CURRICULUM

V SEMESTER

S. No.	Subject Name	L	P	M
Theory				
1.	Immunology	**4**	**0**	**100**
2.	Protein Engineering	**4**	**0**	**100**
3.	Genetic Engineering	**4**	**0**	**100**
4.	Bioinformatics	**4**	**0**	**100**
5.	Mass Transfer Operations	**4**	**0**	**100**
6.	Food Science and Engineering	**4**	**0**	**100**
Practicals				
1.	Immunology	**0**	**3**	**100**
2.	Genetic Engineering	**0**	**3**	**100**

IMMUNOLOGY

AIM

To introduce the science of immunology, to study various types of immune systems, their classification, structure, mechanism of immune activation and to develop the students skill in Immunotechnology.

OBJECTIVES

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

- The immune system, their structure and classification.
- Antibody production and its genetic control.
- Cellular immunology.
- Transplantation and Autoimmunity.
- Techniques in Immunology.

UNIT I

INTRODUCTION TO IM MUNE SYSTEM

Phylogeny of immune system, Innate and acquired immunity, Clonal nature of immune response, Organization and structure of lymphoid organs, Cells of immune system – Hematopoiesis and differentiation – B-Lymphocytes, T-Lymphocytes, Macrophages, Dendrite cells, Natural Killer, Lymphocyte activated killer cells, Eosinophils, Neutrophils, Mast cells.

UNIT II

ASSESSMENT OF CELL MEDIATED IMMUNITY

Identification of lymphocytes and their subsets in blood, T cell activation, Estimation of cytokines, Macrophages activation, Macrophage-microbicidal assays, Hypersensitivity, Immunosuppression.

UNIT III

TRANSPLANTATION AND AUTOIMMUNITY

HLA System, Transplantation – Organ transplantation, Grafting – graft rejection and prevention, Immunosuppressive drugs, Autoimmunity – Auto antibodies in human, Pathogenic mechanism, Experimental models of Autoimmune disease, Treatment of Autoimmune disorders.

UNIT IV

MOLECULAR IMMUNOLOGY

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, Principles and strategy for developing vaccines, Newer methods of vaccine production.

UNIT V

IMMUNOTECHNOLOGY

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

TEXT BOOKS

1. Lydyard, P.M., Whelan, A. and Fanger, M.W., 2003. Instant Notes in Immunology. 2nd Edn., *Viva Books Private Limited*.
2. Dulsy Fatima. Immunology. *Saras Publications*.

REFERENCES

1. Talwar, G.P. and Gupta, S.K., 1992. A Handbook of Practical and Clinical Immunology. Vol. 12., *CBS Publications*.
2. Roitt and Roitt. Immunology.
3. Richard, A., Goldsby, Thomas J. Kindt and Barbara A. Osborne, Kuby. Immunology. IV Edn., *W.H. Freeman and Company*, New York
4. Goding, J.W., 1983. Monoclonal Antibodies : Principles and Practice. *Academic Press*.
5. Benjamin, E. and Leskowitz, S., 1991. Immunology – A Short Course. *Wiley Liss.*, New York.

PROTEIN ENGINEERING

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

BONDS AND ENERGIES IN PROTEIN MAKEUP

Covalent, Ionic, Hydrogen, Coordinate, Hydrophobic and Vander waals interactions in protein structure.

Chemical reactivity in relation to post translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

UNIT II

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 III

PROTEIN FOLDING AND STRUCTURE DETERMINATION

Tertiary structure : Domains, Folding, Denaturation and renaturation. Quaternary structure : Modular nature, Formation of complexes, Protein folding pathways, Stability of folded conformation of proteins. Methods to determine tertiary and quaternary structure – X-ray diffraction, NMR and IR applications.

UNIT IV

STRUCTURE – FUNCTION RELATIONSHIP

DNA – binding proteins : Prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, Helix-turn-helix motifs in homeodomain, Leucine zippers, Membrane proteins : General characteristics, Trans-membrane segments, Prediction, Bacteriorhodopsin and Photosynthetic reaction center, Enzymes : Serine proteases, Ribonuclease, Lysozyme.

