REVISED CURRICULUM AND SYLLABI

(With effect for the 2021 – 2022 admitted batch onwards)
Modified in the Annual Board of Studies meeting held on 11.08.2021

M.Sc. Biotechnology

Department of Biotechnology
College of Science and Technology
Andhra University
Visakhapatnam
Program Outcomes

PO1: Students acquire insight into subjects like Microbiology, Molecular Biology and Genetic Engineering.
PO2: Well versed with biotechnological remedies for human health and environmental problems.
PO3: Trained in basic and advanced areas in Biotechnology to develop Biotechnological processes and products.
PO4: Multidisciplinary proficiency will be attained by utilizing MOOCS courses.
PO5: Awareness will be created regarding intellectual property rights.
PO6: Development of human capital for advanced scientific research and entrepreneurship.

Program Specific Outcomes

PSO1: Students acquire knowledge, critical thinking skills and experience in conducting cutting edge research.
PSO2: Achieve expertise in a chosen specialized area of Biotechnology based on the research experience gained by their project work.
PSO3: Develop practical skills which will empower to enroll in research institutions and industries.
PSO4: Students will be well equipped to pursue higher studies.
PSO5: Able to produce innovative products, meeting the global demands in the field of applied Biotechnology.
PSO6: Students emerge with confidence by developing knowledge both in their subject and soft skills and will be ready to face the challenges in the society.
# ANDHRA UNIVERSITY

M.Sc. BIOTECHNOLOGY- SEMESTER SYSTEM (CBCS)
(WITH EFFECT FOR THE 2021 – 2022 ADMITTED BATCH ONWARDS)

SCHEME OF INSTRUCTIONS AND EXAMINATION

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title of the Paper</th>
<th>Periods/Week</th>
<th>Duration of Exam (Hours)</th>
<th>Maximum Marks*</th>
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* Theory marks include 20 marks for internal assessment
Marks and credits for BT 3.8 and BT 4.5 not included in the total marks and credits.
M.Sc., (Previous) BIOTECHNOLOGY

SEMESTER – I

PAPER BT 1.1 - CELL BIOLOGY & EVOLUTION

Course Outcomes:

CO1. Gain knowledge on the basic components of bacterial, plant and animal cells.
CO2. Awareness regarding the general morphology and functions of endoplasmic reticulum, ribosomes, golgi, lysosomes and cytoskeletal elements.
CO3. Obtain knowledge on how cells generate energy in mitochondria.
CO4. Know the importance of the mechanism of photosynthesis.
CO5. Attain an insight into the biology of cancer cells.
CO6. Familiarize with the origin of basic biological molecules and evolutionary time scale.

Learning Outcomes:

LO1. Able to differentiate bacterial, plant and animal cells and distinguish the cell organelles.
LO2. Gain knowledge regarding the different phases of cell cycle, checkpoints and regulation of cell cycle.
LO3. Understand concepts on signal hypothesis and cell interactions.
LO4. Obtain knowledge regarding the structure and function of mitochondria and chloroplast.
LO5. Comprehend the importance of cancer cell biology in modern science.
LO6. Apprehend the experimental evidences for origin of cells.

Course Specific Outcomes:

CSO1. Obtain knowledge regarding the cell, cell organelles and mechanism of cell division.
CSO2. Have a thorough understanding of mitochondria and synthesis of ATP, the energy currency.
CSO3. Awareness on types and causes of cancer.
CSO4. Understand the evolution of prokaryotes and eukaryotes.

UNIT-I


UNIT-II

UNIT-III


UNIT-IV


UNIT-V


Books suggested:

1. Molecular Biology of the Cell by B. Alberts et.al (Garland publications inc.).
5. Organic Evolution by Rastogi.
PAPER BT 1.2 - BIOMOLECULES

Course Outcomes:

CO1. Gain knowledge on chemical foundations of biology.
CO2. Understand in detail about carbohydrates and lipids.
CO3. Obtain knowledge about amino acids, proteins and heterocyclic compounds.
CO4. Know the importance of nucleic acids and vitamins.
CO5. Familiarize with hormones and phytohormones.
CO6. Attain an insight into bioenergetics.

