VINAYAKA MISSIONS RESEARCH FOUNDATION
DEEMED UNIVERSITY
(VINAYAKA MISSIONS UNIVERSITY)
SALEM, TAMILNADU, INDIA.

FACULTY OF ENGINEERING AND TECHNOLOGY

M.Tech- BIOTECHNOLOGY
PART TIME (WEEKEND)
CURRICULUM-REGULATION-2015

Duration of the Course: 3 years
Total number of credits to be earned for the award of degree: 75

DEPARTMENT OF BIOTECHNOLOGY
VINAYAKA MISSION'S KIRUPANANDA VARIYAR ENGINEERING
COLLEGE
PERIYA SEERAGAPADI, SALEM - 636 308
# CURRICULUM

## I SEMESTER

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**TOTAL CREDITS: 75**
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AIM

To understand the basic concepts of biochemistry. This will be a prerequisite for the courses offered in the subsequent semesters.

OBJECTIVES

At the end of the course, the students would have learnt about

- Carbohydrates and lipids.
- Proteins and nucleic acids.
- Metabolic pathways.
- Bioenergetics.
- Vitamins.

UNIT I

BIOMOLECULES

Biochemistry: The molecular logic of life, Buffering in biological systems, Types of biomolecules, Chemical nature and biological role, Bioenergy – Thermodynamic quantities and laws, Applications of free energy functions, ATP as the main carrier of free energy in biochemical systems, Biological oxidation - reduction reactions, Oxidative phosphorylation, Vitamins and coenzymes.

UNIT II

CARBOHYDRATES

Carbohydrates – Classification, Structure and Properties (Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides), Metabolism of Carbohydrates – Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis, Gluconeogenesis, Pentose Phosphate Shunt. Clinical Correlation – Glycogen storage disease, Diabetes mellitus, Galactosuria, Fructosuria.

UNIT III

LIPIDS

Lipids – Classification, Structure and Properties (Fatty acid, Glycerolipids, Phospholipids, Glycolipids, Sphingolipids, Steroids), Biosynthesis and degradation of lipids – Fatty acid synthesis and oxidative degradation, Triacylglycerol and Phospholipids biosynthesis and degradation, Cholesterol biosynthesis and regulation. Clinical Correlation – Hypercholesterolemia, Atherosclerosis, Fatty Liver, Gaucher’s Disease, Niemann – Pick Disease, Refusme Disease.
UNIT IV

PROTEINS

Proteins – Classification, Structure and Properties (Amino acids, Polypeptides, Conjugated proteins, Glycoproteins and Lipoproteins), Urea cycle and its inherited disorder, Biosynthesis of Gly, Ser, and Cys, Biosynthesis, degradation and disorders of six essential amino acids (Met, Thr, Lys, Ile, Val, Leu).

UNIT V

NUCLEIC ACIDS


Total: 45 hours

TEXT BOOKS


REFERENCES

AIM
To impart knowledge on the fundamental concepts of Bioengineering Mathematics enabling them to do calculations in chemical engineering and biological science.

OBJECTIVES
To understand the concept involved in
- Matrices and Vectors.
- Calculus and its application.
- Differential Equations.
- Numerical Methods.
- Statistics.

UNIT I
MATRICES AND VECTORS

UNIT II
CALCULUS REVIEW
Calculus : Review of Limits, Continuity, Differentiability, Mean Value Theorem. Taylor’s Theorem, Maxima and Minima, Fundamental Theorem of Calculus, Improper Integrals, Applications to Area, Volume, Convergence of Sequences and Series, Power Series, Partial Derivatives, Gradient and Directional Derivatives, Chain Rule, Maxima and Minima.

UNIT III
ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS
First order differential equations : Exact equations, Integrating factors and Bernoulli equations, First order and second order Partial Differential equations - Application to biology, Lagrange’s method and Charpits method.
UNIT IV

NUMERICAL METHODS

Finite Differences – Newton’s Forward and Backward differences formula, Lagrangian Interpolation (Problems only), Algebraic and transcendental methods, False position, Newton Raphson’s method, Solutions of Linear simultaneous equations, Gauss Elimination Method, Gauss Jordan Method and Gauss - Jacobi method (Problems only).

UNIT V

STATISTICS, PROBABILITY AND SAMPLING

Measures of central tendency – Mean, Median, Mode, Measures of dispersion – Moment, Skewness and Kurtosis, Correlation coefficient, Rank correlation, Regressions Lines, Definitions of probability – Samples space, Events, Addition law of probability, Multiplication law and conditional probability, Bays theorem (Without proof) – Simple problems, Definitions of sampling, Student t-test, F-test and Chi square test, Analysis of variance.

Total : 45 Hours

TEXT BOOKS


REFERENCES

AIM

To understand the basic Principles of chemical engineering.

OBJECTIVES

- To study about the unit operations in chemical industry.
- To know about the concept of Thermodynamics, material and energy balance Calculations.
- To understand about the basic concepts of fluid mechanics.
- To study in detail about the methods of transportation of fluids.
- To understand the fundamentals of heat and mass transfer.

UNIT I

INTRODUCTION

Role of chemical engineering in design and analysis of chemical processes, Historical and more recent developments in Chemical engineering and its role in Biological processes. Overview of unit operations and processes in the chemical industry. Units and conversion factor, Introduction to dimensional analysis (Pi – theorem).

UNIT II

THERMODYNAMICS, MATERIAL AND ENERGY BALANCES


UNIT III

FLUID MECHANICS

Classification and Properties of fluids, Fluid statics - forces at fluid surfaces, Pressure and measurement of pressure differences, Fluid flow concepts and basic equations of fluid flow – Continuity equation and Bernoulli’s equation, Shear stress relationship and viscous effects in
fluid flow – Non - Newtonian fluids, Significance of dimensionless groups in fluid flow operations.

UNIT IV

TRANSPORTATION OF FLUIDS

Different types of pumps, Compressors and valves, Measurement of fluid flow using hydrodynamic methods, Direct displacement method, Types of agitators, Flow patterns in agitated vessels, Calculation of power consumption, Applications in bioreactor design.

UNIT V

FUNDAMENTALS OF HEAT AND MASS TRANSFER


Mass Transfer : Molecular and Eddy diffusion, Role of diffusion in bioprocessing, Mass transfer theories, Liquid - solid mass transfer operations - Batch and Fixed bed adsorption, Gas - liquid mass transfer operations - Principles of Absorption, Industrial absorbers.

Total: 45 Hours

TEXT BOOKS

2. Anatharaman. Process calculations

REFERENCES

AIM
To develop the skills of the students by providing hands on training in various biochemical analysis.

OBJECTIVES
At the end of this laboratory course, the students would have learnt about the

- Qualitative analysis.
- Biochemical analysis.
- Enzyme assay.
- Chromatography.

EXPERIMENTS
I. Qualitative Analysis
   (i) Carbohydrates
   (ii) Lipids
   (iii) Proteins
   (iv) Normal and abnormal constituents of urine.

II. Quantitative Analysis
   (i) Estimation of glucose by ortho - Toluidine method
   (ii) Estimation of blood urea by Nessler’s method
   (iii) Estimation of cholesterol by Zak’s method
   (iv) Estimation of bilirubin by Malloy and Erelyn method
   (v) Estimation of protein by Lowry’s method
   (vi) Estimation of nucleic acids by spectrophotometric method
   (vii) Estimation of haemoglobin by Shali’s method.
   (viii) Determination of Erythrocyte Sedimentation Rate by using Westergren Pipette

III. Chromatography
   (i) Separation of sugars and amino acids by Paper chromatography
   (ii) Extraction of lipids and analysis by TLC.

