	4
BT 2.3	Genetic Engineering	4	3	100	4
BT 2.4	Biology of Immune System	4	3	100	4
BT 2.5	Lab-III: Molecular Biology & Genetic Engineering	12	6	100	4
BT 2.6	Lab-IV: Enzymology and Immunology	12	6	100	4
BT 2.7	Non-Core paper (from other departments)	4	3	100	4
	Total marks and credits for II Semester			**700**	**28**
III Semester:					
BT 3.1	Cell Culture Technology and Tissue Engineering	4	3	100	4
BT 3.2	Plant Biotechnology	4	3	100	4
BT 3.3	Animal Biotechnology	4	3	100	4
BT 3.4	Medical and Environmental Biotechnology	4	3	100	4
BT 3.5	Lab-V: Plant Tissue Culture Techniques	12	6	100	4
BT 3.6	Lab-VI: Animal Cell culture and Environmental Biotechnology	12	6	100	4
BT 3.7	Non-Core paper (from other departments)	4	3	100	4
	Total marks and credits for III semester			**700**	**28**
IV Semester:					
BT 4.1	Heterologous Expression and Down Stream Processing		3	100	4
BT 4.2	Bioinformatics and Biostatistics		3	100	4
BT 4.3	Lab-VII: Industrial Biotechnology and Bioinformatics		6	100	4
BT 4.4	Project work & Dissertation			200	8
BT 4.5	Seminar			50	2
BT 4.6	Comprehensive Viva-voce			50	2
	Total marks and credits for IV Semester			**600**	**24**
	Grand Total marks and credits for 4 semesters			**2600**	**104**

***** Theory marks include 15 marks for internal assessment and 85 marks for semester-end examinations. Practical marks include 15 marks for continuous assessment and 85 marks for semester-end examinations in which 10 marks are for Record and 10 marks for Viva-voce.

M.Sc., (Previous) BIOTECHNOLOGY

I SEMESTER

BT 1.1: CELL BIOLOGY

UNIT-I

Structure of typical bacterial, plant and animal cells and functions of cell organelles. Mechanism of cell division. Cell cycle – Molecular events including cell cycle check points and Cdk – cyclin complexes and their role in cell cycle regulation. Ultra structure of plasmamembrane - Components and membrane asymmetry. Transport processes - active transport, ionophores and ion channels. Exo and endocytosis. Phago and pinocytosis.

UNIT-II

General morphology and functions of endoplasmic reticulum. Signal hypothesis. Ribosomes - eucaryotic and procaryotic. Ribosomal proteins. Role of Golgi in protein secretion. Lysosomes and peroxisomes. Cytoskelatal elements. Cell – cell interaction.

UNIT-III

Mitochondria - structure, biogenesis and enzymatic compartmentation. Organization of mitochondrial respiratory chain, mechanism of oxidative of phosphorylation. Ultra structure of the chloroplast. Photosynthesis - photophosphorylation. Carbon dioxide fixation in C-3, C-4 and CAM plants. Photorespiration.

UNIT-IV

Organic evolution: Origin of life. Species concept, population, dones, races, and subspecies. Mechanisms of speciation. Role of isolating mechanisms. Lamarckism, Darwinism, Neo-Darwinism, synthetic theory of evolution. Micro, macro and mega evolution, sequential and divergent evolution. Natural selection.

BOOKS RECOMMENDED:

1. Molecular Biology of the Cell by B.Alberts et.al (Garland publications incorporation.).
2. Molecular Cell Biology, J. Darnell et. al (Scientific American Books) .
3. Cell Biology by N.O.Thorpe (John wiley & sons).
4. Organic Evolution by Rastogi.
5. Principles of organic evolution by J.L.Stebbins (Prentic Hall).

BT 1.2: BIOMOLECULES

UNIT-I

Chemical foundations of Biology – pH, pK, acids, bases, buffers, weak bonds and covalent bonds. Classification, structure, properties and biological significance of carbohydrates. Monosaccharides, Disaccharides, and Polysaccharides. Biological role of peptidoglycans, glycosamino glycans and Lectins. Lipids - classification, structure and properties of fatty acids, triglycerides, phospholipids, sphingolipids and cholesterol.

UNIT-II

Amino acids - Classification, structure and physico-chemical properties. Chemical synthesis of peptides – solid phase peptide synthesis. Proteins - classification, purification and criteria of homogeneity. Structural organization, sequence determination and characterization of proteins. Confirmation of proteins – Ramachandran plots. Denaturation of proteins. Hetero cyclic compounds – Heme and Chlorophylls.

UNIT-III

Structure and properties of purines, pyrimidines, nucleosides, and nucleotides. Covalent structure of DNA and different forms of DNA - A,B and Z. DNA super coiling. Types of RNA and covalent structure of t-RNA. Classification, structure and physiological roles of Vitamins.