Learning Outcomes:

LO1. Understand the different types of chemical bonds in biomolecules.
LO2. Have an insight on carbohydrates and lipids and their role in biological systems.
LO3. Understand the structure and properties of amino acids, proteins and biosynthesis of heme and chlorophyll.
LO4. Apprehend the types, structure and functions of nucleic acids and vitamins.
LO5. Perceive the importance of hormones, phytohormones and various secondary messengers in signal transduction cascade.
LO6. Comprehend the basic concepts of thermodynamics.

Course Specific Outcomes:

CSO1. Have a thorough knowledge of structure and functions of biomolecules produced by the cells.
CSO2. Develop awareness regarding the structure, classification and sequencing of proteins.
CSO3. Understand the mechanism of action of hormones in the body and phytohormones in cellular activities of plants.
CSO4. Awareness on equilibrium of biochemical reactions, redox reactions and free energy changes in biological reactions.

UNIT-I


UNIT-II

Amino acids - Classification, structure and physico-chemical properties. Chemical synthesis of peptides. Solid-phase peptide synthesis. Proteins - classification, purification and criteria

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


UNIT-V


Books suggested:

2. Biochemistry by L. Stryer 4 Ed. (Freeman-Toppan).
3. Text Book of Biochemistry by West et. al. (Mac Millan).
Course Outcomes:

CO1. Gain knowledge on classification and growth of bacteria
CO2. Introduced to methods of sterilization, pasteurization and disinfection.
CO3. Understand the mechanism of recombination and transposition in prokaryotes.
CO4. Obtain knowledge on general characteristics of different plant and animal viruses.
CO5. Attain an insight into the biology of clinically important bacteria, viruses and protozoans.
CO6. Familiarize with emerging, re-emerging diseases and biohazards with their safety precautions.

Learning Outcomes:

LO1. Understand the bacterial classification and reproduction.
LO2. Distinguish the physiological and growth aspects of microbes.
LO3. Appreciate the role of the different gene transfer methods in bacterial evolution.
LO4. Understand concepts of various medically important pathogenic microorganisms.
LO5. Interpret the importance of various emerging viruses and vaccines.
LO6. Aware of biohazards and its management.

Course Specific Outcomes:

CSO1. Knowledge of staining techniques to diagnose bacteria and microbiology of water, milk, air, soil and sewage.
CSO2. Knowledge of horizontal gene transfer and its role in acquiring antibiotic resistance in bacteria.
CSO3. Aware of clinically important bacteria, protozoans and viruses including the latest COVID-19.
CSO4. Understand the economic importance of algae and fungi and management of biohazards.

UNIT-I

UNIT-II


UNIT-III


UNIT-IV


UNIT-V


Books suggested:

2. Microbiology by Tortora, Funke and Case.
6. Emerging and Re-Emerging Infectious Diseases by Dutta Tarun Kumar (Jaypee Brothers Medical Publishers)
PAPER BT 1.4 - ANALYTICAL TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

Course Outcomes:

CO1. Gain knowledge on basic tools and techniques of biotechnology and its principle and applications.
CO2. Obtain knowledge about microscopy and spectroscopy.
CO3. Know the importance of chromatography and centrifugation.
CO4. Familiarize with radioactivity, electrochemical techniques and electrodes.
CO5. Understand the basics of blotting techniques.
CO6. Attain an insight into X-ray diffraction and Flow cytometry.

Learning Outcomes:

LO1. Understand the different types of light and electron microscopy techniques.
LO2. Able to distinguish the different spectroscopic instruments.
LO3. Understand various techniques of chromatography like TLC, GLC and HPLC.
LO4. Perceive the advantages of electrophoresis and centrifugation.
LO5. Comprehend the techniques used in detection of radioactivity.
LO6. Familiarize with basic concepts on blotting techniques, DNA fingerprinting and X-ray diffraction.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on different types of microscopic and spectroscopic techniques.
CSO2. Awareness on concepts of different chromatographic and centrifugation techniques and applications of those techniques in analysis of biomolecules.
CSO3. Distinguish different types of electrophoresis and applications of different kinds of electrodes.
CSO4. Apprehend the significance of different hybridization techniques and DNA fingerprinting.

