CURRICULUM

VIII SEMESTER

S. No.	Subject Name	L	P	M
Theory				
1.	Total Quality Management	**4**	**0**	**100**
2.	Elective IV *	**4**	**0**	**100**
3.	Elective V *	**4**	**0**	**100**
4.	Project Work	**4**	**0**	**100**

* Elective IV
Biophysics
Process Modelling and Simulation
Bioprocess Economics and Plant Design

* Elective V
Cryopreservation Theory and Application
Bioconjugate Technology
Applied Biotechnology

TOTAL QUALITY MANAGEMENT

AIM

To introduce the concepts of Quality, TQM, Statistical Process Control and Management.

OBJECTIVES

To familiarize about

- Quality Concepts.
- TQM principles.
- Statistical Process Control.
- TQM Tools.
- Quality Systems.

UNIT I 10

INTRODUCTION

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic Concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM implementation.

UNIT II 10

TQM PRINCIPLES

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juan Triology, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures.

UNIT III 8

STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality, Statistical Fundamentals – Measures of central tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management Tools.

UNIT IV **9**

TQM TOOLS

Bench Marking – Reasons to Bench Mark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FEMA.

UNIT V **8**

QUALITY SYSTEMS

Need for ISO 9000 and other Quality Systems, ISO 9000 : 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Total : 45 Hours

TEXT BOOKS

1. Dale H. Besterfiled, *et al*., 1999. Total Quality Management. *Pearson Education Asia*.
2. James R. Evans and William M. Lidsay, 2002. The Management and Control of Quality. 5th Edn., *South-Western (Thomas Learning)*.

REFERENCE

1. Feigenbaum, A.V., 1991. Total Quality Management. *McGraw - Hill*.
2. Oakland, J.S., 1989. Total Quality Management. *Butterworth – Hcinemann Ltd*., Oxford.

STEM CELL BIOLOGY (ELECTIVE I)

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 8

INTRODUCTION

Stem cell – Definition, Embryonic stem cells, Adult stem cells, Origin and characterization of human stem cells and potential applications for stem cell research, Cord blood stem cells, Stem cell marker

UNIT II 11

CELL LINES AND TISSUE ENGINEERING

Cell types and sources, Human tissue culture media, Culturing of cell lines, Biology and characterization of cultured cells, Maintenance and management of cell lines, 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 8

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, Immunolabeling procedures, Stem cells and cloning.

UNIT IV **8**

TRANSPLANTATION AND TRANSFECTION

Types of stem cell transplantation – Autologous, Allogeneic, Syngeneic; Nuclear transplantation, Therapeutic transplantation, Transfection methods – Lipofection, Electroporation, Microinjection, Embryonic stem cell transfer and Targetted gene transfer.

UNIT V **10**

APPLICATIONS AND ETHICS

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 – A promising tool for cell replacement therapy, Germ-line therapy, Human stem cell research in India, Human embryonic stem cell ethics and Public policy.

Total : 45 Hours

TEXT BOOKS

1. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey and Joseph D. Bronzino, 2005. Tissue Engineering, Principles and Applications in Engineering. *CRC Press*.
2. John, R. and Master, W., 2004. A Practical Approach. *Oxford University Press*.

REFERENCES

1. Stewart Sell. Stem Cell Handbook. *Humana Press*.
2. Campbell, N.A. and Jane B. Reece, 2002. Biology.6th Edition. *Pearson Education*, Inc. San Francisco, California.
3. Freshney, R. and Ian. Alan, R. Culture of Animal Cells : A Manual of Basic Techniques. Liss Inc.
4. Gamborg, O. L. and Phillips, G.C., 1995. Plant Cell, Tissue, and Organ Culture : Fundamental Methods. *Springer-Verlag,* Berlin Heidelberg.
5. Modlinske, J.A., Reed, M.,A., Wagner, T.E. and Karasiewicz, J., 1996. Embryonic Stem Cells: Developmental Capabilities and their Possible Use in Mammalian Embryo Cloning. *Animal Reproduction Science* 42 : 437 – 446.

METABOLIC ENGINEERING (ELECTIVE I)

AIM

To provide an in-depth understanding of the various aspects of Metabolic engineering.

OBJECTIVES

To understand the concepts of

- Regulation of Biomolecules.
- Synthesis of Primary metabolites.
- Biosynthesis of Secondary metabolites.
- Bioconversions.
- Regulation of Enzyme production.