UNIT-IV

Hormones- classification and mechanism of action of steroid and protein hormones. Signal transduction cascade by cyclic AMP, Phospho inositate and calcium (Ca^{+}), G-proteins, growth factors and membrane receptor tyrosine kinases. Phytohormones and their physiological roles.

BOOKS RECOMMENDED:

1. Principles of Biochemistry by A.L.Lehninger, 2 Ed. (worth).
2. Biochemistry by L. Stryer 4 Ed. (Freeman-Toppan).
3. Text Book of Biochemistry by West et. al., (Mac Millan).
4. Principles of Biochemistry by Smith et. al., (Mc Graw Hill).
5. Harper's Biochemistry (Langeman).
6. Biochemistry by D.Voet and J.G.Voet (John weily).
7. Biochemistry by U. Satyanarayana (Books & Allied (P) Ltd).

BT 1.3: MICROBIAL PHYSIOLOGY & GENETICS

UNIT-I

Classification and cultivation of bacteria. Bacterial reproduction and growth curve. Preparation of bacteriological media. Staining techniques. Differences between gram positive and gram negative bacteria. Methods of sterilization, pasteurization and disinfection. Microbiology of water, milk, air, soil and sewage. Microbes as pathological agents in plant and animals. Clinically important bacteria. Biohazards - safety precautions.

UNIT-II

Chemical nature and classification of bacteriophages. Parasitic and temperate phages. Plant and animal viruses – multiplication of viruses. General characteristics of T Phase, ϕx174, SV40, TMV. Clinically important viruses, retroviruses, HIV, Hepatitis B Virus and viral infections. General account of algae molds and yeasts. Economic importance of algae and fungi. Clinically significant protozoans.

UNIT – III

Microbial genetics: Recombination in prokaryotes, Transformation, conjugation, transduction and sexduction. Mapping of prokaryotic gene. Transposons, retrotransposons and mechanism of transposition. Viral genetics. Biology of plasmids. Extra chromosomal inheritance.

UNIT-IV

Genetics of Eukaryotes: Gene & Environment, Genotype and phenotype, Mendel's experiments, Dominance relationships. Multiple alleles, Gene Interaction, Gene mutations, Sex determination, Sex linkage, Linkage and recombination in diploids. Tetrad analysis. Elements of gene mapping, Pedigree analysis

BOOKS RECOMMENDED:

1. Text book of Microbiology by Pleczar and Reid (Mc Graw Hill).
2. Microbiology by Tortora, Funk & Case.
3. Microbiology by Prescott.
4. Principles of Genetics by Sinnet et.al,., (Mc Graw Hill).
5. Principles of Heridity by Robert Tumarin.
6. Genetics by M.W.Strick Berger (Mac Millan).
7. Cell and Molecular Biology by E,D.P.De Roberties (International edition).

BT 1.4: ANALYTICAL TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

UNIT-I

Principles and applications of light, phase contrast, fluorescence, scanning and transmission electron microscopy. Properties of electromagnetic radiations. Principles, instrumentation and applications of UV, visible, infrared, ORD, CD, NMR spectroscopy. Spectrofluorimetry and mass spectrometry, X-ray diffraction. Flow cytometry.

UNIT-II

Principles and applications of gel-filtration, ion-exchange and affinity chromatography. TLC, GLC and HPLC. Basic principles of sedimentation. Applications of preparative and analytical ultra centrifuges. Principles and applications of lyophilization.

UNIT-III

General principles of electrophoretic techniques. Poly Acryl amide Gel Electrophoresis. Iso-electric focusing. Isotachophoresis. 2-D Electrophoresis. Capillary electrophoresis. Agarose gel electrophoresis of DNA and RNA. Blotting techniques. DNA fingerprinting.

UNIT-IV

Stable and radioactive isotopes. Detection and measurement of radioactivity. Applications of radioisotopes in biological sciences. Autoradiography. Non-isotopic tracer techniques. Principles and range of electrochemical techniques. Operation of pH electrodes. Principles and applications of Ion-selective and gas sensing electrodes. Oxygen electrodes.

BOOKS RECOMMENDED

1. Analytical Biochemistry by David J.Holme (Long man).
2. A Biologists guide to Principles and techniques of practical Biochemistry. Ed.by.B.D.williams (Edward Arnold).
3. Instrumental methods of chemical analysis by G.K.Sharma (Goel).
4. Modern experimental Biochemistry by Rodney Boyer (Pearson Education).
5. Physical Biochemistry by Frefielder (Freeman & Co).
6. Biophysical chemistry principles and techniques by Upadyay, Upadyay and Nath (Himalaya publishing).
7. Instrumental methods of chemical analysis by Chatwal & Anand.