UNIT-I

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 ultracentrifuges. Principles and applications of lyophilization.

UNIT-III

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

UNIT-IV


UNIT-V


Books suggested:

1. Analytical Biochemistry by David J.Holme (Longman).
3. Instrumental methods of chemical analysis by G.K.Sharma (Goel).
5. Physical Biochemistry by Freefielder (Freeman & Co).
6. Biophysical chemistry principles and techniques by Upadyay, Upadyay and Nath (Himalaya publishing).
1. Mitosis in onion root tip cells: All phases (Squash method).
2. Meiosis in onion flower buds: All phases including zygotene, diplotene and diakinesis of prophase I (Smear method).
3. Preparation of liquid and solid media for the growth of microorganisms.
4. Slants and Stab cultures, Isolation and maintenance of microorganisms by plating, streaking and serial dilution methods.
5. Simple staining and Gram’s staining.
6. Acid fast and spore staining.
7. Microscopic examination of bacteria, yeast and molds.
9. Analysis of water for potability and determination of MPN.
10. Microbiological examination of milk.
11. Oligodynamic action of heavy metals.
13. Examination of external features and reproductive bodies of algae and fungi.
14. Representative species of protozoa.

Books suggested:

1. Handbook of Microbiological Media by Atlas R.L.
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

2. Separation of amino acids/ sugars/ lipids by Thin Layer Chromatography.
3. Ultra violet absorption spectra of Nucleic acids and proteins.
4. Determination of molar extinction coefficient of Tryptophane / Tyrosine.
5. Gel filtration of proteins.
6. Ion exchange chromatography of amino acids.
7. Purification of enzyme by Affinity chromatography.
8. Sub cellular fractionation by differential centrifugation.
10. Estimation of Glycine by Formal titration.
15. Estimation of Cholesterol.

Books suggested:

2. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
4. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).
Course Outcomes:

CO1. Gain knowledge on basic enzymology.
CO2. Familiarize with methods of measuring enzyme activity.
CO3. Understand the different metabolic pathways of glucose.
CO4. Know the importance of purines, pyrimidines and their metabolism.
CO5. Knowledge of therapeutic applications of enzymes.
CO6. Appreciate biological role and importance of minerals and trace elements in the human body.

Learning Outcomes:

LO1. To understand the different types of enzymes, enzyme kinetics and enzyme assays.
LO2. Able to distinguish the different mechanisms of enzyme action.
LO3. Comprehend the multiple processes of glucose metabolism.
LO4. Understand the synthesis of fatty acids, ketone bodies and recycling of cholesterol.
LO5. Comprehend the biosynthesis and degradation of amino acids, and nucleotides.
LO6. Apprehend the therapeutic uses of enzymes in clinical analysis and importance of minerals in biological systems.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on different types of enzymes and nomenclature of enzymes.
CSO2. Awareness on importance of enzyme kinetics, assay methods, mechanism of enzyme action and enzyme inhibition studies.
CSO3. Understand the fundamental concepts on various metabolic pathways in biological systems.
CSO4. Familiarize with the clinical significance of enzymes, minerals and trace elements.

UNIT – I

UNIT-II


UNIT – III


UNIT – IV


UNIT-V


Books suggested:

4. Text Book of Biochemistry by West et al. (Mac Millan).
8. Enzymes by Palmer (East).
PAPER BT 2.2- MOLECULAR BIOLOGY

Course Outcomes:

CO1. Gain knowledge on basic concepts of organization of genetic material and structure of gene.
CO2. Understand the mechanism of replication in prokaryotes and eukaryotes.
CO3. Understand the mechanism of transcription in prokaryotes and eukaryotes and post transcriptional modifications.
CO4. Attain an insight into the mechanism of protein synthesis in prokaryotes and eukaryotes and the significance of post translational modifications.
CO5. Understand the ways by which gene expression is regulated in prokaryotes and eukaryotes.
CO6. Familiarize with the factors responsible for DNA damage and different DNA repair mechanisms.