IV. Enzyme assay
   (i) Determination of serum LDH activity
   (ii) Determination of Serum Glutamate Oxaloacetate Transaminase (SGOT) by Mohn and Cook method.
   (iii) Determination of Serum Glutamate Pyruvate Transaminase (SGPT) by IFCC Method
## II SEMESTER

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AIM
To know the fundamentals of microbiology by studying the characteristic structural organisation and replication of microorganisms, microscopy, microbial nutrition and metabolism, effects of microbes and control.

OBJECTIVES
- To have knowledge about the World of microorganisms and microscopy.
- To study the structure and replication concepts of microorganisms.
- To know the requirements of microbial nutrition for growth of microorganisms and the impact of environment on its growth.
- To understand the mechanism of microbial metabolism and the clinical importance of microorganisms.
- To evaluate the control of microorganisms and its environmental applications.

UNIT I
MICRORGANISMS AND MICROSCOPY
Characteristics of microorganisms, Historical review of the foundation of microbiology, Taxonomy methods of studying microorganisms, Microscopy – Light, Electron, Phase contrast and Laser optics systems, Micrometry, Scope of Microbiology.

UNIT II
STRUCTURAL ORGANISATION AND REPRODUCTION OF MICROORGANISMS
Structure, Organization and Reproduction of Bacteria, Yeast, Fungi, Algae, Bacteriophage and Viruses.

UNIT III
MICROBIAL NUTRITION AND ENVIRONMENT
Nutritional requirements, Growth of microorganisms in Natural and Artificial Environment, Aerobic and anaerobic growth, Different methods of enumeration of multiplying microorganisms, Growth curve, Axenic culture, Synchronus culture, Continuous culture, Methods of preservation of microbes, Effects of physical and chemical factors on microbial growth.

UNIT IV
CLINICAL MICROBIOLOGY
Bacterial, Fungal, Viral and Parasitic Diseases, Clinically important microorganisms and their role in infections and immunity, Formation of toxic Substances by microorganisms.

UNIT V
CONTROL OF MICROORGANISMS AND ITS ENVIRONMENTAL APPLICATIONS

Total : 45 Hours

TEXT BOOKS

REFERENCES
AIM
To understand the fundamental concept of Stem Cell Technology.

OBJECTIVES
At the end of the course the student would have gained extensive knowledge on
- Types of Stem cell and its characterization.
- Cell lines and Tissue engineering.
- Isolation and Cloning of Stem cells.
- Types of Stem cell transplantation.
- Applications and Ethics.

UNIT I
STEM CELL AND ITS TYPES
Stem cell – Definition, Embryonic stem cells, Adult stem cells, Origin and characterization of human stem cells and potential applications for stem cell research, Plasticity of human stem cell research, Cord blood stem cells, Stem cell marker.

UNIT II
CELL CULTURE AND TISSUE ENGINEERING
Cell types and sources, Cell culture facilities and applications, Cell and tissue culture medias, Primary cultures and cell lines, Cell culture and scale up, Assays for cell viability and cytotoxicity, Maintenance of stock cells, Biology and characterization of cultured cell, Design and engineering of tissues, Stem cell engineering, Reconstruction of connective tissues, Reconstruction of epithelial or endothelial surfaces – Cells embedded in extracellular matrix material, Culture on a single surface and sandwich configuration, Bioreactor design on tissue engineering – Hollow fibre systems, Microcarrier based systems, Liver tissue engineering.

UNIT III
ISOLATION AND CLONING OF STEM CELLS
Protocols for isolation and identification of stem cells, Culturing and subculturing human neurospheres, Differentiation of human – Neurospheres into neurons, Astocytes and Oligodentrocytes, Immunolabelling procedures, Stem cells and cloning.

UNIT IV

HUMAN EMBRYONIC STEM CELLS


UNIT V

STEM CELL TRANSPLANTATION AND APPLICATION

Types of stem cell transplantation – Autologous, Allogeneic, Syngeneic; Nuclear transplantation, Therapeutic transplantation, Embryonic stem cell transfer and Targetted gene transfer, Neural stem cells for Brain / Spinal cord repair, Miracle stem cell heart repair, Stem cell and future of regenerative medicine, Haematopoietic stem cell therapy for autoimmune disease, Prenatal diagnosis of genetic abnormalities using foetal CD 34+ stem cells, Embryonic stem cell – Germ-line therapy, Human stem cell research in India

Total: 45 Hours

TEXT BOOKS


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AIM
To give an opportunity of verifying the theoretical concept by experimentally in a more explicit and concentrated manner.

OBJECTIVES
The students would have learnt the
- Basic concepts of Microbiology,
- Skills in the preparation, identification and quantification of microorganisms.

EXPERIMENTS
i. Sterilisation Techniques.
ii. Culture Media Preparations
   a. Broth type media
   b. Solid type media
   c. Semi solid type media
iii. Culturing of Microorganisms
   a. Pure Culture techniques
      - Streak plate
      - Pour plate
iv. Identification of Microorganisms
   a. Staining techniques
      - Simple
      - Gram
      - Spore
      - Acid fast
      - Hanging drop
   b. Biochemical testing
v. Environmental Sample Analysis
   - Isolation and enumeration of microbes from sewage or soil samples.
   - Assay of Microbial growth by Substrate Utilisation Test
vi. Food Microbiology
    - Milk
- Fermented food
- Clinical Microbiology
  - Normal Mouth Flora
  - Antibiotic Disc test Assay.

### III SEMESTER

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AIM
The students are introduced to the intricacies of Research and the protocol for a scientific report.

OBJECTIVES
To enable the students to understand the principles
- Scientific writing.
- Data collection, analysis and proper interpretation of the data.
- Processing the collected data and to discuss before arriving at inferences and conclusions.
- Chromatographic techniques & Spectroscopy.

UNIT I
THE SCIENTIFIC WRITING
Need for research, Meaning of research, Characteristics of good research, Major steps in research, Types of research : Pure research, Applied research, Action research Expost Facto research, Experimental research, Survey research, Evaluation of research, Types of research design – Exploratory, Diagnostic, Descriptive and Experimental research designs, Field and documentary sources of data – Primary and secondary data, Survey method, Questionnaire method, Observation method, Case study method, Pilot study and Pre – testing.
Research reports, Thesis – Structure, Style and discourse markers, Topics and topic sentence, Development and illustrations, Logic, Coherence and Cohesion, Journal articles – Format and writing style, Requirement of technical communications – Eliminating wordiness and Jargon – tautology, Redundancy, Imprecise words, Superfluous phrases, Steps to publishing a scientific article in a journal : Types of publications – Communications, Articles, Reviews, When to publish, Where to publish, Specific format required for submission, Organization of the material, Documenting : Abstracts – Indicative or descriptive abstract, Informative abstracts, Foot notes, End notes, Reference styles, Bibliography – Journal abbreviations, Abbreviations used in scientific writing.

UNIT II
TECHNIQUES FOR DATA ANALYSIS

UNIT III

USING DATA TO MAKE DECISIONS

Measures of central tendency – The Mean, Median and Mode, Measures of variability: Range, Mean deviation, Standard deviation, Variance, Coefficient of variance, Probability distributions – Normal, Binomial and Poisson distribution, Correlation methods – Scatter diagrams, Karl Pearson’s correlation coefficient, Spearman’s rank order correlation coefficient, Linear and multiple regression. Non-Parametric tests: Chi square, Mann Whitney test, Kolmogorov – Smirnov two sample test, Duncan’s Multiple test, Test statistical significance: The logic of hypothesis, Testing the null hypothesis (H₀) Level of significance, Degrees of freedom, Students t test, Parametric tests: One way - Analysis of Variance (ANOVA), Two way - Analysis of Variance, Computer software application using Students Statistical Package for Social Science (SPSS) Package for basic and Advanced statistical analysis.