UNIT I 10

INTRODUCTION

Introduction – Jacob Monod model, Catabolite regulation, Glucose effect, cAMP deficiency, Feed back regulation, Regulation in branched pathways, Differential regulation by isoenzymes, Concerted feed back regulation, Cumulative feed back regulation, Amino acid regulation of RNA synthesis, Energy charge, Regulation, Permeability control passive diffusion, Active transport group transportation.

UNIT II 8

SYNTHESIS OF PRIMARY METABOLITES

Alteration of feed back regulation, Limiting accumulation of end products, Feed back, Resistant mutants, Alteration of permeability, Metabolites.

UNIT III 9

BIOSYNTHESIS OF SECONDARY METABOLITES

Precursor effects, Prophophase, Idiophase relationship, Enzyme induction, Feed back regulation, Catabolite regulation by passing control of secondary metabolism, Producers of secondary metabolites.

UNIT IV **9**

BIOCONVERSIONS

Advantages of bioconversions, Specificity, Yields, Factors important to bioconversion, Regulation of enzyme synthesis, Mutation, Permeability, Co-metabolism, Avoidance of product inhibition, Mixed or sequential bioconversions, Conversion of insoluble substances.

UNIT V **9**

REGULATION OF ENZYME PRODUCTION

Strain selection, Improving fermentation, Recognizing growth cycle peak, Induction, Feed back repression, Mutants resistant to repression, Gene dosage.

Total : 45 Hours

TEXT BOOKS

1. Wang, D.I.C., Cooney, C.L., Demain, A.L., Dunnil, P., Humphery, A.E. and Lilly, M.D., 1980. Fermentaion and Enzyme Technology. *John Wiley and Sons*.
2. Stanbury, P.F. and Whitaker, A., 1984. Principles of Fermentation technology. *Pergamon Press.*

REFERENCE

1. Zubay, G., 1989. Biochemistry. *Mac Millan Publishers*.

MATERIAL SCIENCES AND TECHNOLOGY (ELECTIVE I)

AIM

To study about the Structure and functions of Biomolecules and Biomaterials.

OBJECTIVES

To understand

- The solid crystalline structure and properties of Biomolecules.
- Structure and functional relationship of Proteins and Nucleic acid.
- Techniques to study Biomolecular structure.
- Production and uses of Biomaterials.
- Synthesis and uses of Biopolymers.

UNIT I 10

BIOMATERIALS

Definition, Classification, Mechanical properties, Visco elasticity, Wound healing, Body responses to implant materials.
Carbohydrates, Modified carbohydrates for biomedical applications, Polydextrose.
Proteins, Collagen, Fibroin their structure and production.
Biopolymers – Definition, Synthesis, Dextrans, Polyhydroxybutyrate (PHB), Polycaprolactone (PCL), Polyphenol resins; Production of a copolymer of PHB and PHV (polyhydrovaleric acid), Biodegradable polymers.

UNIT II 8

BIOPHYSICAL PROPERTIES

Strong and weak interactions in biomolecules, Dielectric properties of biomolecules, Electronic properties of biomolecules – Conductivity, Photoconductivity and Piezoelectric effect.
Unit cells, Crystal structures (Bravais Lattices), Theoretical density computations, Crystallography and Miller indices.

UNIT III 9

IDENTIFICATION OF BIOMOLECULES

X-ray crystallography, Plane polarised light, Circular and elliptical polarised light, Definition of Circular Dichroism (CD), Optical, Rotatory Dispersion (ORD) and their comparative studies, Application to biomolecules, Phenomenon of Luminescence, Fluorescence, Phosphorescence.

UNIT IV **9**

CONFORMATIONS OF PROTEINS AND NUCLEIC ACIDS

Conformation of proteins and enzymes, Energy status, Modification of structure, Dynamics of protein folding, Helix coil transformation, Structure in relation to function, Co-operative properties of enzymes.
Conformation of nucleic acids, Helix coil transformation, Thermodynamics of DNA denaturation, Changes in nucleic acid structure.

UNIT V **9**

APPLICATIONS OF BIOMATERIALS

Artificial heart, prosthectic, cardiac, limb prosthesis, externally procured limb prosthesis and dental implants, Soft tissue replacements, sutures, percutaneous and skin implants,maxillofacial augumentation, heart tissue replacement implants, fracture fixation devices, joint replacements.

Total : 45 Hours

TEXT BOOKS

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, 2004. Biomaterial Science – An Introduction to Materials in Medicine. 2nd Edn., *Academic Press*.
2. Park, J.B., 1984. Biomaterials Science and Engineering. *Plenum Press*.