Learning Outcomes:

LO1. Understand the packing of DNA and genome organization.
LO2. Knowledge of the role of different enzymes involved in DNA replication process.
LO3. Understand the mechanism of transcription and post transcriptional modifications.
LO5. Knowledge of different ways by which gene expression is regulated.
LO6. Apprehend the types of DNA damage and repair mechanisms.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on organization of genetic material, different types of genes and fine structure of the eukaryotic gene.
CSO2. Awareness regarding mechanisms involved in replication and gene expression in both prokaryotes and eukaryotes.
CSO3. Appreciate the control of gene expression at various levels.
CSO4. Familiarize with the concept of DNA damage and repair and have an idea of mutations.

UNIT – I

UNIT – II

Transcription in prokaryotes and eukaryotes. RNA polymerases, DNA binding domains in transcription factors - zinc finger, leucine zipper, helix-loop-helix and helix turn helix. Mechanism of transcription. Maturation and processing of m-RNA - splicing, 5' end capping and 3' end tailing. Alternative splicing. RNA editing and transport. RNAi and small RNAs.

UNIT – III


UNIT – IV


UNIT-V


Books suggested:

1. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan)
2. Genes VIII by B.Lewin (Oxford)
3. Cell and Molecular Biology by E,D,P.DeRoberties (International edition)
5. DNA Science by David Micklos Carolina Publishing Company.
7. RNAi-Design and application by Barik, Sain Eds. (Springer).
PAPER BT 2.3- GENETIC ENGINEERING

Course Outcomes:

CO1. Understand the overall concept of r-DNA technology.
CO2. Introduced to different enzymes used in genetic engineering.
CO3. Obtain knowledge on salient features and types of cloning vectors.
CO4. Know the different gene transfer techniques.
CO5. Attain an insight into selection of recombinant cells, PCR and microarray techniques.
CO6. Familiarize with the applications of genetic engineering in various fields.

Learning Outcomes:

LO1. Obtain an overview of rDNA technology, isolation and purification of DNA, RNA and plasmid DNA.
LO2. Comprehend the types and usage of specific enzymes in genetic engineering.
LO3. Knowledge on the ability to create and use vectors in r DNA technology.
LO4. Able to differentiate between different gene transfer techniques.
LO5. Understand the screening methods employed in selecting recombinant clones in genetic engineering.
LO6. Apprehend the latest technologies like genome editing and protein engineering.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on the steps involved in gene cloning.
CSO2. Awareness regarding the tools used in genetic engineering.
CSO3. Understand various techniques of gene transfer and selection of rDNA clones.
CSO4. Familiarize with applications of rDNA technology.

UNIT-I


UNIT-II

Enzymes used in genetic engineering. Restriction endonucleases - Classification, nomenclature and properties. Restriction mapping. DNA polymerase-I. Polynucleotide kinase. Terminal nucleotide transferase. Reverse transcriptase - structure, mechanism and functions. Alkaline phosphatase. S1 nuclease. DNA Ligases and ligation of foreign DNA to vectors - cohesive and blunt end methods.
UNIT – III


UNIT – IV


UNIT – V


Books suggested:

4. DNA Science by David Micklos (Carolina Publishing Company).
5. From genes to clones by Winneker.
6. From genes to genomes concepts and applications of DNA technology by Jeremy W dale and Malcolm von Scrantz, Wiley Black well
7. Molecular Biotechnology by Glick.
10. Protein Engineering by Bornscheuer (Springer)
PAPER BT 2.4- BIOLOGY OF IMMUNE SYSTEM

Course Outcomes:

CO1. Gain knowledge on cells and organs of the immune system.
CO2. Obtain knowledge on cell mediated immunity.
CO3. Obtain knowledge on antibody mediated immunity.
CO5. Understand various immunological techniques.
CO6. Able to understand hypersensitivity reactions and self-reactivity.