UNIT IV

CHROMATOGRAPHIC TECHNIQUES


UNIT V

SPECTROSCOPY


Total: 45 Hours

TEXT BOOKS

REFERENCES
AIM
To study in detail about the immune system and the immunotechniques.

OBJECTIVES
• To have a basic knowledge about the immune system.
• To study about the cell mediated immunity.
• To study about the immunity against specific diseases.
• To understand the role of markers and the safety guidelines for rDNA.
• To read in detail about the different types of vaccines and therapeutics.

UNIT I
INTRODUCTION TO IMMUNE SYSTEM
Phylogeny of immune system, Innate and acquired immunity, Hematopoiesis and differentiation, Organization and structure of lymphoid organs, Cells of immune system – B - Lymphocytes, T - Lymphocytes, Macrophages, Dendritic cells, Natural killer, Lymphocyte activated killer cells, Eosinophils, Neutrophils, Mast cells, Clonal nature of immune response, Antibody structure and function – Structural features and biological properties of IgG, IgM, IgA, IgD and IgE.

UNIT II
ASSESSMENT OF CELL MEDIATED IMMUNITY
Identification of lymphocytes and their subsets in blood, T - cell and B - cell activation, Macrophage activation, Macrophage microbicidal assays, Cytokines : Monokines, Lymphokines and Interleukines, In vitro experimentation – Application of the above technology to understand the pathogenesis of infectious diseases.

UNIT III
DISEASES AND IMMUNE SYSTEM
Immunity to Virus, Bacteria, Parasites, Genetic control of immune response, MHC associated predisposition to disease, Infectious diseases – Leprosy, Tuberculosis, Malaria, Filariasis, Amoebiasis, Rabies, Typhoid, Hepatitis, AIDS.

UNIT IV

10

IMMUNOTECHNIQUES

Antigen - antibody interaction, Agglutination and precipitation, Complement fixation test, Immunodiffusion, Radio Immuno Assay (RIA), Enzyme Linked Immunosorbent Assay (ELISA), Western blotting, Immunelectrophoresis, SDS – PAGE, Purification and synthesis of antigen, Fluorescence immunoassay – Immuno Fluorescence (IF), Substrate Labelled Fluorescent Immunoassay (SLFIA), DELFIA, Fluorescence Activated Cell Sorter (FACS), Immunomics.

UNIT V

9

VACCINES AND IMMUNOTHERAPEUTICS

Basic principles of vaccine development, Protein based vaccines, DNA vaccines, Plant based vaccines, Recombinant antigens as vaccines, Reverse vaccinology, Engineered antibodies – Catalytic antibodies, Idiotypic antibodies, Combinatorial libraries for antibody isolation.

Total: 45 Hours

TEXT BOOKS


REFERENCES

2. Roitt and Roitt. Immunology.
AIM
To develop skills of students in Immunology by performing simple experiments in the laboratory.

OBJECTIVES
At the end of the course the student would have gained knowledge to

- Perform test for blood grouping, ELISA and identification of T-cell, Immunofluorescence etc.

EXPERIMENTS
1. Handling of animals, immunization and raising antisera.
2. Identification of cells in a blood smear.
3. Identification of blood groups.
4. Immunodiffusion and immunoelectrophoresis.
5. Testing for Typhoid antigens by Widal test.
6. Enzyme Linked Immunosorbent Assay (ELISA).
7. Isolation and culture of peripheral blood mononuclear cells.
8. Isolation of monocytes from blood.
9. Immunofluorescence.
10. Identification of T-cell rosetting using sheep RBC.

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TOTAL
AIM
To study in detail about the basic concepts underlying the technique of recombinant technology.

OBJECTIVES
• To have a basic knowledge about the cloning vectors.
• To study about the concepts involved in cloning.
• To know the techniques in Genetic Engineering.
• To understand the role of markers and the safety guidelines for rDNA.
• To read in detail about the various applications of transgenesis.

UNIT I
10 CLONING VECTORS
Concepts of recombinant DNA technology – Cutting (Restriction enzymes) and joining of DNA, Plasmid biology, Plasmids as vectors – pBR 322, Derivatives of pBR 322, pUC vectors, Lambda vectors, In vitro packaging, M13 vectors, Cosmids, Phasmids, Retroviral vectors, Baculovirus vectors, Cloning vectors in Gram positive bacteria (pJ101), Cloning vectors in Gram negative bacterium (Col E1, R1, pT181, pSC 101), Cloning vectors in Streptomyces (SLP and SCP), Expression vectors – Prokaryotic expression vectors (E. coli, Streptomyces) and Eukaryotic expression vectors.

UNIT II
8 CLONING STRATEGIES AND RECOMBINANT DNA TECHNOLOGY
Preparation of competent cells, Transformation, Gene transfer methods in plants and animals, Construction and screening of genomic DNA and cDNA library, Analysis of gene expression, Chromosome walking, Chromosome jumping, Transcript mapping, Gene targetting, Transposon tagging.

UNIT III
9 TECHNIQUES IN GENETIC ENGINEERING
DNA Labeling – Radioactive and non-radioactive methods, DNA amplification using PCR and its applications, Random Amplified Polymorphic DNA (RAPD), RT-PCR, Ligase chain reaction, Heteroduplexing. DNA sequencing – Maxam and Gilbert method and Sanger and Coulson enzymatic chain termination method, Nucleic acid hybridization – Southern, Western and Northern, Gene targeting vectors: Gene replacement, Gene knockout, Gene addition – Reporter gene technology, Enhancer trap technology, Phage display technology, Baculovirus Display (BUDS), Yeast one hybrid and two hybrid vectors, iRNA technology: Therapeutic potential of RNAi in metabolic diseases, Gene synthesis.

UNIT IV

GENETIC ENGINEERING AND SAFETY GUIDELINES

Mutagenesis – Deletion mutagenesis, Oligonucleotide derived mutagenesis, Site directed mutagenesis and their applications, Molecular Markers – Variable Number Tandem Repeats (VNTR’s), Minisatellite sequences, Short Tandem Repeats (STR), Microsatellite sequences, Restriction mapping, DNA fingerprinting – Restriction Fragment Length Polymorphism (RFLP) analysis, Gene therapy, Molecular diagnostic methods for genetic diseases, In situ methods to locate transgenes and transcripts, Safety guidelines for recombinant DNA technology and guidelines for the disposal of bio-waste.

UNIT V

APPLICATIONS OF TRANSGENIC PLANTS AND ANIMALS

Gene products: Insulin, Human Gonadotrophic Hormone (HGH), BST, Factor VIII, Interferons, Production of antibodies by genetic engineering, Targetting gene therapeutics: ribozymes, Triple helix therapeutics, Oligonucleotide aptemers, Intrabodies, Genetically engineered vaccines, Biofortification (Nutraceuticals), Plantibodies and Pharmaceutical pharming, Plastics from plants, Flavr Savr tomato, Blue roses, Golden rice, Transgenic animals – Mastitis resistant cattle, Tick resistant sheep, Fast growing sheep, Fast growing fish, Antimalarial mosquitoes, Antifreeze proteins, Fat Salomon, Mutation detection fish, Spider silk from goat milk, Low phosphorus Enron pig, Vaccination for animal health, Engineering food for animals.

