MANAGEMENT AND ENTREPRENEURSHIP

Sub Code	**: 10AL 51**	**IA Marks**	**: 25**
Hrs/week	**: 04**	**Exam Hours**	**: 03**
Total Lecture Hrs	**: 52**	**Exam Marks**	**: 100**

PART – A

MANAGEMENT

UNIT - 1

MANAGEMENT: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modem management approaches.

7 Hours

UNIT - 2

PLANNING: Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.

6 Hours

UNIT - 3

ORGANIZING AND STAFFING: Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees- Centralization Vs Decentralization of authority. and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing--:Process of Selection & Recruitment (in brief).

6 Hours

UNIT - 4

DIRECTING & CONTROLLING: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief):

7 Hours

PART-B

ENTREPRENEURSHIP

UNIT - 5

ENTREPRENEUR: Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - its Barriers.

6 Hours

UNIT – 6

SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition Only)

7 Hours

UNIT - 7

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

7 Hours

UNIT - 8

PREPARATION OF PROJECT: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

7 Hours

TEXT BOOKS:

1. **Principles of Management –** P. C.Tripathi, P.N. Reddy – Tata McGraw Hill,
2. **Dynamics of Entrepreneurial Development & Management** Vasant Desai - Himalaya Publishing House

3. **Entrepreneurship Development** – Poornima. M. Charantimath Small Business Enterprises - Pearson Education - 2006 (2 & 4).

REFERENCE BOOKS:

1. **Management Fundamentals** - Concepts, Application, Skill Development - Robers Lusier - Thomson
2. **Entrepreneurship Development** - S.S.Khanka - S.Chand & Co.
3. **Management** - Stephen Robbins - Pearson Education/PHI - 17th Edition, 2003.

BIOKINETICS & BIOREACTION ENGINEERING

Sub. Code	:	10BT-52	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

Law of mass action and rate equation, definitions and examples of elementary and non-elementary reactions, theories of reaction rate and temperature dependency, analysis of experimental reactor data - evaluation of rate equation by integral and differential analysis for constant volume system. Conceptual numericals. **08 Hours**

UNIT 2:

BIOCHEMICAL EQUILIBRIA

Equilibrium in chemically reactive systems (single and multiple reactions), evaluation of reaction equilibrium constant, concentration/conversion data, effect of temperature on equilibrium – derivation of G *vs.* T relation, application of above concepts to biochemical systems. Conceptual numericals. **04 Hours**

UNIT 3:

BIOREACTORS

Design equations for homogeneous system - batch, stirred tank and tubular flow reactor, size comparison of single reactors, combination of reactor systems - Qualitative design for parallel and series reactors and recycle reactors. Conceptual numericals. **08 Hours**

UNIT 4:

NON-IDEAL BIOREACTORS

Non-ideal reactors, residence time distribution studies for pulse and step input, Exit age distribution of fluid in reactors, RTD's for CSTR and PFR, calculations of conversions for First order reactions, tanks in series models. Conceptual numericals. **06 Hours**

PART B

UNIT 5:

ENZYME KINETICS

Enzyme active site, types of enzyme specificities, enzyme kinetics, initial velocity studies, formation of ES complex, derivation of Michaelis-Menton equation, definition of Km and Vmax, Lineweaver-Burk and Eadie-Hofstee plots. Units of enzyme activity, Enzyme inhibition: competitive, uncompetitive and non-competitive; Regulations – allosteric and feed back regulation. Conceptual numericals. **10 Hours**

UNIT 6:

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Phases of cell growth in batch cultures; simple unstructured kinetic models for microbial growth - Monod model; Growth of Filamentous Organisms. Growth associated (primary) and non-growth associated (secondary) product formation kinetics; Leudeking-Piret models; substrate and product inhibition on cell growth and product formation; Conceptual numericals. **05 Hours**

UNIT 7:

METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry of cell Growth and Product Formation- elemental balances, degrees of reduction of substrate and biomass; available-electron balances; yield coefficients of biomass and product formation; maintenance coefficients. Energetic analysis of microbial growth and product formation - oxygen consumption and heat evolution in aerobic cultures; thermodynamic efficiency of growth. Conceptual numericals. **05 Hours**

UNIT 8:

MEDIA DESIGN AND STERILIZATION

Medium requirements for fermentation processes- Carbon, nitrogen, minerals, vitamins and other complex nutrients; oxygen requirements; Medium formulation for optimal growth and product formation - examples of simple and complex media; Thermal death kinetics of microorganisms; Batch and continuous heat – Sterilization of Liquid media; Filter sterilization of liquid media.