REFERENCES

1. Ratledge, C. and Kristiansen, B., 2001. Basic Biotechnology. 2nd Edn., *Cambridge University Press*.
2. Doi, Y., 1990. Microbial Polyesters. *VCH Weinheim*.

BIOLOGICAL SPECTROSCOPY (ELECTIVE II)

AIM

The course enables the student to understand the principles of various spectroscopic techniques and its significance to biological systems and processes.

OBJECTIVES

To emphasize on the principles, operations and applications of

- General spectroscopic techniques.
- Infrared Spectroscopy.
- Ultraviolet – Visible Spectroscopy.
- Nuclear Magnetic Resonance Spectroscopy.
- Electron Para Magnetic Resonance Spectroscopy.

UNIT I 9

SPECTROSCOPY AND OPTICAL ROTATORY DISPERSION

Interaction of radiation with matter, definitions frequency, wavelength, wave number, type of electromagnetic radiation, inter particle forces and energies, energy levels, population of energy levels, scattering, absorption and emission, Polarized light, Optical rotation, Circular dichroism – Circular dichroism of nucleic acids and proteins.

UNIT II 9

ULTRA – VIOLET AND VISIBLE ABSORPTION SPECTROSCOPY

Electronic energy levels – electronic transitions, Selection regales, Absorption range of biological chromophores, Transition metal d-d transitions – Charge transfer spectra, Application of UV spectra to proteins, Properties associated with the transition dipole moment and interactions between them, Measurement of molecular dynamics by fluorescence spectroscopy.

UNIT III 9

MASS SPECTROSCOPY

Ion sources sample introduction – Mass analyzers and ion detectors, Biomolecule mass spectrometry – Peptide and protein analysis – Carbohydrates and small molecules, Specific applications.

UNIT IV **10**

NUCLEAR MAGNETIC RESONANCE

The phenomenon – Magnetization – Measurement, Spectral parameters in NMR, Intensity, Chemical shift-spin, Spin coupling, T1 and T2 relaxation times, Line widths, Nuclear overhauser effect, Chemical exchange, Paramagnetic centers, Applications of NMR in biology, Assignment in NMR, Studies of macromolecules, Ligand binding, Ionization studies and pH kinetics, Molecular motion.

UNIT V **8**

ELECTRON PARAMAGNETIC RESONANCE

Introduction – Resonance condition – Measurement – Spectral parameters, Intensity g values – Spectral anisotropy, Time scale of EPR – Spin labels transition metal ions, Spin trapping.

Total : 45 Hours

TEXT BOOKS

1. Chatwal and Anand. Instrumental Methods of Analysis.
2. Skoog, D., 2000. Instrumental Methods of Analysis.

REFERENCES

1. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, *Benjamin Cummins and Company*.
2. Atkins, P.W., 1990. Physical Chemistry, 4^{th} Edn., *Oxford.*

MOLECULAR MODELLING AND DRUG DESIGN (ELECTIVE II)

AIM

The subject puts emphasis on the principles of Modelling and the studies of simulation of drug design and delivery.

OBJECTIVES

To familiarize and expose and to develop the skill of the students on the concept of

- Fundamental binding forces in molecules and molecular mechanism.
- Computer simulation methods.
- Molecular dynamic simulation method.
- Metropolis method.
- Significance of molecular Modelling in drug discovery and design.

UNIT I 9

EMPIRICAL FORCE FIELDS MOLECULAR MECHANISMS

Bond stretching – Angle bending – Torsional I terms – Out of plane bonding motions – Electrostatic interactions – Van Der Waals interactions – Effective pair potentials – Hydrogen bonding – Simulation of liquid water.

UNIT II 9

COMPUTER SIMULATION METHODS

Calculation of thermodynamic properties – phase space – practical aspects of computer simulation – Boundaries monitioring Equilibrium – Long range process – Analysing results of simulation and estimating errors.

UNIT III 9

MOLECULAR DYNAMICS SIMULATION METHODS

Molecular dynamics using simple modules – Molecular dynamics with continuous potentials – Running Molecular Dynamics simulation – Constant dynamics – Time dependent properties – Molecular Dynamics at constant Temperature and pressure.

UNIT IV **9**

MONTE CARLO SIMULATION METHODS

Metropolis methods – Monte Carlo simulation of molecules – Monte Carlo simulation of polymers – Calculating chemical potentials – Monte Carlo or Molecular dynamics.

UNIT V **9**

MOLECULAR MODELLING TO DISCOVER AND DESING NEW MOLECULES

Molecular Modelling in drug discovery – Deriving and using 3D Pharmacores – Molecular dockling – Structure Based methods to identify lead components – *de novo* ligand design.