UNIT V

PROTEIN ENGINEERING AND PROTEIN DESIGN

Site directed mutagenesis – Protein data base analysis, Methods to alter primary structure of protein, Examples of engineered proteins, Protein design, Principles and examples.

TEXT BOOKS

1. Doanald Voet and Judith Voet, G., 2001. Biochemistry. 3rd Edn., *John Wiley and Sons*, 2001.
2. Branden, C. and Tooze, J., 1999. Introduction to Protein structure. 2nd Edition", *Garland Publishing, NY, USA*.
3. Thomas E. Creighton, 1993. Proteins. Structure and Molecular Properties. 2nd Edn., *W.H. Freeman.*

REFERENCES

1. Moody P.C.E. and Wilkinson A.J., 1990. Protein Engineering. *IRL Press,* Oxford, UK.
2. Thomas M. Devlin. Text Book of Biochemistry with Clinical Correlations. 4th Edn., *John Wiley and Sons, Inc.*

GENETIC ENGINEERING

AIM

To understand the scope of Genetic Engineering and its potential impact on virtually all areas of Biology

OBJECTIVES

To impart advanced technological knowledge through a detailed study on

- The basic concepts in Genetic Engineering
- Techniques involved in rDNA Technology
- Cloning Vectors and Strategies
- Construction of Libraries and Gene mapping
- Gene Modifications
- Applications of recombinant rDNA Technology.

UNIT I

BASIC TOOLS IN GENETIC ENGINEERING

Core techniques in Gene manipulations – Cutting and joining of DNA, DNA Labeling – Radioactive and non-radioactive methods, DNA amplification using PCR and it's applications, 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, Northern and Western.

UNIT II

CLONING AND EXPRESSION VECTORS

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 (p1J101), 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 III

CLONING STRATEGIES

Construction of Recombinant DNA, Preparation of competent cells, Transformation, Transfection, Selection and screening of Recombinants, Expression systems using *E. Coli*, *Streptomyces*, Yeast, Baculovirus and Animal viruses, Cloning in plants, Ti Plasmids of *Agrobacterium*, Structure and function of T-DNA, Gene transfer - Shotgun method, Nuclear injection method.

UNIT IV

GENE LIBRARIES AND GENE MAPPING

Construction and screening of Genomic DNA and cDNA Library, Analysis of Gene expression, Chromosome walking, Chromosome jumping, DNA Probes, Molecular Markers - Variable Nucleotide Tandem Repeats (VNTR's), Minisatellite sequences, Short Tandem Repeats (STR), Microsatellite sequences, Restriction mapping, Transcript mapping, Gene targetting, Transposon tagging.

UNIT V

GENE MODIFICATIONS AND APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY

Mutagenesis – Deletion mutagenesis, Oligonucleotide derived mutagenesis, Site directed mutagenesis and their applications, DNA Fingerprinting - RFLP analysis, Applications of Recombinant DNA Technology for the production of Recombinant proteins – Insulin, Interferon and Growth hormones, Biodegradable plastics, Diagnostics, Pathogenesis, Genetic diversity, Therapeutic vaccines, Transgenic plants and animals, Antisense RNA technique, Safety lines for Recombinant DNA techniques and Guidelines for the disposal of Bio-waste.

TEXT BOOKS

1. Old, R.W. and Primrose, S.B., 1993. Principles of Gene Manipulation. An Introduction to Genetic Engineering. *Blackwell Scientific Publication*.
2. Freifelder, D., 1987. Molecular Biology. *Jones and Bartlett Publishers Inc.*
3. Brown, T.A. Gene Cloning.

REFERENCES

1. Sambrook and Elliot. Molecular Cloning. Vol. III.
2. Lewin, B.I. Genes VIII. *John Wiley & Sons, New York*.
3. Watson, J. Recombinant DNA Technology.
4. Winnacker. From Genes to Clones.
5. Ansubel, F.M., Brent, R., Kingston, R.E. and Moore, D.D., 1988. Current Protocols in Molecular Biology. *Greene Publishing Associates,* New York.