BT 1.5: LAB - I: CELL BIOLOGY AND MICROBIOLOGY

01. Mitosis in onion root tip cells: All phases (Squash method).
02. Meiosis in onion flower buds: All phases including zygotene, diplotene and diakinesis of prophase I (Smear method).
03. Preparation of liquid and solid media for growth of microorganisms.
04. Slants and Stab cultures, Isolation and maintenance of microorganisms by plating, streaking and serial dilution methods.
05. Biochemical characterization of selected microbes.
06. Simple staining and Grams staining.
07. Acid fast and spore staining.
08. Microscopic examination of bacteria, yeast and molds.
09. Growth of a microorganism and growth curve.
10. Analysis of water for portability and determination of MPN.
11. Microbiological examination of milk.
12. Oligodynamic action of heavy metals.
13. Evaluation of disinfectants by phenol coefficient method.
14. Isolation of viruses.
15. Examination of thallus structure and reproductive bodies of algae.
16. Examination of external features and reproductive organs of fungi.
17. Representative species of protozoa.

BOOKS RECOMMENDED:

1. Handbook of Microbiological Media by Atlas R.L.
2. Manual of Clinical Microbiology by Lennettee E.H.
3. Manual of Clinical Microbiology by Murray PR.
4. A Laboratory manual of Microbiology: Microbes in action.

BT 1.6: LAB-II: BIOCHEMICAL ANALYSIS AND TECHNIQUES

01. Separation of amino acids by paper chromatography.
02. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
03. Ultra violet absorption spectra of nucleic acids and proteins.
04. Determination of molar extinction coefficient of tryptophane / tyrosine.
05. Gel filtration of proteins.
06. Ion exchange chromatography of amino acids.
07. Purification of enzyme by affinity chromatography.
08. Subcellular fractionation by differential centrifugation.
09. Polyacrylamide gel electrophoresis of proteins.
10. Determination of isoelectric point of glycine.
11. Estimation of glycine by formal titration.
12. Estimation of reducing sugars by Benedict's titrimetric method.
13. Estimation of total carbohydrates by anthrone method.
14. Estimation of proteins by Lowry and Bradford methods.
15. Estimation of ascorbic acid.
16. Determination of Iodine value of oils.
17. Estimation of cholesterol.

BOOKS RECOMMENDED:

01. Hawk's physiological chemistry Ed. by Oser (Mc Graw Hill).
02. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
03. An introduction to practical biochemistry by D.T.Plummer (Mc Graw Hill).
04. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).
05. Biochemistry - a laboratory courses by J.M.Beckar (Academic Press).

M.Sc., (Previous) BIOTECHNOLOGY

II SEMESTER

BT 2.1: ENZYMOLOGY & METABOLISM

UNIT – I

Classification and Nomenclature of Enzymes. Enzyme kinetics. Factors affecting the rates of enzyme catalysed reactions. Assay of enzyme activity – units of enzyme activity. Multisubstrate reactions. Enzyme – substrate (protein ligand) binding. Methods for measurement of km. Coenzymes, metalloenzymes, and isoenzymes with examples.

UNIT-II

Active site determination. Mechanism of enzyme action of Chymotrypsin & Trypsin, carboxy peptidase-A and ribonuclease A. Multienzyme systems. Covalent modification. Zymogen activation. Enzyme inhibition – Competitive, non-competitive and uncompetitive. Allosteric enzymes, Ribozymes and catalytic antibodies.

UNIT – III

Glycolysis, Glycogenolysis, glycogenesis, gluconeogenesis, HMP shunt path way and their regulation. Tricarboxylic acid (TCA) cycle, Glyoxylate cycle and its significance. Biosynthesis and oxidation of fatty acids. Metabolism of cholesterol. Ketone bodies. Biosynthesis of Heme and chlorophylls.

UNIT – IV

Protein turnover. General metabolic reactions of amino acids. Urea cycle. Nitrogen fixation. Essential and non-essential amino acids. Biosynthesis and degradation of aromatic and branched chain aminoacids. Inborn errors of amino acid metabolism. Biosynthesis of purine and pyrimidine nucleotides and their regulation. Catabolism of purines and pyrimidines.

BOOKS RECOMMENDED:

01. Principles of Biochemistry by A.L.Lehninger, 2 Ed. (worth).
02. Lehninger Principles of Biochemistry by Nelson, D and Cox, D. Macmillon Pub.
03. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan).
04. Text Book of Biochemistry by West et. al., (Mac Millan).
05. Principles of Biochemistry by Smith et. al., (Mc Graw Hill).
06. Harper's Biochemistry (Langeman).
07. Biochemistry by D.Voet and J.G.Voet (John weily).
08. Enzymes by Palmer (East).