Total: 45 Hours

TEXT BOOKS


REFERENCES


4. Winnacker. From Genes to Clones.


AIM
To study in detail about the advanced concepts of Bioprocess Engineering.

OBJECTIVES
- To have a basic knowledge about the Sterilization and Inoculum development
- To study about the concepts involved in design of Bioreactors.
- To know the techniques in Process control of fermentation process
- To read in detail about the various fermentation products
- To know about the bioprocess considerations in plant and animal cultures.

UNIT I
13
STERILIZATION AND INOCULUM DEVELOPMENT

UNIT II
13
DESIGN AND ANALYSIS OF BIOREACTORS
Design and operation of Bioreactors- bioreactor design of agitator/agitator motor, power consumption in aerated bioreactor, design of sparger, mixing time estimation, oxygen mass transfer capability in bioreactor, Removal of Heat in bioreactor, Main parameters to be monitored and controlled in fermentation processes, Batch and continuous stirred tank reactor, Design and analysis of Packed bed and membrane bioreactors – Design and operation of Novel bioreactors – Airlift loop reactor, Fluidized bed and Trickle bed bioreactors, Immobilized enzyme bioreactors.
UNIT III

PROCESS CONTROL AND APPLICATIONS

Biologically important set points and their importance, Measurement of physical and chemical parameters in bioreactors – Monitoring and control of dissolved oxygen, pH, impeller speed and temperature in stirred tank fermenter, Types of controls, Monitoring, Control-loops, Feed back and feed forward, Self adapting controllers, Expert system approach.

UNIT IV

CULTIVATION AND PRODUCT DEVELOPMENT


UNIT V

BIOPROCESS CONSIDERATIONS IN ANIMAL AND PLANT CELL CULTURE

Animal cell cultures – Methods used for the cultivation of animal cells, Bioreactor consideration and products. Plant cell cultures – Comparison to microbes, Bioreactor considerations – Economics of tissue culture.

Total : 45 Hours

TEXT BOOKS


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**AIM**

The course aim is to offer hands on training in the area of Cell culture and cell identification. This will serve as a prerequisite for Post graduate and specialized studies and Research.

**OBJECTIVES**

At the end of the course from various sources, the students would have learnt the methodology
- To isolate cells and to identify them by specialized Microscopy. This will be extremely beneficial to take up project work in Cellular biology.
- To familiarize with core Nucleic acid techniques such as extraction and nucleic acid separations.
- To amplify DNA using Polymerase Chain Reaction.
- To detect and characterize Nucleic acids, through the application of gene probes and blotting techniques.
- To acquire skills in Gene cloning and screening of recombinants.
- To analyze proteins through SDS-PAGE and Western blotting.

**EXPERIMENTS**

1. Leishman staining
2. Giemsa staining
3. Osmosis and tonicity
4. Tryphan blue assay
5. Staining for different stages of mitosis in Allium cepa (Onion)
6. Staining for different stages of meiosis using (Grasshopper)
7. Blue and White selection for recombinants
8. Isolation of Genomic DNA from Plant / Animal / Bacterial Cells
9. Isolation of Total RNA
10. Isolation of Plasmid DNA
11. Quantification of DNA and RNA
12. Gel Electrophoresis of DNA – Agarose Gel, Polyacrylamide gel.
13. Southern Blotting.
14. Polymerase Chain Reaction.
15. Elution of Plasmid DNA from Agarose gel.
16. Restriction digestion of Bacterial Genomic and Plasmid DNA.
17. Ligation of DNA.
18. Preparation of Competent Cells.
20. Screening and selection of Recombinants and Confirmation of Insert DNA in Plasmid.
21. SDS-PAGE.
22. Western Blotting.

REFERENCES

AIM
To develop the skills of the students by providing hands on training in various concepts of Bioprocess Engineering.

OBJECTIVES
At the end of this laboratory course, the students would have learnt about the

- Sterilization and Inoculum development
- Design of Bioreactors.
- Process control of fermentation process
- Production of various fermentation products

List of Experiments
1. Demonstration of a Fermentor and its components.
2. Determination of KL a by sodium sulphite oxidation method
3. Centrifugation
4. Batch Sedimentation
5. Liquid-Liquid extraction
6. Batch Distillation
7. Ammonium Sulphate precipitation
8. Estimation of MM parameters
9. Effect of substrate concentration on growth of E.coli
10. Immobilization of Enzyme- α amylase
11. Effect of temperature on enzyme activity
12. Effect of pH on Enzyme activity
13. Production of wine
14. Estimation of Biomass

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AIM
To understand the basics of entrepreneurship and concepts involved in Bioindustries.

OBJECTIVES
To discuss in detail about the

- Basic Management principles
- Understanding Management strategy
- Bio safety and Bioethics
- Entrepreneurship in Biotechnology
- Biotech demand and investment

UNIT I
BASIC MANAGEMENT PRINCIPLES

UNIT II
MANAGEMENT STRATEGY
Diversification / Merger, Takeover and liquidation strategies – Strategy evaluation and correction – Strategy implementation.

UNIT III

BIOSAFETY AND BIOETHICS

UNIT IV

ENTREPRENEURSHIP IN BIOTECHNOLOGY

UNIT V

BIOTECH DEMAND AND INVESTMENT

Total : 45 Hours

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**AIM**

To familiarize the students with various instruments that are applied in the field of Biotechnology.

**OBJECTIVES**

To study in detail about the
- Introduction of Spectroscopy
- Optical instruments.
- Molecular spectroscopy.
- Thermal and X-ray methods.

**UNIT I**

**INTRODUCTION**
Electromagnetic Radiation and equation of wave, Different types of Molecular Energies, Quantization of Energy and its calculation, Definition and Importance of Spectroscopy, Region of different spectra, Absorption and emission spectra, Instruments – Signal to noise ratio, Spectral Width, Signal Intensity, UV-Visible – Theory of Electronic Spectra (Atomic and Band Spectra, L-B Law, Application and Exception), Chromophore, Auxochrome, Woodward’s rule, Solvent Effect (Bathochromic shift, etc.)

**UNIT II**

**COMPONENTS OF OPTICAL INSTRUMENTS**
Classification and Calibration of Instrumental Methods. General designs of optical instruments, Sources of Radiation, Wavelength Selectors, Sample Containers, Radiation

UNIT III 9

MOLECULAR SPECTROSCOPY

UNIT IV 9

THERMAL METHODS

UNIT V 9

X-RAY METHODS

Total: 45 Hours

TEXT BOOKS

REFERENCES
ELECTIVE 1  PROTEIN ENGINEERING  

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AIM

This course imparts advance knowledge on proteins through a detailed study of protein structure, characteristic property and significance in biological systems.

OBJECTIVES

- To focus on the primary, secondary, tertiary and quaternary structure and their determination.
- Structure and functions of protein of particular importance.
- Protein design principles and database analysis.

UNIT I

PROTEIN ARCHITECTURE

Primary structure: Peptide mapping, Peptide sequencing – Automated Edman method and mass spectroscopy. MALDI – TOF, High - throughput protein sequencing setup, Secondary structure: Alpha, Beta, Loop structures and methods to determine.

Super-secondary structure: Alpha-turn-alpha, Beta-turn-beta (hairpin), Beta-sheets, Alpha-beta-alpha, Topology diagrams, Up and down and TIM barrel structures nucleotide binding folds, Prediction of substrate binding sites.