Total : 45 Hours

REFERENCES

1. Leach, A.R., 1996. Molecular Modelling Principles and Applications. *Longman*.
2. Haile, J.M., 1997. Molecular Dynamics Simulation Elementary Methods. *John Wiley and Sons.*

IMMUNOTECHNOLOGY (ELECTIVE II)

AIM

To provide an in-depth understanding of the techniques and the concepts in immunotechnology.

OBJECTIVES

To emphasize the concepts of

- Antigens, Antibodies and Immunodiagnosis.
- Assessment of Cell Mediated Immunity.
- Immunopathology.
- Molecular Immunology.
- Recent Trends in Immunology.

UNIT I 10

ANTIGENS, ANTIBODIES AND IMMUNODIAGNOSIS

Types of antigens, Structure, Preparation of antigens for raising antibodies, Handling of animals, Adjuvants and their mode of action. Monoclonal and polyclonal antibodies – Their production and characterization, Western blot analysis, Immuno electrophoresis, SDS-PAGE, Purification and synthesis of antigens, ELISA – Principle and applications, Radio Immuno Assay (RIA) – Principles and applications, Non isotopic methods of detection of antigens – Enhanced chemiluminescence assay.

UNIT II 9

ASSESSMENT OF CELL MEDIATED IMMUNITY

Identification of lymphocytes and their subsets in blood, T cell activation parameters, Estimation of cytokines, Macrophage activation, Macrophage microbicidal assays, I*n vitro* experimentation – Application of the above technology to understand the pathogenesis of infectious diseases.

UNIT III 9

IMMUNOPATHOLOGY

Preparation of storage of tissue, Identification of various cell types and antigens in tissues, Isolation and characterization of cell types from inflammatory sites and infected tissues, Functional studies on isolated cells, Immuno cytochemistry – Immuno fluorescence, Immuno enzymatic and immuno ferritin techniques, Immuno electron microscopy.

UNIT IV **9**

MOLECULAR IMMUNOLOGY

Preparation of vaccines, Application of recombinant DNA technology for the study of the immune system, Production of antidiotypic antibodies, Catalytic antibodies, Application of PCR technology to produce antibodies and other immunological reagents, Immunotherapy with genetically engineered antibodies.

UNIT V **8**

CURRENT TOPICS IN IMMUNOLOGY

Trends in immunology of infectious diseases and tumors, Topics as identified from time to time.

Total : 45 Hours

TEXT BOOKS

1. Talwar, G.P., and Gupta, S.K., 1992. A Handbook of Practical and Clinical Immunology. Vol. I & II. *CBS Publications*.
2. Weir, D.M., 1990. Practical Immunology. *Blackwell Scientific Publications, Oxford.*

REFERENCE

1. Austin, J.M. and Wood, K.J., 1993. Principle of Cellular and Molecular Immunology. *Oxford University Press,* Oxford.

BIOREACTOR THEORY (ELECTIVE III)

AIM

To impart more knowledge about Bioreactors.

OBJECTIVES

On completion of the course the students are expected to know about

- Bioreactor Principles.
- Ideal and Non-ideal Bioreactors.
- Optimization.
- Types of Bioreactors.
- Design and Modelling of Bioreactors.

UNIT I 9

BIOREACTOR PRINCIPLES

Definition of Bioreactor, Basic principles of Bioreactor, Classification and their Configuration.

UNIT II 9

IDEAL AND NON-IDEAL BIOREACTORS

Analysis of batch, Continuous flow, Fed batch bioreactor, Non-ideal effects

UNIT III 9

OPTIMIZATION

Optimization of reactor system, Multiphase Bioreactor.

UNIT IV 9

BIOREACTOR TYPES

Unconventional bioreactors, Hollow fiber reactor, Perfusion reactor for animal and plant cell culture, Control of bioreactor.

UNIT V **9**

DESIGN AND MODELLING

Bioreactor Modelling and stability anlaysis, Mechanical design of bioreactors.

Total : 45 Hours

REFERENCES

1. Bailey and Ollis, 1986. Biochemical Engineering and Fundamentals. *Mc Graw Hill,* 2nd Edn.
2. Shuler and Kargi, 1992. Bioprocess Engineering. *Prentice Hall.*

CANCER BIOLOGY (ELECTIVE III)

AIM

To impart a detailed knowledge in the area of Cancer biology.