Learning Outcomes:

LO1. Attain fundamental knowledge on the architecture of the immune system.
LO2. Comprehend and articulate the principles of clonal nature of immune response, immunological memory and immune regulation.
LO3. Have knowledge regarding the structure and functions of different classes of MHC.
LO4. Understand the various immunological techniques like RIA, ELISA, FACS and hybridoma technology.
LO5. Recognize how hypersensitivity and allergy derive from “mis-direction” of normal adaptive immune responses.
LO6. Apprehend the immune response in humans against invading microorganisms and tumor immunology.

Course Specific Outcomes:

CSO1. Awareness regarding concepts of immunity, cells and organs of immune system.
CSO2. Have a thorough knowledge on components of immune system and immune response.
CSO3. Distinguish different types of immunological techniques and their application in disease diagnosis.
CSO4. Gain knowledge about autoimmunity and transplantation immunology.

UNIT-I


UNIT-II

T-cell receptor – structure and function. T cell maturation, activation, and differentiation. Types of cells mediated immunity, effector functions of $T_H$ and $T_C$ cells and lymphokine

UNIT-III


UNIT-IV

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

UNIT-V

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 suggested:

1. Essentials of Immunology by Roitt (ELBS).
2. Immunology by Roit et.al (Harper Row).
3. Textbook of Immunology by S.T. Barrot (Mosby).
5. Principles of Microbiology and Immunology by Davis et.al (Harper).
1. Isolation of RNA from yeast.
2. Estimation of RNA using orcinol reagent.
3. Isolation of DNA from microbial, plant and animal sources.
4. Estimation of DNA using diphenylamine reagent.
5. Isolation of plasmid DNA.
6. Digestion of plasmid DNA with restriction endonucleases.
7. Separation of DNA fragments by Agarose gel electrophoresis.
8. Elution of DNA from agarose gels.
9. Ligation of DNA fragments.
13. Amplification of DNA by PCR.
14. Southern blotting technique.
15. RFLP mapping.
16. RAPD mapping

**Books suggested:**

1. Biotechnology-A laboratory course by Becker J.M.
BT 2.6: LAB: IV- ENZYMEOLOGY AND IMMUNOLOGY

1. Assay of Amylase from Saliva.
2. Assay of Trypsin.
3. Assay of Acid-phosphatase from potato.
5. Assay of Catalase from liver.
6. Time course of enzyme activity
7. Effect of pH and determination of optimum pH.
8. Effect of temperature on enzyme activity and calculation of energy of activation.
9. Effect of substrate concentration on enzyme activity and determination of Km.
10. Effect of metal ions on enzyme activity.
12. Handling of mice and rats, techniques of immunization and bleeding.
15. Radial immunodiffusion.
17. Immunoelectrophoresis.
18. Latex agglutination test.
19. Enzyme Linked Immunosorbent Assay (ELISA).
20. Western blotting.

Books suggested:

2. Biochemical methods By Sadasivam and Manickam (Wiley Eastern limited).
7. Manual of clinical laboratory immunology by Rose NR.
8. The experimental foundations of modern immunology by Clark W.R.
9. Laboratory Immunology by Bradshaw L.J.
M.Sc., (Final) BIOTECHNOLOGY

SEMESTER – III

PAPER BT 3.1 - CELL CULTURE TECHNOLOGY AND TISSUE ENGINEERING

Course Outcomes:

CO1. Gain knowledge on plant tissue culture media and techniques.
CO2. Familiarize with animal cell culture techniques.
CO3. Obtain knowledge about artificial tissues and organs.
CO4. Familiarize with different types of stem cells, their differentiation and propagation.
CO5. Understanding of applications of stem cells.
CO6. Attain knowledge on neuromorphology, neurophysiology and neurodegenerative diseases.

Learning Outcomes:

LO1. Understand the different types of plant cell culture techniques and their importance.
LO2. Able to distinguish the different mechanisms of mammalian cell culture techniques.
LO3. Understand production of various artificial tissues and organs and their role in transplantation studies.
LO4. Comprehend the importance of stem cells in bone marrow transplantation.
LO5. Apprehend the significance of morphology and physiology of nerve fibers.
LO6. Understand the different kinds of neurodegenerative diseases.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on plant tissue culture technology and their applications in plant research.
CSO2. Understand the concept of animal cell and tissue culture and its utility in generation of artificial tissues and organs.
CSO3. Understand the biology and engineering of stem cells.
CSO4. Familiarize with neuro humoral transmission and neurodegenerative diseases.