UNIT II

PROTEIN FOLDING AND STRUCTURE DETERMINATION

UNIT III

PROTEIN LIGAND BINDING EQUILIBRIA
Equilibrium dissociation constant, Kinetic approach to equilibrium, Binding measurements at equilibrium, Derivation of Langmuir isotherm, Multiple binding sites, Graphic analysis of equilibrium ligand binding data, Equilibrium binding with ligand depletion (Tight binding interactions), Competition among ligands for common binding site.

UNIT IV

MEMBRANE PROTEINS AND RECEPTORS
Membrane proteins and receptors, Bacteriorhodopsin, Photosynthetic centers, Fibrous proteins, Collagen, Spider silk, Actin and myosin – Serine proteases, Ribonuclease and lysozyme, Epidermal growth factor, Insulin and PDGF receptors and their interaction with effectors, Protein phosphorylation, Immunoglobulins, Nucleotide and binding proteins.

UNIT V

ENGINEERING AND DESIGN OF PROTEIN STRUCTURES
Protein engineering to increase protein stability, Disulfide bridges, Positive effects of glycine and proline, Stabilizing the dipoles of α helices – Combinatorial methods, Phage display, Optimization of proteinase inhibitors by affinity and specificity, Structural scaffolds, Random peptide libraries (EPO receptor), DNA shuffling, β-structure conversion to α structure.

Total : 45 Hours

TEXT BOOKS

REFERENCES
AIM
To understand the fundamental concepts in enzymology and to study the kinetics and applications of enzymes in an explicit manner.

OBJECTIVES
To impart knowledge on
- Enzyme nomenclature and purification
- Mechanism of enzyme action and kinetics
- Enzyme immobilization and mass transfer effects
- Design of enzyme reactors
- Application of enzymes in various fields
- Enzymatic biotransformation of drugs

UNIT I
INTRODUCTION
Introduction to enzymes, Classification, Sources, Mechanism of enzyme action. Strategies of purification of enzymes, criteria of purity, molecular weight determination and characterization of enzymes. Enzymes of biological importance - Acetylcholinesterase, angiotensin converting enzyme (ACE), ACE Inhibitors, HMG Co A reductase inhibitors, pseudocholinesterase, 5'-nucleotidase (5NT), glucose-6-phosphate dehydrogenase (GPD), CKisoforms, immunoreactive trypsinogen (IRT) and chymotrypsin; amylase isoenzymes.

UNIT II
KINETICS OF ENZYME ACTION
Methods for investigating the kinetics of Enzyme catalysed reactions – Initial velocity
Studies, Estimation of Michaelis Menten parameters, Effect of pH and temperature on
enzyme activity, kinetics of inhibition. Modeling of rate equations for single and multiple
substrate reactions.

UNIT III
IMMOBILIZED ENZYMES
Techniques of enzyme immobilization; kinetics of immobilized enzymes, effect of solute,
partition & diffusion on the kinetics of immobilized enzymes, design and configuration of
immobilized enzyme reactors; applications of immobilized enzyme technology, Economic
argument for immobilization

UNIT IV ENZYMES IN FUNCTIONAL GROUP TRANSFORMATION
Functional group interconversion using enzymes (hydrolysis reaction, oxidation/reduction
reactions, C-C bond formations), Retrosynthetic biocatalysis, Chemoenzymatic synthesis of
natural products. Industrial process using enzymes for production of drugs, fine chemicals
and chiral intermediates.

UNIT V ENZYMATIC TRANSFORMATION
Reaction engineering for enzyme-catalyzed biotransformations. Catalytic antibodies.
Biocatalysts from extreme Thermophilic and Hyperthermophilic microorganisms
(extremozymes). The design and construction of novel enzymes, artificial enzymes,
Biotransformation of drugs (hydroxylation of Steroids), Host Guest Complexation chemistry,
enzyme design using steroid templates, enzymes for production of drugs, fine chemicals and
chiral intermediates.

TOTAL : 45 Hours

TEXT BOOKS:
   Hill, 1986.

REFERENCES:
AIM
To make the students understand about the various concepts involved in the development of drugs and its manufacture in Biopharmaceuticals.

OBJECTIVES
To impart knowledge on
- Sources of Biopharmaceuticals
- Drug action, metabolism and development process
- Preparation, Preservation and Quality testing of drugs.
- Growth Factors and hormones as Biopharmaceuticals
- Vaccines, adjuvants as Biopharmaceuticals

UNIT I
PHARMACEUTICALS OF BIOLOGICAL ORIGIN
Current status and future prospects of biopharmaceuticals – Pharmaceuticals of animal origin, plant origin and microbial origin – Sources of biopharmaceuticals.

UNIT II
DRUG DEVELOPMENT PROCESS
Toxicity studies – Clinical trial, clinical trial design, trial size and study population – Randomized control studies.

UNIT III

9

PRINCIPLES OF DRUG MANUFACTURE
Compressed tablets, Dry and wet granulation, Slugging or direct compression, Tablet presses, Coating of tablets, Capsule preparation, Oral liquids – Vegetable drugs – Topical applications, Preservation of Drugs, Analytical methods and other tests used in drug manufacture, Packing techniques, Quality management, Good Manufacturing Practice (GMP).

UNIT IV

9

GROWTH FACTORS AND HORMONES

UNIT V

9

ANTIBODIES, VACCINES, ADJUVANTS AND ANTI-SENSE TECHNOLOGY

Total : 45 Hours

TEXT BOOKS

REFERENCES
AIM
To introduce the concepts of Nanotechnology and to understand its applications in biotechnology.

OBJECTIVES
To study about
- The basic concepts of Nanotechnology.
- Fabrication and characterisation of nanomaterials.
- Nanoparticles in Biosystems.
- Role of microbes in nanotechnology.
- Applications of Nanobiotechnology.

UNIT I
INTRODUCTION TO CONCEPTS OF NANOTECHNOLOGY
Principle of size, Types of approaches-nano architecture, Molecular manipulations – Bond width Sp hybridization, allotropy, mean path, tensile strength. Overview of micro and nano systems, synthesis properties and characterisation of nano materials. Four generation of nano science, Fabrication, Application of nano particles (long and short term).

UNIT II
FABRICATION AND CHARACTERISATION

UNIT III

NANOMOLECULES IN BIOSYSTEMS

UNIT IV

MICRO ORGANISMS AND NANOBIO TECHNOLOGY
Nanobiotechnology and micro organisms, Polyhydroxyalkanoates (PHA), Cyanophycin inclusions, Magnetosomes, Alginates, Bacteriophages, Bacterial spores, Bacterial protein complexes, s - layer proteins, Bacteriorhodopsin, Nanoscale magnetic iron minerals in bacteria, Nanoparticle - Biomaterial hybrid system.

UNIT V

APPLICATIONS OF NANOBIO TECHNOLOGY AND NANOANALYTICS
Nanomedicine, Nanobiosensor – Electrochemical DNA sensors, Nanobiochips, Nanocrystals in Biological Detection, Fabrication of novel biomaterials through molecular self-assembly, Small scale systems for in vivo drug delivery, Nanotechnology for diagnosis and treatment, Common techniques available for the measurement of nanoparticles – Biochemical computers, Biomechanical computers, Organic and Bioelectronic computers.

Total : 45 Hours

TEXT BOOKS
REFERENCES
AIM

The paper is meant for an in depth study of the nuances of Metabolic engineering.