BT 2.2: MOLECULAR BIOLOGY

UNIT – I

Organization of genetic material - Packing of DNA in to chromatin - protein components of chromatin, histones, nucleosome organization. Solenoids loops, domains & scaffolds. Gene amplification, polytene chromosomes. DNA replication – apparatus, enzymes involved and mechanism. Replication at telomeres. DNA damage and repair mechanism. Nuclear genome.C - value paradox. Mitochondrial & plastid genomes and genes. Fine structure of the eukaryotic gene. Split genes. Different kinds of genes: overlapping, assembled, polyprotein & nested genes.

UNIT – II

Transcription in prokaryotes and eukaryotes. Mechanism of transcription, enzymes and transcription factors, zinc finger, leucine zipper mechanism. Maturation and processing of m-RNA, splicing, 5' end capping & 3' end tailing. RNA editing and transport. RNAi and small RNAs.

UNIT – III

Translation in prokaryotes and eukaryotes: Genetic code - properties of the genetic code, deciphering of the genetic code. Ribosome as a translation factory. t - RNA as an adaptor, its mode of function. Post translational modifications. Leader sequences & protein targeting.

UNIT – IV

Regulation of gene expression in prokaryotes - The operon concept, lac & tryp operons. Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers. Cis-trans elements. Environmental & developmental regulation. DNA methylation & gene expression. Chromatin structure & gene expression.

BOOKS RECOMMENDED:

01. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan)
02. Genes VIII by B.Lewin (Oxford)
03. Cell and Molecular Biology by E,D.P.De Roberties (International edition)
04. Molecular Biology by David Frefielder.
05. DNA Science by Carolina Publishing Company.
06. Molecular Biology of the Gene by J.D.Watson et. al.,(Benjamin).
07. RNAi-Design and application by Basic (Springer).
08. Small RNAs-Analysis and Regulatory functions by Nellen (Springer).

BT 2.3: GENETIC ENGINEERING

UNIT-I

Isolation of DNA and RNA. Restriction mapping, DNA sequencing by chemical and enzymatic methods. Nucleic acid blotting – southern and northern blotting. DNA cloning. Enzymes used in genetic engineering : Restriction endonucleases - types, nomenclature and properties. DNA polymerase-I, polynucleotide kinase, DNA ligase, terminal nucleotide transferase, Reverse transcriptase, alkaline phosphatase, S_1 nuclease.

UNIT-II

Salient features of cloning vectors, types of cloning vectors - plasmids, cosmids, phages (lamda and M13 phages), animal (SV40, Baculo) and plant (CMV) viruses, Artificial chromosomes - YACs and MACs. Ligation of foreign DNA to vectors - cohesive and blunt end methods - homopolymer tailing and adaptors. Preparation of gene libraries and c-DNA libraries .

UNIT – III

Techniques of gene transfer - transformation , transfection, micro injection, electroporation, lipofection and biolistics. Selection of r-DNA clones and their expression. Nucleic acid probes, colony and fluorescent in-situ hybridization.

UNIT – IV

Polymerase Chain Reaction and its applications. DNA micro array technology. Applications of genetic engineering in agriculture, animal husbandry, medicine and in industry. Genomics – genome sequencing by shot gun and hierarchical method. Genome annotation – identification of genes, promoters and exon – intron boundries

BOOKS RECOMMENDED:

01. Recombinant DNA technology by Watson et. al., (Scientific American Books).
02. Genes-VIII by Benjamin Lewin.(Oxford).
03. Principles of Gene Manipulation by Old and Primrose.(Blackwell).
04. DNA Science by Carolina Publishing Company.
05. From genes to clones by Winneker.
06. From genes to genomes concepts and applications of DNA technology by Jeremy W dale and Malcolm von Scrantz, Weil publications
07. Molecular Biotechnology by Glick.
08. Genetic Engineering by Sandhya Mitra.
09. Genomes by T.A. Brown

BT 2.4: BIOLOGY OF IMMUNE SYSTEM

UNIT-I

Types of immunity – innate, acquired, passive and active. Organisation and structure of lymphoid organs – bone marrow, thymus, spleen and lymphnodes. Cells of the immune system – B-Lymphocytes, T-Lymphocytes. T-cell receptor – structure and function. Macrophages. Types of cell mediated immunity and lymphokine activatd killer cells. Clonal nature of immune response, Immunological memory. Immuno regulation. Adjuvants and immunological tolerance.

UNIT-II

Nature of antigens and antibodies. Structure and function of antibodies. Isotypes, Allotypes and Idiotypes. Antigen – antibody interactions. The generation of antibody diversity, antigen receptors on B & T lymphocytes. Major Histocompatibility Complex (MHC). Human leukocyte antigens (HLA), MHC restriction and typing. Lymphokines, effector cell mechanisms, genetic control of immune response. Complement system.