UNIT-I

UNIT-II


UNIT-III


UNIT-IV


UNIT-V


Books suggested:

1. Plant tissue culture – theory and practice by Bhojwani S.S.
2. Plant cell culture – A practical approach by Dixion R.A.
7. Plant tissue and cell culture, by Street, HE (Blackwell).
8. Stem cells in regenerative medicine by Audet (Springer).
9. Cell and tissue reaction engineering by Eibl (Springer).
PAPER BT 3.2- PLANT BIOTECHNOLOGY

Course Outcomes:

CO1. Gain knowledge on basic concepts in different approaches involved in developing transgenic plants for human welfare.
CO2. Introduced to molecular markers and their applications.
CO3. Understand technological ideas in plant science to address disease resistant varieties and organic farming.
CO4. Know the importance of production of transgenic plants for the quality enhancement in crop production.
CO5. Attain insight in to the laboratory culturing and production of micro algae.
CO6. Acquire knowledge on different types of biofertilizers and biopesticides.

Learning Outcomes:

LO1. Perceive the fundamental aspects in plant biotechnology.
LO2. Understand various gene delivery strategies for producing transgenic plants.
LO3. Understand the use of molecular markers in crop improvement.
LO4. Understand the strategies for increasing nutritional value and yield in plants.
LO5. Apprehend transgenic technology for crop yield.
LO6. Gain knowledge on algal biotechnology with culturing of micro and macro algae and understand about concepts of bio fertilizers and bio pesticides.

Course Specific Outcomes:

CSO1. Have a thorough knowledge of plant genetic engineering.
CSO2. Awareness regarding transgenic science in plant improvement.
CSO3. Able to understand agricultural biotechnology.
CSO4. Familiarize with concepts of large-scale biomass production, development of biofertilizers and biopesticides for enhanced crop production.

UNIT-I


UNIT-II

Transgenic science in plant improvement - Modern Plant Breeding. Molecular markers and their significance. Molecular markers based crop improvement. Quantitative trait loci (QTL)

UNIT-III


UNIT-IV


UNIT-V


Books suggested:

2. Biotechnology in Agriculture by Swaminathan, M.S. (Mc. Milllan India Ltd).
5. Biotechnology in Sustainable and Organic Farming by A K Yadav S R Chaudhary N C Talukdar (Shree Publisher).
Course Outcomes:

CO1. Gain knowledge on basic infertility conditions.
CO2. Familiar with methods of advanced techniques like IVF in biological systems.
CO3. Obtain knowledge about transgenesis in animals.
CO4. Know the important ecological sources of aquatic species.
CO5. Understand different methods for improving aquaculture.
CO6. Attain an insight on basic features of development in animals and cell culture assays.

Learning Outcomes:

LO1. Understand the different types and causes of male and female infertility in mammals.
LO2. Emphasize on IVF as a technique in improving livestock.
LO3. Familiarize with the methods of production of transgenic animals
LO4. Perceive the advantages of aquatic biotechnology with the versatile diversity in aquatic animals.
LO5. Comprehend the concepts on culturing of aquatic species.
LO6. Apprehend fundamentals of development biology in animals and cell culture assays used in animal cell cultures.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on different types of infertility conditions and treatment methods available.
CSO2. Awareness regarding concepts of IVF, immunocontraception and biotechnological approaches for the management of pests, mosquitoes and nematodes.
CSO3. Understand the fundamental concept of production of transgenic animals.
CSO4. Familiarize with basic concepts on aquatic biotechnology and medical embryology.

UNIT-I


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 by-products. Pearl culture technology – principles and applications.