OBJECTIVES

A comprehensive programme for the students to

- Learn the engineering aspects of metabolism.
- Understand the underlying concepts of Cellular reactions.
- Study the applications of metabolic flux analysis.
- Get to know details of metabolic control.
- Know about the analysis of metabolic networks.

UNIT I

REVIEW OF CELLULAR METABOLISM


UNIT II

MATERIAL BALANCES AND DATA CONSISTENCY

Comprehensive models of cellular reactions, Stoichiometry of cellular reactions, Reaction rates, Dynamic mass balances, Yield co-efficients and linear rate equations, Analysis of over determined systems – Identification of gross measurement errors.

UNIT III

METABOLIC FLUX ANALYSIS

**UNIT IV**

**METABOLIC CONTROL ANALYSIS**

9

Fundamentals of metabolic control analysis, Control co-efficients and the summation theorems, Determination of flux control co-efficients, MCA of linear pathways, Branched pathways, Theory of large deviations.

**UNIT V**

**ANALYSIS OF METABOLIC NETWORKS**

9

Control of flux distribution at a single branch point, Grouping of reactions, Case studies, Extension of control analysis to intermetabolite, Optimization of flux amplifications, Consistency tests and experimental validation.

**Total : 45 Hours**

**TEXTBOOKS**


**REFERENCES**

ELECTIVE II  BIOREACTOR ENGINEERING

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AIM

This course introduces basic principles involved in Bioreactor engineering and makes the students learn the fundamentals needed for a Bioreactor design.

OBJECTIVE

This course aims to elaborate on concepts like

- Transport process in Bioreactor.
- Monitoring of Bioprocesses.
- Design and analysis of Biological reactors.
- Fermentation technology.
- Scale up of reactors.

UNIT I

TRANSPORT PROCESS IN BIOREACTOR

Gas-liquid mass transfer in cellular systems, Determination of oxygen transfer rates, Mass transfer for freely rising or falling bodies, Forced convection mass transfer, Overall K_La estimation and power requirements for sparged and agitated vessels, Mass transfer across free surfaces, Other factors affecting K_La, Non-Newtonian fluids, Heat transfer correlations, Thermal death kinetics of microorganisms, Batch and continuous heat, Sterilization of liquid media, Filter sterilisation of liquid media, Air, Design of sterilisation equipment batch and continuous.

UNIT II

MONITORING OF BIOPROCESSES
On-line data analysis for measurement of important physico-chemical and biochemical parameters, Methods of on-line and off-line biomass estimation, Microbial calorimetry, Flow injection analysis for measurement of substrates, Product and other metabolites, State and parameter estimation techniques for biochemical processes.

UNIT III 9

DESIGN AND ANALYSIS OF BIOLOGICAL REACTORS

Ideal bioreactors – Batch, Fed batch, Continuous, Cell recycle, Plug flow reactor, Two stage reactors, Enzyme catalyzed reactions, Reactor dynamics and stability, Reactors with non-ideal mixing, Other types of reactors – Fluidized bed reactors, Packed bed reactors, Bubble column reactors, Trickle bed reactors.

UNIT IV 9

FERMENTATION TECHNOLOGY

Case studies on production of Lactic acid, Glutamic acid, Pencillin, Microbial lipase and Protease, Recombinant insulin. Case studies should deal with strain improvement, Medium designs, Process optimization etc.

UNIT V 9

SCALE-UP OF REACTORS

Scale-up by geometry similitude, Oxygen transfer, Power correlations, Mixing time.

Total : 45 Hours

TEXT BOOKS


REFERENCES

2. Lee and James, M. Biochemical Engineering, PHI, USA.
AIM
To study about in detail the marine organisms and the application of biotechnology on the marine environment.

OBJECTIVES
To learn and study about the details of
- Marine organisms in the ocean.
- Biotechnology of aquatic animals.
- Biomedical importance of marine organisms.
- Biomaterials produced by the marine organisms.
- The impact of biotechnology for improving the marine environment.

UNIT I
INTRODUCTION TO MARINE MICROBES IN THE OCEAN

UNIT II
BIOTECHNOLOGY OF AQUATIC ANIMALS
Shell Fish and Crustacean Culture: Aqua Culture – Shrimps, Corals, Pearl Oyster, Sea weeds, Edible Mussels, Crabs, Fish Breeding and Mass Production, Induced Breeding, Artificial insemination, Transgenic Breeding, Fish Farming and Culture, Developments of Healthy Fish Diets, Disease Prevention in Fish and GM Fish and Shell Fish. Aquaculture of Marine Invertebrates such as Bryozoans, Sponges and Tunicates. Isolation, Cultivation and Fermentation of Microorganisms from their Invertebrate hosts.

Disease Associated with Cultured Shrimps and Fishes: Disease Management – Vaccines, Antibiotics, Immunostimulants, Immunomodulants, Diagnostic Kits, Probiotics.

UNIT III

BIOMEDICAL IMPORTANCE OF MARINE ORGANISMS

Marine Pharmacology: Pharmaceutical and Bioactive Natural Products – Microalgae as a source of Bioactive Molecules – New Antibiotics, Antiviral and Anticancer Drugs, Anti Fungal drugs, Medicines and Marine Organisms – Potentialities in the treatment of Infectious Diseases, Osteoporosis and Alzheimer’s Disease.

Cyanobacterial Biotechnology – Secondary Metabolites and Biosynthetic Gene clusters of Marine Cyanobacteria – Applications in Biotechnology – Secondary Metabolites from Marine derived Fungi.

UNIT IV

BIOMATERIALS AND BIOPROCESSING


Biopotential Uses of Halophilic Organisms, Role of Halophilic Bacteria and Artemia in salt purification.

Tetrodotoxins, Conotoxins, extremozymes from Microbes, Nucleases form Marine Microbes, Exoenzymes from Benthic Flora.

UNIT V

ENVIRONMENTAL AND BIOTECHNOLOGY

Oil spillage and Oil degradation in coastal waters, Genetically Engineered Marine Organisms, algal blooms and phosphate removal, biodegradation of pesticides and heavy metals discharged coastal waters, management of solid wastes disposed into coastal waters, water quality management in Hatcheries and grow out ponds - Biofilters in recycling of water, use of microcosm.

Total: 45 Hours

TEXT BOOKS

REFERENCES

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AIM
This course makes the students knowledgeable in the organization of a plant cell culture laboratory and prepare themselves to exploit the vast plant biodiversity for economically important products.

OBJECTIVES
To expose and make the students understand the concepts of
- Basic concepts in plant Cell propagation and sterile techniques
- Micro propagation
- Cell culture
- Haploid and embryo culture
- Transgenic plants

UNIT I 9
Laboratory organization, Sterile techniques, Nutrition medium, Explant culture, Callus culture, Cell and organ differentiation, Cell culture, Suspension cultures - Batch and continuous cultures, Growth measurements, Photobioreactors.

UNIT II 9
Organogenesis, Somatic embryogenesis Micro propagation, Protoplast - isolation culture, regeneration, somatic hybridization, cybrid technology, Embryo culture and embryo rescue, artificial seeds overcoming crossing barriers, Somaclonal variation, in vitro selection of mutants, Production of haploids – Anther and Pollen culture, Triploid Production: In vitro Pollination and Fertilization, Germplasm storage and cryopreservation.

UNIT III 9
Origin and characterization of different cell types - differentiation - organ culture - Subculture - cell clines - Selection of medium - chemically defined and serum free media - Role of serum in cell culture - Strategies of medium optimization - commercially available medium for mammalian cell culture - different methods - long term cultivation of human adult tissue, Insect cell culture.