OBJECTIVES

To expose and make the students understand the concepts of

- Basics in cancer biology.
- Mechanism of carcinogenesis.
- Oncogenes.
- Pathogenesis of cancer.
- Therapeutics of cancer.

UNIT I 10

FUNDAMENTALS OF CANCER BIOLOGY

Regulation of cell cycle, Mutations that cause changes in signal molecules, Effects on receptor, Signal switches, Tumour suppressor gene, Modulation of cell cycle in cancer, Different forms of cancers, Diet and cancer. Cancer screening and early detection, Detection using biochemical assays, Tumor markers, Molecular tools for early diagnosis of cancer.

UNIT II 8

PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis, Chemical carcinogenesis, Metabolism of carcinogenesis, Principles of physical carcinogenesis, X - ray radiation, Mechanism of radiation carcinogenesis.

UNIT III 9

PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, Activation of kinases, Oncogenes, Identification of Oncogenes, Retroviruses and oncogenes, Detection of oncogenes. Oncogenes / Proto oncogene activity. Growth factors related to transformation. Telomerases.

UNIT IV **9**

PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, Heterogeneity of metastatic phenotype, Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumour cell invasion.

UNIT V **9**

NEW MOLECULES FOR CANCER THERAPY

Different forms of therapy, Chemotherapy, Radiation therapy, Detection of cancers, Prediction of aggressiveness of cancer, Advances in cancer detection, Use of signal targets towards therapy of cancer, Gene therapy.

Total : 45 Hours

TEXT BOOKS

1. Maly, B.W.J., 1987. Virology A Practical Approach. *IRLI Press*, Oxford.
2. Dunmock, N.J. and Primrose, S.B., 1988. Introduction to Modern Virology. *Blackwell Scientific Publications*, Oxford.

REFERENCES

1. An Introduction Top Cellular and Molecular Biology of Cancer, *Oxford Medical Publications*, 1991.
2. Primrose, S.B. and Twyman, R.M., 2006. Principles of Gene Manipulation and Genomics. *Blackwell Publishing*.

MOLECULAR PATHOGENESIS (ELECTIVE III)

AIM

To widen the students knowledge in the area of Molecular Pathogenesis.

OBJECTIVES

To make the students understand about the concepts of

- Pathogenicity.
- Host-defense against Pathogens and Pathogenic strategies.
- Molecular pathogenesis.
- Experimental studies on Host-Pathogen interaction.
- Modern approaches to control Pathogens.

UNIT I 8

INTRODUCTION

Introduction to pathogenesis, Attributes of microbial pathogenicity, Components of microbial pathogenicity, Population genetics of Microbial Pathogenicity, Methods to detect genetic diversity and Structure in nature population, Epidemiology, Cryptic diseases.

UNIT II 9

HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES

Attributes and components of microbial pathogenesis, Host Defense : Skin, Mucosa, Cilia, Secretions, Physical movements, Limitation of free iron, Antimicrobial compounds, Mechanism of killing by humoral and cellular defense mechanisms, Complements, Inflammation process, General disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III 12

MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)

Virulence, Virulence factors, Virulence-associated factors and virulence lifestyle factors, Molecular genetics and gene regulation in virulence of pathogens, *Vibrio Cholerae* : Cholera toxin, Co-regulated pili, Filamentous phage, Survival *E. coli* pathogens : Enterotoxigenic *E. coli* (ETEC), Labile and stable toxins, Entero-pathogenic *E. coli* (EPEC), Type III secretion, Cytoskeletal changes, Intimate attachment;

Enterohaemerrohogic *E. coli* (EHEC), Mechanism of bloody diarrohea and Hemolytic Uremic Syndrome, Enteroaggregative *E. coli* (EAEC). Shigella : Entry, Macrophage apoptosis, Induction of macropinocytosis, Uptake by epithelial cells, Intracellular spread, Inflammatory response, Tissue damage. Plasmodium : Life cycle, Erythrocyte stages, Transport mechanism and processes to support the rapidly growing schizont, Parasitiparous vacuoles and knob protein transport, Antimalarials based on transport processes. Influenza virus : Intracellular stages, Neuraminidase and Haemagglutinin in entry, M1 and M2 proteins in assembly and disassembly, Action of amantidine.

UNIT IV **8**

EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS

Virulence assays : Adherence, Invasion, Cytopathic, Cytotoxic effects, Criteria and tests in identifying virulence factors, Attenuated mutants, Molecular characterization of virulence factors, Signal transduction and host responses.