UNIT-III

Immunological techniques - ELISA, RIA, Western Blot, Immunoblot and Immuno fluorescent techniques. FACS. Hybridoma technology - production and applications of monoclonal antibodies. Antibody engineering, chimeric antibodies.

UNIT-IV

Hypersensitivity - types of hypersensitivity - immediate and delayed hypersensitivity, autoimmune diseases, transplantation and immunity, immunity to infectious agents. Vaccines and Vaccination, types of vaccines including new generation vaccines. Tumor immunology.

BOOKS RECOMMENDED:

01. Essentials of Immunology by Roit (ELBS).
02. Immunology by Roit et.al (Harper Row).
03. Text book of Immunology by S.T,Barrot (Mosby).
04. Immunology by Kubay.
05. Principles of Microbiology and Immunology by Davis et.al., (Harper).

BT 2.5 LAB III: MOLECULAR BIOLOGY AND GENETIC ENGINEERING

01. Isolation of RNA from yeast.
02. Estimation of RNA using orcinol reagent and by UV spectrophotometry.
03. Isolation of DNA from microbial, plant and animal sources.
04. Estimation of DNA using diphenylamine reagent and by UV spectrophotometry.
05. Enzyme induction in E.Coli.
06. Isolation of plasmid DNA.
07. Digestion of plasmid DNA with restriction endonucleases.
08. Separation of DNA fragments by Agarose gel electrophoresis.
09. Elution of DNA from agarose gels.
10. Ligation of DNA fragments.
11. Bacterial transformation and identification of transformants.
12. Cloning of green fluorescent protein.
13. Gene expression in bacteria.
14. Amplification of DNA by PCR.
15. Southern blotting technique.
16. RFLP and RAPD mapping.

BOOKS RECOMMENDED:

01. Biotechnology: A laboratory course by Becker J.M.
02. Molecular Cloning : A laboratory manual Vols. 1-3, Sambrook, J.
03. Lab manual in Biochemistry by J.Jayaraman (Wiley Eastern Limited).
04. Biochemistry – A lab course by J.M.Becker (Academic Press).

BT 2.6: LAB : IV- ENZYMOLOGY AND IMMUNOLOGY

01. Assay of amylase from Saliva.
02. Assay of trypsin.
03. Assay of acid-phosphatase from potato.
04. Assay of Lipase from serum.
05. Assay of Catalase from liver.
06. Time course of enzyme activity
07. Effect of pH and determination of optimum pH.
08. Effect of temperature on enzyme activity and calculation of energy of activation.
09. Effect of substrate concentration on enzyme activity and determination of Km.
10. Effect of metal ions on enzyme activity.
11. Purification of an enzyme.
12. Determination of A, B, O and Rh blood groups in human beings.
13. Handling of mice and rats, techniques of immunization and bleeding.
14. Dissection and identification of thymus, spleen and lymph nodes.
15. Ouchterloney double diffusion.
16. Radial immunodiffusion.
17. Quantitative precipitin assay.
18. Immunoelectrophoresis.
19. Latex agglutination test.
20. Enzyme Linked Immunosorbent Assay (ELISA).
21. Western blotting.
22. Diagnostic test for typhoid fever by Widal test.
23. VDRL test for syphilis.
24. Pregnancy tests.

BOOKS RECOMMENDED:

01.Hawk's physiological chemistry Ed. by Oser (Mc Graw Hill).
02.Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
03.An introduction to practical biochemistry by D.T.Plummer (Mc Graw Hill).
04.Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).
05.Biochemistry - a laboratory courses by J.M.Beckar (Academic Press).
06.Immunology methods manual - The comprehensive source book by Lefkovits. I.
07.Manual of clinical laboratory immunology by Rose NR.
08.The experimental foundations of modern immunology by Clark W.R.
09.Laboratory Immunology by Bradshaw LJ.

M.Sc., (Final) BIOTECHNOLOGY

III SEMESTER

BT 3.1: CELL CULTURE TECHNOLOGY AND TISSUE ENGINEERING

UNIT-I

Plant tissue culture technology: culture media – composition and preparation. Factors governing in vitro behaviour, Somatic embryogenesis, organogenesis and plant regeneration. Culture types. Micro propagation, Haploids, somaclonal variations, , metabolite production in cultures. Isolation of protoplasts, protoplast fusion and culture. Somatic hybridization.

UNIT-II

Animal cell and tissue culture. Primary culture, balanced salt solutions and simple growth medium. Serum and protein free defined media. Cell lines, primary and established cell line cultures. Basic techniques of mammalian cell culture in vitro. Tissue and organ culture. Production and use of artificial tissues and organs – Skin, liver and pancreas. Apoptosis - mechanism and significance.