UNIT-IV


UNIT-V


Books suggested:

1. Elements of Biotechnology by PK Gupta (Rastogi & Co).
4. Principles and practices of aquaculture by TVR Pillay.
5. Coastal aquaculture by Santhanam.
6. Fisheries of India by CBL Srivatsava.
7. Molecular Biotechnology by Glick.
PAPER BT 3.4- MEDICAL AND ENVIRONMENTAL BIOTECHNOLOGY

Course Outcomes:

CO1. Introduced to techniques involved in development of health care products.
CO2. Understanding PCR and its applications.
CO4. Gain knowledge on environmental pollution sources, adverse effects and biotechnological control.
CO5. Obtain knowledge on renewable sources of energy and bioleaching of ores.
CO6. Attain insight into biotechnological remedies for environmental problems.

Learning Outcomes:

LO1. Apprehend the principles of biotechnological techniques used in the production of health care products.
LO3. Understand concepts and applications of biotechnology for control and management of pollution and global environmental problems.
LO5. Have an idea of production of biofuels to save the environment.
LO6. Understand the relationship between environmental pollution and human health.

Course Specific Outcomes:

CSO1. Understand biotechnological strategies to combat pandemics and for the human health care products.
CSO2. Insight into biotechnological applications for disease diagnosis and therapy
CSO3. Have a thorough knowledge of global environmental problems and alternate strategies in producing biofuels.
CSO4. Awareness regarding the impact of environmental pollutants on human health.

UNIT-I

Medical Biotechnology - Overview of Medical Biotechnology. Human health care products from recombinant DNA Technology. Insulin, growth hormone, factor VIII, tissue plasminogen activator, interferons, lymphokines, Hepatitis-B vaccine and SARS-CoV-2 vaccine. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis.

UNIT-II

Biotechnological applications for Disease diagnosis. DNA probes. Enzyme probes - glucose
oxidase, lactate oxidase, monoamine oxidase. Polymerase Chain Reaction amplification and diagnosis. PCR applications in forensic medicine. Biotechnological solutions for controlling emerging diseases. Genetic diseases and gene therapy.

UNIT-III


UNIT – IV


UNIT – V


Books suggested:

1. Biotechnology by B.D.Singh (Kalyani).
2. Ecology and Environment by PD Sharma.
5. Biotechnological innovations in environmental management by Leach, CK and Van Dam Mieras, MCE (Butterworth Heinemann, Oxford (Biotol Series).
BT 3.5: LAB - V: PLANT TISSUE CULTURE TECHNIQUES

1. Preparation of media for plant tissue culture (MS and B5).
2. Establishment of callus cultures from carrot cambial tissue.
3. Establishment of cell cultures and plating.
4. Embryo culture.
5. Organogenesis and regeneration of plants.
6. Another culture and production of haploids.
7. Micropropagation using the suitable system: Potato/solanum sps.
8. Isolation of protoplast and culture.
9. Polyethylene glycol (PEG) mediated fusion of protoplasts.
10. Agrobacterium culture and transformation.

Books suggested:

1. Plant cell culture – A practical approach by Dixion RA.
2. Plant tissue culture – theory and practice by Bhojwani, S.S
3. Biotechnology: A laboratory course by Becker, J.M.
BT 3.6: LAB-VI: ANIMAL CELL CULTURE AND ENVIRONMENTAL BIOTECHNOLOGY

1. Preparation of animal cell culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. MTT assay for cell viability.
5. Estimation of dissolved oxygen and salinity in water samples.
7. Estimation of Biochemical Oxygen Demand (BOD).
8. Determination of suspended solids in industrial effluents.
9. Removal of color of the industrial effluents by biological methods.
10. Reduction of pollution load in effluents by biological methods (laboratory models).

Books suggested:

5. Introduction to Biodeterioration, D.Allsopp and K.J.Seal, ELBS/Edward Arnold.
Course Outcomes:

CO1. Gain knowledge on fundamentals of industrial biotechnology.
CO2. Acquire knowledge on design and types of bioreactors and fermentation process.
CO3. Insight on production of active recombinant proteins of mammalian origin.
CO4. Gain knowledge on different methods of downstream processing.
CO5. Aware of the industrial production of various biotechnological products.
CO6. Familiarize with immobilization of enzymes and biosensors in the field of biotechnology.