UNIT V **8**

MODERN APPROACHES TO CONTROL PATHOGENS

Classical approaches based on serotyping, Modern diagnosis based on highly conserved virulence factors, Immuno and DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines – DNA, Subunit and cocktail vaccines.

Total : 45 Hours

TEXT BOOKS

1. Iglewski, B.H. and Clark, V.L., 1990. Molecular Basis of Bacterial Pathogenesis. *Academic Press.*
2. Peter Williams, Julian Ketley and George Salmond, 1998. Methods in Microbiology : Bacterial Pathogenesis. Vol. 27. *Academic Press.*

REFERENCES

1. Recent Reviews in *Infect. Immu., Mol. Microbiology*, *Biochem. J.*, *EMBO* etc.
2. Nester, Anderson, Roberts, Pearsall and Nester, 2001. Microbiology : A Human Perspective. 3rd Edn., *Mc Graw-Hill*.
3. Eduardo, A., and Groisman, 2001. Principles of Bacterial Pathogenesis. *Academic Press*.

BIOPHYSICS (ELECTIVE IV)

AIM

To develop the skills of the students in the area of Biophysics

OBJECTIVES

To study in detail about

- Molecular structure of biological system.
- Conformation of proteins and Nucleic acids.
- Transport across ion channels.
- Energetics of biological system.

UNIT I 9

MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS

Intra molecular bonds – covalent – ionic and hydrogen bonds – biological structures – general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

UNIT II 9

CONFORMATION OF NUCLEIC ACIDS

Primary structure – the bases – sugars and the phosphodiester bonds – double helical structure – the a, b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

UNIT III 9

CONFORMATION OF PROTEIN

Conformation of the peptide bond – Secondary structures – Ramachandran plots – use of potential functions – Tertiary structure – foldings – hydration of proteins – hydropathy index.

UNIT IV **9**

CELLULAR PERMEABILITY AND ION TRANSPORT

Ionic conductivity – transport across ion channels – mechanism – ion pumps – proton transfer – nerve conduction – techniques of studying ion transport and models.

UNIT V **9**

ENERGETICS AND DYTNAMICS OF BIOLOGICAL SYSTEMS

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows.

Total : 45 Hours

TEXT BOOKS

1. Glaser, R., 2000. Biophysics. *Springer Verlag*.
2. Duane, R., 1999. Biophysics : Molecules in Motion. *Academic Press.*

PROCESS MODELLING AND SIMULATION (ELECTIVE IV)

AIM

This course aims to develop the skills of the students in the area of process Modelling and simulation.

OBJECTIVES

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

- Basics of Modelling.
- Modelling of chemical engineering systems.
- Dynamic simulation.

UNIT I 9

BASICS OF MODELLING

Principles of formulation, Fundamental laws – continuity equation, Energy equation, Equations for motion, Transport equation, Equations of state, Equilibrium, Chemical kinetics.

UNIT II 9

MODELLING OF CHEMICAL ENGINEERING SYSTEMS – I

CSTR – Series of isothermal, Constant – Holdup CSTR, CSTR with variable hold up, Two heated tar, Gas phase, Pressurized CSTR, Non-isothermal CSTR, Single component vapourizer.

UNIT III 9

MODELLING OF CHEMICAL ENGINEERING SYSTEMS – II

Batch reactor, Reactor with mass transfer, Single component vapourizer, Multi component flash drum, Ideal binary distillation column, Multi component non-Ideal distillation column, Batch distillation with holdup.

UNIT IV 9

DYNAMIC SIMULATION – I

Batch reactor, Gravity flow tank, Three CSTR in series, Non-iso thermal CSTR.

UNIT V **9**

DYNAMIC SIMULATION – II

Binary distillation and multi component distillation column, Variable pressure distillation, Ternary batch distillation with holdup.

Total : 45 Hours

TEXT BOOKS

1. William L. Luyben, 1990. Process Modelling, Simulation and Control for Chemical Engineers , 2nd Edn., *Mc Graw Hill Iinternational Editions*, New York.
2. Davis, M.E., 1984. Numerical Methods and Modelling for Chemical Processes. *Wiley*, New York.

REFERENCES

1. Bisio, A. and Robert L. Kabel, 1985. Scale-up of Chemical Processes. *Wiley*, New York.
2. Dewn, M.M., 1986. Process Modelling, *Wiley*, New York.
3. Finlasyson, B.A., 1980. Non Linear Analysis in Chemical Engineering. *McGraw Hill*, New York.

BIOPROCESS ECONOMICS AND PLANT DESIGN (ELECTIVE IV)

AIM

To enhance the skills of the students in the area of Bioprocess Economics and Plant Design.