UNIT-III

The biology of stem cells – Different types of stem cells – embryonic stem cells, fetal tissue stem cells, adult stem cells; stem cell differentiation, stem cell plasticity – Differentiation versus stem cell renewal. Isolation and propagation of embryonic stem cells; chimeras; generation of knockout mice and knock-in technology.

UNIT-IV

Hematopoietic stem cells and bone marrow transplantation: Cells for hematopoietic reconstitution – Cord blood stem cells; cells for adoptive cellular immunotherapy; bone marrow transplantation - advantages and disadvantages. Allogenic, autologous, syngenic and congenic transplantation. Clinical applications of stem cell therapy; neurodegenerative diseases – Parkinson's disease, Alzheimers, spinal cord injury and other brain syndromes.

BOOKS RECOMMENDED:

01. Plant tissue culture – theory and practice by Bhojwani S.S.
02. Plant cell culture – A practical approach by Dixion R.A.
03. Culture of Animal cells by R.I.Freshney. Wiley – Liss.
04. Animal Cell Culture – A Practical approach Ed. by John R.W.Masters (IRL Press).
05. Animal cell culture techniques, Ed. Martin Clynes, Springer.
06. Plant Cell, Tissue and Organ Culture, By Reinert, J. and YPS Bajaj (Springer – Verlag).
07. Plant tissue and cell culture, by Street, HE (Blackwell).
08. Stem cells in regenerative medicine by Audet (Springer).
09. Cell and tissue reaction engineering by Eibl (Springer).

BT 3.2: PLANT BIOTECHNOLOGY

UNIT-I

Plant Genetic engineering: Gene cloning techniques, Techniques for gene transfer into plants. Mechanism of gene transfer by T_I and R_I plasmids as vectors. Reporter genes, transient gene assays and identification of transgenic plants. Molecular markers and their significance. RFLP, , AFLP and QTL in plants. RAPD for molecular mapping and crop improvement.

UNIT-II

Agricultural Biotechnology: Engineering of herbicide tolerance in plants, production of disease resistant plants by gene transfer; Development of insect resistant plants. Biotechnological strategies for engineering stress tolerance.

UNIT-III

Altering protein and oil quality traits in seeds. Chloroplast transformation – advantages in tobacco and potato, plants for expression of bacterial, viral and eukaryotic genes. Edible vaccines and plantibodies. The genetic manipulation of crop yield by enhancement of photosynthesis.

UNIT-IV

Algal Biotechnology: Laboratory culture of micro algae. Large scale biomass production. Marine micro algae/sea weeds and their products. Edible sea weeds and their cultivation. Biofertilizers – Blue green algal fertilizers – Azolla, Anabaena, symbiotic association. Sea weed fertilizers. Mycorrhizal biofertilizers, bacterial fertilizers. Biopesticides in agricultural production.

BOOKS RECOMMENDED:

01. Plant Biotechnology by A. Slater, N.W. Scott and M.R. Fowler (Oxford University press).
02. Biotechnology in Agriculture by Swaminathan, M.S (Mc. Milllan India Ltd).
03. Biotechnology and its applications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).
04. Plant Biotechnology, by Kung, S.and C.J.Arntzen (Butterworths).

BT 3.3: ANIMAL BIOTECHNOLOGY

UNIT-II

Types and causes of male and female infertility, sperm collection, Cryopreservation, artificial insemination, Oocyte recovery, superovulation, oocyte maturation in vitro, In vitro fertilization in humans and cattle. Embryo culture, embryo transfer in farm animals. Immunocontraception - hormonal methods. Biotechnological approaches for the management of pests, mosquitoes and nematodes. Live stock improvement

UNIT-II

Production of transgenic animals - mice, sheep and fish. Molecular pharming and animal cloning. Somatic cell nuclear transfer in humans – Legal and ethical aspects. Potential applications of transgenic animals – Animal models for diseases and disorders. Transgenic poultry and transgenic insects as bioreactor.

UNIT-III

The concept of aquatic biotechnology and blue revolution. Economically important aquatic resources from fresh water, brackish water and marine habitats – the finfish, shellfish, lime fish, algae, corals, and holothurians. Bioactive compounds from corals. Fish bioproducts. Pearl culture technology – principles and applications.

UNIT-IV

Aquaculture - Fresh water fish culture practices and types. Freshwater prawn culture. Brackish water fish, shrimp and crab culture practices. Fresh water fish hatchery and seed production. Hypophysation and induced breeding techniques. Eyestalk oblation. Techniques involved in transgenic fish production. Post harvest technology. Diagnosis of shrimp & fish diseases caused by bacterial, fungal and viral pathogens using molecular methods.