Learning Outcomes:

LO1. Emphasize on basic concepts of bioreactors, growth kinetics and significance of different factors influencing microbial growth in fermenter.
LO2. Insight on types of fermentation strategies for the submerged and solid-state fermentations.
LO3. Understand the heterologous expression and GRAS strains in production of recombinant proteins
LO4. Importance of downstream processing in industrial production and processing technology in production of different microbial metabolites.
LO5. Understand various uses of free enzymes and immobilized enzymes involved in industrial biotechnology.
LO6. Understand how to evaluate and apply principles of biosensor technology in various fields.

Course Specific Outcomes:

CSO1. Have a thorough knowledge of types and operation of bioreactors.
CSO2. Awareness regarding production of active recombinant proteins of mammalian / eukaryotic origin.
CSO3. Indepth knowledge of downstream processing.
CSO4. Familiarize with enzyme technology and applications of enzymes in pharmaceutical, food processing and other industries.
UNIT-I


UNIT-II


UNIT-III

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

UNIT-IV


UNIT-V


Books suggested:

1. Biotechnology – Volumes 1 to 5 by Rehem.
2. Industrial Microbiology by LE Casida Jr.
3. Industrial Microbiology by Presscot and Dunn.
4. Biotechnology by BD Singh (Kalyani).
5. Biochemical engineering fundamentals by Bailey and Ollis.
PAPER BT 4.2 - BIOINFORMATICS AND BIOSTATISTICS

Course Outcomes:

CO1. Gain knowledge on basics of computer and its use in biological research.
CO2. Know the importance of internet and its applications in biotechnology research.
CO3. Understand types of biological databases and searching of databases.
CO4. Understand sequence alignment, protein structure prediction and phylogeny studies.
CO5. Obtain knowledge about biostatistics and its application in biological research.
CO6. Familiarize with drug development using tools of bioinformatics.

Learning Outcomes:

LO1. Understand the different types of operating systems.
LO2. Able to distinguish the different applications of internet in biological research.
LO3. Understand various online tools and offline tools and role of databases in bioinformatics.
LO4. Knowledge of the advantages of protein structure prediction and molecular phylogeny.
LO5. Comprehend the uses of biostatistics in data tabulation representation and error calculations.
LO6. Apprehend the significance of bioinformatics approach for drug development by molecular dynamic simulation.

Course Specific Outcomes:

CSO1. Have a thorough knowledge on computers and scope of computers in current biological research.
CSO2. Awareness on concepts of tools and databases of bioinformatics.
CSO3. Understand the fundamental concepts of genome annotation, sequence alignment and protein structure prediction.
CSO4. Familiarize with basic concepts of drug development using bioinformatics tools.

UNIT-I


UNIT-II

UNIT-III


UNIT-IV


UNIT-V


Books suggested:

1. Bioinformatics – D.Mount
2. Programming in C by Balaguru Swamy.
11. 3D QSAR in Drug Design: Theory, Methods and Applications, Ed. Kubinyi H., Ledien ESCOM.
BT 4.3: LAB: VII: INDUSTRIAL BIOTECHNOLOGY AND BIOINFORMATICS

1. Production of protease/amylase by batch fermentation.
2. Immobilization of an enzyme (invertase/lipase/amylase) by gel entrapment.
3. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
4. Screening of soil samples for isolation of Bacteria, Fungi and Actinomycetes.
5. Selective isolation of Actinomycetes from soil samples.
6. Microbiological assay of an antibiotic including the construction of standard curve.
7. UV survival curve.
8. Production of alcohol by \textit{S.cerevisiae} and its estimation.
9. Production of citric acid by \textit{A.niger}.
10. Production of red wine from grapes.
11. Searching Data from NCBI Database.
12. Working on EMBL.
13. Searching structural data from PDB.
14. Genome Map viewer from NCBI.
15. Database search using BLAST.
16. Sequence alignments.
17. Sequence and structure visualization.

Books suggested:

1. A manual of Industrial Microbiology and Biotechnology by Demain A.L.
2. Immobilization of enzymes and cells: Methods in Biotechnology vol.1 by Bickerstaff G.F.
4. Biotechnology - A laboratory course by Becker J.M.