OBJECTIVES

To learn about

- Business Organizations.
- Project Design and Development.
- Cost Estimation and Profitability.
- Economics and Plant Design.
- Quality control requirements.

UNIT I 9

PROCESS ECONOMICS AND BUSINESS ORGANIZATION

Definition of Bioprocess, Bioprocess economics, Importance of various M – Inputs – Globalization concept – Competition by dumping – Its effect on plant size – Status of India with adjoining ASEAN countries (Singapore, Malaysia, Indonesia, etc.,) – Project profile concept – Detail; Structure and types of organizations; Simple management principles.

UNIT II 9

PROJECT DESIGN AND DEVELOPMENT

Choosing a project, Market survey, Importance of Techno – Economic – Viability, studies, Sourcing of processes, Process alternatives, Fixing most economic processes, Technology scanning, Plant location principles, Plant lay out, Process flow sheets, Preparation of budgetary investment and production costs.

UNIT III 9

COST ESTIMATION, PROFITABILITY AND ACCOUNTING

Capital investment, Concept of time-value of money, Source sink concept of profitability, Capital costs, Depreciation, Estimation of capital costs, Manufacturing costs, Working capital, Profitability standards, Project profitability evaluation, Alternative investments and replacements, Annual reports, Balance sheets, Performance analysis.

UNIT IV **8**

PROCESS OPTIMIZATION TECHNIQUES

Optimum design – Design strategy, Economic –Balance, Different unit operations with single and multiple variables.

UNIT V **10**

QUALITY AND QUALITY CONTROL

Current good manufacturing practices. Concepts of quality control in 20^{th} century; Elements of quality control envisaged by ISI since 1947; Emergence of statistical process control(SPC), Simple SPC concept details, Fundamental concepts of ISO 9000 quality system and the various requirements of ISO certification.

Total : 45 Hours

TEXT BOOKS

1. Peters, M.S. and Klaus, D., 1991. Plant Design and Economics for Chemical Engineers. *Mc Graw Hill International Edition*, Chemical Engineering series.
2. Senapathy, R., 2001. Text Book of Principles of Management and Industrial Psychology. *Lakshmi Publications*

REFERENCE

1. Rudd and Watson, 1987. Strategy for Process Engineering, *Wiley Publications*.

CRYOPRESERVATION THEORY AND APPLICATION (ELECTIVE V)

AIM

To impart knowledge on the fundamentals, basic concepts and principles involved in Cryopreservation.

OBJECTIVES

To study in detail about the

- Principles of cryopreservation.
- Cryogenics and *ex situ* conservation.
- Cellular cryobiology and anhydrobiology.
- Embryo cryofreezing and cryopreservation.
- Cryopreservation in therapeutics and aquaculture.

UNIT I 10

INTRODUCTION

Cryopreservation - History and Definition, temperature factor – normal biochemical reaction leading to death, Damages caused by general freezing of cell and tissues, Natural cryopreservation, Gaia theory (James Love Lock), freezing and refrigeration.

UNIT II 8

VARIATION IN CRYOPRESERVATION

Cryobiology, Cryogenics, Frozen zoo, *ex situ* conservation, Long time preservation.

UNIT III 9

TECHNOLOGY OF CRYOPRESERVATION

General Biotechnology in cryopreservation, Cellular cryobiology and anhydrobiology, Deep freezing damages, *in vitro* storage and cryopreservation.

UNIT IV 9

CRYOPRESERVATION AND FERTILITY

Fertility failures, Embryo cryofreezing, techniques in embryo freezing, Storage thawing, retrieval, Cryoprotectant solution.

UNIT V **10**

CRYOPRESERVATION MAN'S HOPE

Cryopreservation of egg, Sperm of *Homosapiens*, Techniques employed in aquaculture (Fish Plankton), Crawthron collection, Design and use of thermal transport containers for cryopreservation, Role of cryopreservation in therapeutics.

Total : 45 Hours

TEXT BOOKS

1. Benson, E., Paul T. Lynch and Glyn N. Stacey, 1998. Advance in Plant Cryopreservation Technology Current Application. Erica.
2. Annamaria Pardo, John M. Baust and Todd Upton, 2005. Improving Quality in Cryopreserved Cells.

BIOCONJUGATE TECHNOLOGY (ELECTIVE V)

AIM

To develop the skills of student in the area of Bioconjucate technology.

OBJECTIVES

At the end of the course, the student would have learnt about.