BIOINFORMATICS

AIM

This course aims to develop the skills of the students in Bioinformatics. This will facilitate the students to undertake Projects in the Modern Biology.

OBJECTIVES

- Basics of Bioinformatics
- Sequence Data Bases and their uses
- Introduction to Sequence alignment
- Evolutionary Tree and Phylogeny
- Applications of Bioinformatics.

UNIT I

INTRODUCTION TO BIOINFORMATICS

Introduction, Scope of Bioinformatics - Basic UNIX commands and protocols, e-mail, ftp, telnet, Internet, http.

UNIT II

DATABASES

Introduction to databases – Database search – Sequence database search – Biological databases and their uses.

UNIT III

SEQUENCE ALIGNMENT AND DYNAMIC PROGRAMMING

Introduction – Strings – Edit distance between two strings – String similarity – Pair wise sequence alignment – Multiple sequence alignment, Dot matrix analysis – Substitution matrices. Dynamic programming – BLAST, FASTA, Amino acid substitution matrices, PAM, BLOSSUM.

UNIT IV

EVOLUTIONARY TREE AND PHYLOGENY

Trees, Parsimony, Phylogeny, Phylogenetic alignment – Connection between multiple alignment and Tree construction.

UNIT V

APPLICATION OF BIOINFORMATICS

Application of Bioinformatics in various fields – Medicine, Agriculture and Industries.

TEXT BOOKS

1. Rastogi, S.C., Namita Mendiratta, Parag Rastogi. Bioinformatics – Concepts, Skills, Application.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., 2000. Instant Notes in Bioinformatics. *BIOS Scientific Publishers*.
3. Teresa, K., Attwood and David J. Parry-Smith. Introduction to Bioinformatics. *Pearson Education Ltd*.

REFERENCES

1. Bergeran, B., 2002 Bioinformatics Computing. *PHI*.
2. Richard Durbin, Sean Eddy, Anders Krogh and Graeme Mitchison, 1998. Biological Sequence Analysis : Probabilistic Models of Proteins and Nucleic Acids. *Cambridge University Press*.
3. Bishop, M.J., Rawlings, C.J., 1997. DNA and Protein Sequence Analysis. A Practical Approach. *IRL Press,* Oxford.
4. Gibas, C. and Jambeck, P., 1999. Developing Bioinformatics Skills. *O'Reilly*.
5. Dan Gusfield, 1997. Algorithms on Strings Tree and Sequence. *Cambridge University Press*.
6. Baldi, P. and Brunak, S., 1998. Bioinformatics : A Machine Learning Approach. *MIT Press*.

MASS TRANSFER OPERATIONS

AIM

To develop the skills of the students in the area of Mass Transfer Operations in Biotechnological process.

OBJECTIVES

- To introduce the Mass Transfer principles
- To study in detail about the Principles of Absorption
- To study the Vapour – Liquid Equilibrium
- To understand the concept of Liquid – Liquid Equilibrium
- To study the concept of Solid – Fluid operation.

UNIT I

DIFFUSION

Molecular diffusion in fluids and solids, Inter phase Mass transfer, Mass transfer coefficients, Analogies in Transport phenomenon.

UNIT II

GAS – LIQUID OPERATION

Principles of gas absorption, Single and Multiple component absorption, Design principles of absorbers, Industrial absorbers, HTU, NTU concepts.

UNIT III

DISTILLATION

Vapour – Liquid Equilibria, Methods of distillation – Batch, Continuous, Flash, Steam, Vaccum, Molecular and Extractive distillation, Mc CABE-THIELE and PONCHONSAVARIT Principles, HETP, HTU and NTU concepts.

UNIT IV

LIQUID – LIQUID EXTRACTION

Liquid – Liquid Equilibria, Staged and Continuous extraction, Solid – Liquid equilibria, Leaching principles.