UNIT IV

Cell quantification - practical consideration - growth kinetics - medium and nutrients - Types of culture system monolayer culture - Roller bottle - modification - fermenter system - Suspension culture - adaptation - static suspension culture - Scaling up factors - stirred fermenters - Air lift fermenters - Encapsulated cells, Preservation and characterization of cell lines, cytotoxicity and viability assays.

UNIT V

TISSUE ENGINEERING

Developmental biology, Tissue engineering : Basic principles and consideration – Cell type and source, metabolic requirements of cells, reconstruction of connective tissues, reconstruction of epithelial or endothelial surfaces – Cell embedded in extracellular matrix material, Culture on a single surface and sandwich configuration, Scaffolds and tissue engineering – Basic properties, Bioreactor design on tissue engineering – Hollow fibre systems, Microcarrier based systems, Tissue engineering of the liver.

Total : 45 Hours

TEXT BOOKS


REFERENCES

AIM
To get knowledge in the field of Food process technology and its application.

OBJECTIVES
To understand the role of

- Biomolecules in food.
- Food additives in food processing.
- Microorganism in food fermentation.
- Microorganism in food spoilage.
- Microorganism in food preservation.

UNIT I
9
FOOD CHEMISTRY
Constituents of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals, Texture, Flavour and Organoleptic properties of food, Dietary sources, Role and functional properties in food, Biotechnology in relation to the food industry.

UNIT II
9
FOOD MICROBIOLOGY
Sources and activity of microorganisms associated with food, Bacteria, Yeast and Molds – Sources, Types and Species of importance in food processing and preservation, Fermented foods – Dairy products, Meat, Fishery, Non-beverage plant products, Beverages and related products, Single cell protein, Food fermentation, Food chemicals, Food borne diseases – Infections and intoxications, Food spoilage – Causes.
UNIT III
FOOD PROCESSING AND FOOD ADDITIVES 9
Raw material characteristics, Cleaning, Sorting and grading of foods, Physical conversion operations – Mixing, Emulsification, Extraction, Filtration, Centrifugation, Membrane separation, Crystallization, Heat processing, Classification, Intentional and non-intentional additives, Functional role in food processing – Meat, Fisheries, Vegetables, Food colourants – Natural and artificial, Food flavours, Enzymes as food processing aids.

UNIT IV
FOOD PRESERVATION AND FOOD BORNE DISEASES 9
Principles involved in the use of high temperatures – Sterilization, Pasteurization, Blanching, Thermal death curves of microorganisms, Canning, Frozen storage – Freezing characteristics of foods, Microbial activity at low temperature, Factors affecting quality of frozen foods, Irradiation preservation of foods, Classification, Food infections – Bacterial and other types, Food intoxications and poisonings.

UNIT V
APPLICATIONS OF FOOD BIOTECHNOLOGY 9
Fermented food – Batter and baked goods, Dairy products – Milk processing, Cheese, butter, Yoghurt, Ice-cream, Vegetable and fruit products, Edible oils and fats, Meat, Poultry and fish products, Confectionery and beverages.

Total : 45 Hours

TEXT BOOKS

REFERENCES
AIM
The course offers the fundamental concepts in disease transmission, basic principles of molecular methods used in diagnosis, treatment and preventive measures.

OBJECTIVES
Students who successfully completed this course will be able to
- Identify the mode of infection and transmissions of disease causing organisms.
- Relate the microorganisms and their specific disease in detail.
- Explain the genetic nature of human diseases.
- Comprehend the recent molecular analysis and how these methods are used in current diagnostics of infectious diseases.
- Understand the treatment and preventive measures in the medical field.

UNIT I
MODE OF INFECTION AND TRANSMISSION
History of infection, Mode of transmission, Pre-disposing factors of microbial pathogenicity, Normal microbial flora of the human body, Types of infectious diseases, Host - Parasite relationships, Clinical specimens – Collection, Transport and Processing of samples, Interpretation of results.

UNIT II
MICROBIAL, FUNGAL AND VIRAL INFECTIONS AND DISEASES
Bacteria: Representative diseases to be studied in detail are – Tetanus, Diphtheria, Cholera, Typhoid, Tuberculosis, Leprosy, Plague, and Syphilis, Infections caused by Anaerobic bacteria, Spirochetes, Chlamydia and Rickettsiae.

Viruses: Diseases to be studied in detail are – Viral hepatitis, Influenza, Rabies, Polio and AIDS and Viral cancers.

Fungi: Diseases to be taken up in the following categories: Superficial, Subcutaneous, Systemic and Opportunistic mycoses.

Protozoa: Diseases to be discussed are – Amoebiasis, Toxoplasmosis, Trichomoniasis and leishmaniasis.

UNIT III
INHERITED HUMAN DISEASES
Inherited human diseases – Single gene diseases, Complex traits, Cancer genetics, Immunogenetics, Pre-natal diagnosis – Chorionic villus sampling, Amniocentesis pre-implantation diagnosis, Identification and isolation of disease genes – Positional cloning, Functional cloning, Genetic counselling, Concept of gene therapy

UNIT IV
MODERN DIAGNOSTIC METHODS
Modern approaches for diagnosis of infectious diseases, Automated DNA sequencing, Microarrays, Isolation and purification of nucleic acids, Nucleic acid labelling, Hybridization, Basic concepts of gene probes, Dot hybridization and PCR assays, Different levels of Biosafety containments for rDNA experiments.

UNIT V
TREATMENT AND PREVENTIVE MEASURES
Viral vaccines: Conventional – Killed / Attenuated, DNA, Peptide, Recombinant proteins, Bacterial and viral vectors, Biological warfare agents, Mode of action of antibiotics and antiviral: Molecular Mechanism of Drug Resistance (MDR), Anti-viral chemotherapy, Anti-fungal chemotherapy.

Total Hours: 45

TEXT BOOKS
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AIM

This paper provides details of important topics in Environmental biotechnology and will be useful for those who are looking for a challenging career in Environmental biotechnology.

OBJECTIVES

The students are introduced to the topics like

Environment and pollution

- Concept of biodegradation and bioremediation
- Treatment of waste water
- Solid and hazardous waste management
- Environmental management and ethics

UNIT I

ENVIRONMENT AND POLLUTION

Air, Water and Land, Ecosystem, Ecological adaptations, Interactions among soil microorganisms, Biogeochemical cycles, Concepts of biodiversity, Endangered species, *In situ* and *Ex situ* conservation, Gene banks, Types of environmental pollution, Biosensors to detect environmental pollution.

UNIT II

BIODEGRADATION AND BIOREMEDIATION

Biodegradability testing, Biodegradation – Xenobiotic compounds, Pesticides and surfactants, Bioremediation – Efficacy and side effect testing, Approaches – *In situ*
bioremediation (Land forming, Bioventing, Biosparging, Bioaccumulation, Bioaugmentation), Ex situ bioremediation – Composting, Vermicomposting, Biophile process, Phytoremediation, Bioremediation of ecosystem – Soil and aquifiers, Marine oil pollutants and Air pollutants.

UNIT III 9

WASTE WATER TREATMENT

UNIT IV 9

SOLID AND HAZARDOUS WASTE MANAGEMENT
Waste minimization technique, Solid Waste Management (MSW), Methods of collection and disposal, Hazardous waste management – Classification, Methods of treatment and disposal.