- Modification of amino acids, sugars and nucleic acids.
- Chemistry of active groups.
- Chemical tags and probes in Bioconjucate technology.
- Enzyme and DNA labeling.
- Applications.

UNIT I 9

FUNCTIONAL TARGETS

Modification of Amino acids, Peptides and Protein – Modification of sugars, Polysaccharides and glycoconjugates – Modification of nucleic acids and oligonucleotides.

UNIT II 9

CHEMISTRY OF ACTIVE GROUPS

Amine reactive chemical reactions – Thiol reactive chemical reactions – Carboxylate reactive chemical reactions – Hydroxyl reactive chemical reactions – Aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III 9

BIOCONJUGATE REAGENTS

Zero length cross linkers – Homobifunctional cross linkers – Heterobifuntional crosslinkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV **9**

ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUCATION

Properties of common enzyme – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA – enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V **9**

BIOCONJUGATE APPLICATIONS

Preparation of Hapten – carrier immunogen conjugates – antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives – Colloidal – gold – labelled proteins – modification with synthetic polymers.

Total : 45 Hours

TEXT BOOK

1. Hermanson, G.T., 1999. Bioconjugate Techniques, *Academic Press.*

APPLIED BIOTECHNOLOGY (ELECTIVE V)

AIM

To develop the skills of the student in different areas of Biotechnology and its potential impacts on all areas of biology.

OBJECTIVES

To have a through knowledge about

- Transgenic plants, animals and its uses.
- Application of microbes in Industry.
- Gene therapy, Stem cell technology and Tissue engineering.
- Application of Environmental biotechnology.
- Production of recombinant pharmaceutical products.

UNIT I 8

PLANT AND ANIMAL BIOTECHNOLOGY

Plant tissue culture and application of transgenics for crop improvement in agriculture, horticulture and forestry, Plantibodies, plastic from plant Flavr Savr Tomato, Transgenic animals and its uses.

UNIT II 9

MEDICAL BIOTECHNOLOGY

Gene therapy – gene delivery methods, New approaches, Applications of stem cell in the treatment for major diseases in reparative medicine, Hematopoietic Stem Cell transplantation, Applications of tissue engineering – reconstruction of connective tissues, epithelial and endothelial surfaces, DNA fingerprinting, DNA based diagnosis of Genetic disease.

UNIT III 9

BIOPHARMACEUTICAL TECHNOLOGY

Production of recombinant pharmaceutical products – Biotechnology derived products (Therapeutic proteins): Study of hematopoietic growth factor, Interferons and Interleukins, Insulin, Growth hormones, Vaccines and Monoclonal antibody based pharmaceuticals, Recombinant coagulation factors and thrombolytic agents, Somatostatin, Somatotropin.

UNIT IV **9**

BIOPROCESS TECHNOLOGY

Application of microbes in industry – Industrial Processing, recovery, extraction and purification, Production of antibiotics, solvents, organic acids, amino acids, enzymes, vitamins, single cell protein, food substances from brewing and dairy industry.

UNIT V **10**

ENVIRONMENTAL BIOTECHNOLOGY

Use of genetically engineered organisms, Bioremediation and its applications. Fuel technology – Ethanol and Biogas. Biotechnological applications in waste management, Novel methods for pollution control, Biosensors, Biodegradable plastics, Biotechnology in Pesticide, Tannery and Paper industry.

Total : 45 Hours

TEXT BOOKS

1. Gupta, P.K. Elements of Biotechnology. *Rastogi Publications*.
2. Vaidyanath Pratap Reddy and Sathya Prasad, 2004. Introduction to Applied Biology and Biotechnology. 1st Edn., *B. S. Publications.* Hyderabad.
3. Gary Walsh. Biopharmaceutical : Biochemistry and Biotechnology. 2nd Edn., *John Wiley & sons Ltd.*
4. Samuel E. Lynch and Be Roberts J. Geng. Tissue Engineering.

REFERENCES

1. Maulik and Patel, 1996. Molecular Biotechnology Therapeutic Applications and Strategies. *Wiley & Sons*.
2. Cruger, W. and Cruger, A., 2004. Biotechnology : A Text Book of Industrial Microbiology. 2nd Edn., *Panima Publishers*.
3. Kumar, H.D. Modern Concepts and Biotechnology. *Vikas Publication House Pvt. Ltd*.
4. Casida, L.E., 2000. Industrial Microbiology. *New Age International*, Delhi.
5. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey, Joseph D. Bronzino, 2005. Tissue Engineering, Principles and Applications in Engineering , *CRC Press*.
6. Sharma, B.K. Environmental Chemistry.