BOOKS RECOMMENDED:

01. Elements of Biotechnology by PK Gupta (Rastogi & Co).
02. Biotechnology by Kashav. T (Wiley Eastern Ltd).
03.Concepts in Biotechnology by Balasubrahmanian et. al.,(University press).
04.Principles and practices of aquaculture by TVR Pillay.
05.Coastal aquaculture by Santhanam.
06.Fisheries of India by CBL Srivatsava.
07.Molecular Biotechnology by Glick.

BT 3.4: MEDICAL AND ENVIRONMENTAL BIOTECHNOLOGY

UNIT-I

Health care products. Products from recombinant DNA Technology - insulin, growth hormone, factor VIII, tissue plasminogen activator, interferons, lymphokines and Hepatitis-B vaccines.

UNIT – II

Disease diagnosis: DNA probes, Enzyme probes - glucose oxidase, lactate oxidase, monoamine oxidase. PCR amplification and diagnosis - Applications in forensic medicine. Genetic diseases and gene therapy. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis.

UNIT – III

Environmental pollution – types, sources and control. Reduction of environmental impact of industrial effluents, chemical herbicides and fertilizers. Removal of oil spills. Environmental monitoring and biomonitoring. Bioremediation - solid and liquid waste treatment. Biomass and energy production from waste. Bioleaching – Microbial recovery of metals and acid mine drainage. Water pollution and its control. Microbiology of waste water treatment.

UNIT-IV

Environment and energy: Renewable sources of energy – Biogas, waste materials, energy crops, cellulose. Production of energy and fuel using microorganism – Biofuels and Biodiesal. Global environmental problems: Ozone depletion, UV-B, Green house effect. Biodiversity - benefits to mankind - Conservation; Ecology and sustainable development.

BOOKS RECOMMENDED:

01. Biotechnology by B.D.Singh (Kalyani).
02. Ecology and Environment by PD Sharma.
03. Fundamentals of Ecology, by Odum, EP (Mc Graw Hill)
04. Environmental Biotechnology by Forster, C.F. and Wase D.A.J. (Ellis Horwood).
05. Biotechnological innovations in environmental management by Leach, CK and Van Dam-Mieras, MCE (Butterworth-Herinemann, Oxford (Biotol Series).
06. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
07. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).

BT 3.5: LAB - V: PLANT TISSUE CULTURE TECHNIQUES

01. Preparation of media for plant tissue culture (MS and B5).
02. Establishment of callus cultures from carrot cambial tissue.
03. Establishment of cell cultures and plating.
04. Embryo culture of maize/ crotalaria.
05. Organogenesis and regeneration of plants from tobacco explants.
06. Anther culture and production of haploids.
07. Micropropagation using suitable system: Potato/solanum's
08. Enzymatic isolation of protoplast and culture.
09. Polyethylene glycol (PEG) mediated fusion of protoplasts.
10. Agrobacterium culture and transformation.
11. Reporter gene assay (GUS).

BOOKS RECOMMENDED:

01. Plant cell culture – A practical approach by Dixion RA.
02. Plant tissue culture – theory and practice by Bhojwani, S.S.
03. Biotechnology: A laboratory course by Becker, J.M.

BT 3.6: LAB-VI: ANIMAL CELL CULTURE AND ENVIRONMENTAL BIOTECHNOLOGY

01. Preparation of animal cell culture media and membrane filtration.
02. Preparation of single cell suspension from spleen and thymus.
03. MTT assay for cell viability and growth.
04. Demonstration of sections of human ovary, testis and aborted human embryos.
05. Estimation of dissolved oxygen and salinity in water samples.
06. Estimation of Chemical Oxygen Demand (COD).
07. Estimation of Biochemical Oxygen Demand (BOD).
08. Determination of suspended solids in industrial effluents.
09. Removal of color of the industrial effluents by biological methods.
10. Reduction of pollution load in effluents by biological methods (laboratory models).

BOOKS RECOMMENDED:

01. Animal cell culture – A practical approach Ed. By John R.W. Masters (IRL Press).

02. Animal cell culture techniques, Ed. Martin clyenes (Springer).

03. Comprehensive Biotechnology. Vol. 4. M.Moo-Young (Ed-in-chief), Pergamon Press, Oxford.

04. Environmental Chemistry. A.K.De, Wiley Eastern Ltd, New Delhi.

05. Introduction to Biodeterioration, D.Allsopp and K.J.Seal, ELBS/Edward Arnold.

M.Sc. (Final) BIOTECHNOLOGY

IV SEMESTER

BT 4.1: HETEROLOGOUS EXPRESSION AND DOWN STREAM PROCESSING

UNIT-I

Heterologous Expression: Expression vectors and hosts Generally Regarded As Safe (GRAS) organisms. Production of active recombinant proteins of mammalian/Eukaryotic origin in prokaryotes. Large scale production of proteins from recombinant microorganisms. Principles of microbial growth – Batch fermentation, feed-batch fermentation – continuous fermentation, high density cell cultures – Bioreactors – Large scale fermentation system – tandem Airlift reactors – Single stirred tank reactors.