UNIT V

SOLID – FLUID OPERATION

Types of adsorption, Nature of adsorbants, Theories of adsorption – Adsorption equilibria – Batch and Fixed bed adsorption.

TEXT BOOKS

1. Treybal, R.E., 1981. Mass Transfer Operations. 3rd Edn., *Mc Graw Hill*.
2. Geankoplie, C.J., 2002. Transport Processes and Unit Operations. 3rd Edn., *Prentice Hall of India*.
3. Mc Cabe, W.L., Smith, J.C., Harriot, P., 1993. Unit Operations in Chemical Engineering. 5th Edn., *McGraw Hill Book Co.,* New York.

REFERENCES

1. Coulson and Richardson's, 1998. Chemical Engineering. Vol. I & II, *Asian Books Pvt. Ltd*.
2. Badger and Banchero. Introduction to Chemical Engineering. *Tata Mc Graw Hill*, New Delhi.

FOOD SCIENCE AND ENGINEERING

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

FOOD AND ENERGY

Constituents of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals, Dietary sources, Role and functional properties in food, Contribution to organoleptic and textural characteristics, Biotechnology in relation to the food industry.

UNIT II

FOOD ADDITIVES

Classification, Intentional and non-intentional additives, Functional role in food processing – Meat, Fisheries, Vegetables, Dairy products and Preservation, Food colourants – Natural and artificial, Food flavours, Enzymes as food processing aids.

UNIT III

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.

UNIT IV

FOOD BORNE DISEASES

Classification, Food infections – Bacterial and other types, Food intoxications and poisonings – Bacterial and non-bacterial, Food spoilage – Factors responsible for spoilage, Spoilage of vegetable, Fruit, Meat, Poultry, Beverage and Other food products.

UNIT V

FOOD PRESERVATION

Principles involved in the use of sterilization, Pasteurization and Blanching, Thermal death curves of microorganisms, Canning, Frozen storage – Freezing characteristics of foods, Microbial activity at low temperatures, Factors affecting quality of foods in frozen storage, Irradiation preservation of foods.

TEXT BOOKS

1. Coultate, T.P., 1992. Food – The Chemistry of Its components. 2nd Edn., Royal Society, London.
2. Sivasankar, B., 2002. Food Processing and Preservation, *Prentice Hall of India Pvt. Ltd*., New Delhi.

REFERENCES

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., *McGraw Hill Book Co.*, New York.
2. Jay, J.M., 1987. Modern Food Microbiology, *CBS Publications*, New Delhi.
3. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier.
4. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology.
5. George, J.B., 1987. Basic Food Microbiology. CBS Publishers and Distributors.
6. James, M.J., 1987. Modern Food Microbiology. CBS Publishers and Distributors.

IMMUNOLOGY LAB

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 techniques like blood grouping, ELISA and identification of T-cell, Immunofluorescence etc. This will be of help in facilitating the students for project work.

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 Immuno Sorbent Assay (ELISA).
7. Isolation of pheripheral blood mononuclear cells.
8. Isolation of monocytes from blood.
9. Immunofluorescence.
10. Identification of T-cell rossetting using sheep RBC.

GENETIC ENGINEERING LAB

AIM

To understand and develop the skills involved in rDNA Technology

OBJECTIVES

- 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.

1. Isolation of Genomic DNA from Plant / Animal / Bacterial Cells.
2. Isolation of Total RNA.
3. Isolation of Plasmid DNA.
4. Quantification of DNA and RNA.
5. Gel Electrophoresis of DNA – Agarose Gel, Polyacrylamide gel.
6. Southern Blotting.
7. Polymerase Chain Reaction.
8. Elution of Plasmid DNA from Agarose gel.
9. Restriction digestion of Bacterial Genomic and Plasmid DNA.
10. Ligation of DNA.
11. Preparation of Competent Cells.
12. Transformation in *E. coli.*
13. Screening of Recombinants and Confirmation of Insert DNA in Plasmid.
14. SDS-PAGE.
15. Western Blotting.