UNIT V 9

ENVIRONMENTAL MANAGEMENT
Sustainable development, Environmental issues at Global and National level, Laws governing environment, Environment Impact Assessment (EIA), Environmental ethics

Total : 45 Hours

TEXT BOOKS

REFERENCES
ELECTIVE IV
APPLIED BIOINFORMATICS

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AIM
This course aims to develop the skills of the students in Bioinformatics in different aspects like Genome analysis, sequence alignment, construction of Phylogeny tree and applications.

OBJECTIVES
To introduce the students to
- The basics of Bioinformatics.
- Understanding of popular genome analysis and methods.
- A comprehensive understanding of sequence alignment and the related statistics.
- Understand the basic concepts of Evolutionary tree and phylogeny.
- The applications of Bioinformatics in various fields.

UNIT I
INTRODUCTION
Introduction, Scope of Bioinformatics - Basic UNIX commands and protocols, E-mail, ftp, telnet, Internet, http.
Introduction to databases – Database search – Sequence database search – Biological databases and their uses.

UNIT II
GENOME ANALYSIS
Isolation of genomic and organelle DNA from prokaryotes and eukaryotes, Mapping and sequencing genes, Electrophoretic karyotyping, Construction and screening of genomic DNA libraries, Functional genomics: Sequence based, Microarray based approaches, *In silico* vector construction.

**UNIT III**

**SEQUENCE ALIGNMENT AND DYNAMIC PROGRAMMING**
Basic concepts of sequence similarity, Identity and homology, Definitions of homologues, Orthologues, Paralognes, Sequence patterns and profiles: Basic concept and definition of sequence patterns, Motifs and profiles, Various types of pattern representations viz., Consensus, Regular expression (Prosite-type) and profiles, Profile-based database searches using PSI-BLAST, Analysis and interpretation of profile-based searches.

**UNIT IV**

**EVOLUTIONARY TREE AND PHYLOGENY**
Trees, Parsimony, Phylogeny, Phylogenetic alignment – Connection between multiple alignment and Tree construction, Tools for phylogenetic analysis – CLUSTALW, PHYLIP, MEGA.

**UNIT V**

**APPLICATION OF BIOINFORMATICS**
Emerging new ideas on treating biological systems, Applications of Bioinformatics in various fields – Medicine, Agriculture and Industries.

**Total : 45 Hours**

**TEXT BOOKS**

**REFERENCES**


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**ELECTIVE IV**

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**AIM**

To develop advance level skills in the areas of Genomics and Proteomics.

**OBJECTIVES**

To emphasize the concepts of

- Genome organisation.
- Mapping techniques.
- Micro array techniques.
- 2DE and Mass spectrometry.
- Application of Proteomics.

**UNIT I**

OVERVIEW OF GENOMES OF BACTERIA, ARCHAE AND EUKARYOTA


**UNIT II**

PHYSICAL MAPPING TECHNIQUES
Top down and bottom up approach, Physical Maps - Restriction Map, Linking and jumping of cloned genome sequencing placing small fragments on map, SI assembly, Gap closure, Pooling strategies, Cytogenetic mapping techniques, Comparitive Map, Integrated Map, HGP, DNA microarray, Understanding of microarray data, Correlation of gene expression data to biological processes and computational analysis tools, Metabolic pathways – Databases such as KEGG, EMP.

UNIT III
9
FUNCTIONAL GENOMICS
Gene finding, Annotation, ORF and functional prediction, Subtractive DNA library screening, Differential display and representational difference analysis – SAGE, TOGA application of sequence based and structure based approaches to assign gene functions – e.g., sequence comparison, structure analysis (esp. active site, binding sites) and comparison, pattern identification, use of various derived databases in function assignment.

UNIT IV
9
PROTEOMICS TECHNIQUES
Protein level estimation, Edman protein micro sequencing, Protein cleavage, 2D gel electrophoresis, Metabolic labelling, Detection of proteins on SOS gels, Pattern analysis, Mass spectrometry principles of MALDI-TOF, Tandem MS-MS peptide mass fingerprinting.

UNIT V
9
PROTEIN PROFILING
Post translational modification – Glycoprotein analysis, Phosphoprotein analysis – Protein arrays – Basic principles of bioinformatics-based tools for analysis of proteomic data, Databases such as DIP, PPI server and tools for analysis of Protein-Protein interaction.

Total: 45 Hours

TEXT BOOKS
REFERENCES

### ELECTIVE IV  MOLECULAR DIAGNOSTICS AND THERAPEUTICS

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**AIM**

The course offers the fundamental concepts and basic principles of Molecular infections and diagnosis, instrumentation and detection of genetic disorders

**OBJECTIVES**

Completing the course, the students should be able to

- Explain and interpret the nature of infection.
- Identify the importance of early detection of pathogens.
- Describe the genetic nature of Human diseases.
- Apply his knowledge in current diagnostics of infectious diseases.
- Understand the instrumentation and biosafety aspects involved in molecular diagnosis.

**UNIT I**

**INTRODUCTION**

History of infection, Mode of transmissions, Pre-disposing factors of microbial pathogenicity, Normal microbial flora of the human body, Types of infectious diseases, Host - Parasite relationships, Clinical specimens – Collection, Transport and Processing of samples, Interpretation of results.
MICROBIAL, FUNGAL & VIRAL INFECTIONS

UNIT III

MEDICAL GENETICS
Organization of Human genome, Human Genome Project, Identifying human disease genes, Oncogenes, Tumour suppressor genes, Genetic disorders, Neonatal and Pre-natal disease diagnostics, Gender identification, Analysis of mitochondrial DNA for maternal inheritance, Gene therapy and other molecular based therapeutic approaches, Genetic counselling.

UNIT IV

METHODS IN MOLECULAR DIAGNOSTICS
Isolation and purification of nucleic acids, Nucleic acid labelling, Hybridization, PCR and types, PCR based molecular typing, Molecular diagnosis of pathogens based on 18S and 16S rRNA sequences, PCR in Forensic science.

UNIT V

INSTRUMENTATION FOR MOLECULAR DIAGNOSTICS
Good Laboratory Practices, Automated DNA sequencing, Microarrays, Different levels of biosafety containments for rDNA experiments, Biosafety aspects of tissue / Cell transplantation.

Total: 45 Hours

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AIM
To study in detail about the various concepts of cancer including its carcinogenesis, diagnosis and therapy.

OBJECTIVES
- To know about the fundamental details of Cancer
- To study about the mechanism of carcinogenesis
- To understand about metastasis of cancer
- To study in detail about the cell biology of cancer
- To know about the diagnosis and therapeutics of cancer

UNIT I
9
FUNDAMENTALS
Cancer: Definition, causes, properties, classification, Cell cycle-phases, cyclins and CDKs, check points, Regulation and modulation of cell cycle in cancer, Apoptosis – Extrinsic and intrinsic pathways, apoptosome and caspases – Relevance of apoptotic and anti-apoptotic factors in cancer, Role of Immune system in cancer – role of individual immune cell types against cancer, role of cytokines in immune cell programming against cancer.

UNIT II
9
MECHANISM OF CARCINOGENESIS


UNIT III

INVASION AND METASTASIS OF CANCER


UNIT IV

SUSCEPTIBILITY TO CANCER

Genes conferring susceptibility to cancer, genetic instability – Types, sensing and repairing DNA damage, telomere attrition, aneuploidy – Telomeres and senescence – Cell-Matrix adhesion, cell-cell interaction, cell-cell signaling, malignancy – Role of cadherin, integrin, metalloproteinases and cell invasion.

UNIT V

CANCER DIAGNOSIS AND THERAPY


Total : 45 Hours

TEXT BOOKS


REFERENCES