UNIT-II

Down stream processing: Harvesting microbial cells – Membrane filtration system, high speed semi continuous centrifugation – disrupting microbial cells. Gram scale purification of recombinant proteins – Chromatography systems and analytical methods for large scale purification. Stabilization of the proteins.

UNIT-III

Processing technology: Microbial metabolites - Organic solvents (Alcohol, Acetone, Butanol), Organic acids (Citric acid, lactic acid), Wines and beers, Antibiotics (penicillin, streptomycin, tetracycline, semi synthetic penicillins), Vitamins (Vitamin B_{12} and Riboflavin), Amino acids (lysine, glutamic acid). Production of single cell proteins.

UNIT-IV

Enzyme technology: Sources production, isolation and purification of enzymes for the industrial use. Application of enzymes in pharmaceutical, food processing and other industries. Different techniques of immobilization of enzymes, applications and kinetics of immobilized enzymes. Design and operation of immobilized enzyme systems and bioreactors. Whole cell immobilization. Biosensors - principle and types.

BOOKS RECOMMENDED:

01. Biotechnology – Volumes 1 to 5 by Rehem.
02. Industrial Microbiology by LE Casida Jr.
03. Industrial Microbiology by Presscot and Dunn.
04. Immobilized enzymes by Messing.
05. Biochemical engineering fundamentals by Bailey and Ollis.
06. Biotechnology by BD Singh (Kalyani).

BT 4.2: BIOINFORMATICS AND BIOSTATISTICS

UNIT-I

Scope of computers in current biological research. Basic operations, architecture of computer. Introduction of digital computers. Organization, low level and high level languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Introduction of programming in C. Introduction to Internet and its applications.

UNIT-II

Introduction to Bioinformatics – Genomics and Proteomics. Bioinformatics – Online tools and offline tools. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA.

UNIT-III

Multiple sequence alignment and Dynamic programming. Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction. Protein secondary structure prediction. Protein 3D structure prediction. Protein docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery.

UNIT-IV

Brief description and tabulation of data and its graphical representation. Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance. Simple linear regression and correlation. Types of errors and level of significance. Tests of significance – F & t tests, chi-square tests, ANOVA.

BOOKS RECOMMENDED:

01. Bioinformatics – D.Mount
02. Programming in C by Balaguru Swamy.
03. Introduction to Bioinformatics by Arthur M.Lesk, Oxford.
04. Biostatistics – Daniel. (Wiley).
05. Statistics by S.C.Gupta.
06. Statistical Methods by G.W.Snedecor & W.G.Cochran.
07. Fundamentals of Biostatistics – Khan & Khanum.
08. Let us C – Kanetkar.
09. Fundamentals of Biostatistics by U.B.Rastogi (Ame Books Ltd).

BT 4.3: LAB:VII : INDUSTRIAL BIOTECHNOLOGY AND BIOINFORMATICS

01. Production of protease/amylase by batch fermentation.
02. Immobilization of an enzyme (invertase/lipase/amylase) by gel entrapment.
03. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
04. Screening of soil samples for isolation of bacteria, fungi and actinomycetes.
05. Selective isolation of actinomycetes from soil samples.
06. Microbiological assay of an antibiotic including the construction of standard curve.
07. UV survival curve.
08. Production of alcohol by S.cerevisiae and its estimation.
09. Production of streptomycin by fermentation.
10. Production of citric acid by A.niger.
11. Production of red wine from grapes.
12. Production of Glutamic acid by M. glutamicus.
13. Searching Data from NCBI Database.
14. Working on EMBL.
15. Searching structural data from PDB.
16. Genome Map viewer from NCBI.
17. Database search using BLAST.
18. Sequence alignments.
19. Sequence and structure visualization.

BOOKS RECOMMENDED:

01. A manual of Industrial Microbiology and Biotechnology by Demain A.L.
02. Immobilization of enzymes and cells: Methods in Biotechnology vol.1 by Bickerstaff G.F.
03. Principle of fermentation technology by Stanbury.
04. Biotechnology: A laboratory course by Becker J.M.

BT 4.4: PROJECT WORK

The candidate should submit a project report by the end of final year course on a topic relevant Biotechnology, based on the laboratory experiments/case studies/field studies carried out in a Biotechnology/related industry and should give a seminar on the project work.

BT 4.5: SEMINAR

Each student will deliver seminars on the topics from the emerging areas of Modern Biology, Biotechnology or its applications under the supervision of a faculty member from the second semester on wards. A comprehensive seminar on the project work will be evaluated.

BT 4.6: COMPREHENSIVE VIVA-VOCE

Covering the entire syllabi and up to date knowledge in Biotechnology.