07 Hours

TEXT BOOKS

Chemical Reaction Engineering by Levenspiel O., John Wiley.
Elements of Chemical Reaction Engineering by Fogler, H.S., Prentice Hall.
Bioprocess Engineering by Shuler and Kargi Prentice Hall.
Enzyme Kinetics and Mechanism by Paul F Cook & W W Cleland, Garland Science.

REFERENCE BOOKS

Bioprocess Engineering by Aiba, Humprey & Millis, Academic Press.
Biochemical Engineering by James Lee, Prentice-Hall.
Biochemical Engineering Fundamentals by Bailey and Ollis, McGraw Hill.
Bioprocess Engineering Principles by Pauline M. Doran, Elsevier Science
Principles of Biochemistry by Albert Lehninger, CBS publishers
Bioenergetics by L Eruster, Greena Publishing Associates.
Enzyme Kinetics by Plowman, McGraw Hill.
Chemical Engineering Kinetics by Smith J.M., McGraw Hill.
Wolf R. Vieth, Bioprocess Engineering – Kinetics, Mass Transport, Reactors and Gene Expression. A Wiley – Interscience Publication.
Chemical Reactor Analysis and Design by Forment G F and Bischoff K B., John Wiley.
Biocatalytic Membrane Reactor by Drioli, Taylor & Francis.

BIOINSTRUMENTATION & BIOSENSORS

Sub. Code	:	10BT-53	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

Electrical quantities and units; functional elements of an instrumentation system; static and dynamic characteristics; principles of analog and digital meters; CRO, energy meters, time and frequency meters; multimeters. Transducers: Classification, resistive strain gages, RTD, LVDT, Peizoelectric transducers, electromagnetic transducers, optical transducers, transducers for biomedical applications. Conceptual numericals. **06 Hours**

UNIT 2:

BIOMEDICAL IMAGING & INSTRUMENTATION

The terminology of medical instrumentation and imaging, a review of medical and physiological signals; Principles, instrumentation (schematic) and applications of: EEG, ECG, EMG, Radiography, Nuclear Medicine, SPECT, PET, CT, MRI, Ultrasound Imaging, Photoacoustic imaging, Digital Mammography, Endoscopy. **10 Hours**

UNIT 3:

CARDIAC AND VASCULAR SYSTEM

Overview of cardiovascular system, Types of blood pressure sensors, Lumped parameter modeling of a catheter-sensor system, Heart sounds, Cardiac catheterization, Indirect measurement of blood pressure, Measuring blood flow rate, Measuring blood volume, Pacemakers, Defibrillators, Cardiac-assist devices, Replacement heart valves – related instrumentation of equipments involved and sensors. Conceptual numericals. **05 Hours**

UNIT 4:

RESPIRATORY SYSTEM

Modeling the respiratory system, Measuring gas flow rate, Measuring lung volume, Tests of respiratory mechanics, Measuring gas concentration, Tests of gas transport, Ventilators, Anesthesia machines, Heart-Lung machine – related instrumentation of equipments involved and sensors. Conceptual numericals. **05 Hours**

PART B

UNIT 5:

ANALYTICAL INSTRUMENTS

pH meters, Radiometric Devices, Fluorescence Spectrophotometers, Chromatology (chromatographic techniques – GC & HPLC), Electrophoresis, and Lab on a chip - related instrumentation, Validation/Calibration, Commissioning and Maintenance of all the above equipments. Conceptual numericals. **06 Hours**

UNIT 6:

ASSAY TECHNOLOGIES AND DETECTION METHODS

Introduction; Bioassay Design and Implementation; Radiometric Assays; Scintillation Proximity Assays; Types of fluorescence measurements and instrumentation; Reporter gene Assay applications; Bio-analytical Applications. **06 Hours**

UNIT 7:

AUTOMATION AND ROBOTICS

Introduction to Automation, types, LERT classification system, components of a robot, softwares used in robotics, Barcode technology, objectives, decoding, symbologies used, barcode reader (pen-type, laser type, CCD camera and camera based readers). PC based and Microcontroller based automation. **04 Hours**

UNIT 8:

BIOSENSORS

Introduction to Biosensors: Concepts and applications. Biosensors for personal diabetes management. Microfabricated Sensors and the Commercial Development of Biosensors. Electrochemical sensors, Chemical fibrosensors, Ion-selective FETs, Noninvasive blood-gas monitoring, Blood-glucose sensors. Noninvasive Biosensors in Clinical Analysis. Applications of Biosensor-based instruments to the bioprocess industry. Application of Biosensors to environmental samples. Biochips and their application to genomics. BIAcore - an optical Biosensor. **10 Hours**

TEXT BOOKS

Bioinstrumentation and Biosensors by Donald L Wise, Marcel Dekker Inc.

Biosensors by Cooper J M (2004). Oxford Publications.
Hand book of Biomedical Instrumentation – R. S. Khandpur, TMH.
Biosensors and their applications by Yang Victor C & Ngo That T, Springer.
Biosensors – An introduction by Eggins Brain R. Wiley, John & Sons.
Advances in Laboratory Automation-Robotics by J.R. Strimaitis and J.N. Little, Zymark Corporation.
Principles of Applied Biomedical Instrumentation by Geddes & Baker.

REFERENCE BOOKS

Automation technologies for genome characterization, John Wiley & Sons, Inc.
Transducers and Instrumentation by Murthy D V S. Prentice Hall.
High Throughput Screening, Edited by John. P. Devlin, Marcel Dekker.
Commercial Biosensors by Graham Ramsay, John Wiley & Son, INC.
Introduction to bioanalytical sensors by Alice J Cunningham Newyrok, John Wiley.
Applied biosensors by Doland L Wise, CRC Press.
Encyclopedia of Medical devices and Instrumentation by J G Webster, John Wiley.
Introduction to Biomedical equipment technology by J J Carr, J M Brown, Prentice Hall.
Introduction to Biomedical Engineering by J Enderle, S Blanchard & J Bronzino, Elsevier.

IMMUNOTECHNOLOGY

Sub. Code	:	10BT-54	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

THE IMMUNE SYSTEM

Introduction, cells and organs of the immune system, Primary and secondary Lymphoid organs, antigens, antibodies and their structure, types of immune responses; anatomy of immune response. Classification of immune system - innate and adaptive immunity. **06 Hours**

UNIT 2:

HUMORAL-IMMUNITY

B-lymphocytes and their activation; structure and function of immunoglobulins; immunoglobulin classes and subclasses (allotypes, idiotypes and anti-idiotypic antibodies), Genetic control of antibody production, production of monoclonal and polyclonal antibodies. **08 Hours**

UNIT 3:

CELL-MEDIATED IMMUNITY

Thymus derived lymphocytes (T cells) - their ontogeny and types, MHC Complex, antigen presenting cells (APC), mechanisms of T cell activation, macrophages, dendritic cells, langerhans cells, mechanism of phagocytosis, Antigen processing and presentation. **06 Hours**

UNIT 4:

IMMUNE REGULATION AND TOLERANCE

Complement activation and types and their biological functions**,** cytokines and their role in immune response, immunotolerance, Hypersensitivity its types and treatment. **06 Hours**

PART B

UNIT 5:

IMMUNOLOGICAL DISORDER

Autoimmune disorders and types, pathogenic mechanisms and treatment (rheumatoid arthritis), experimental models of auto immune disease, primary and secondary immunodeficiency disorders, mechanism of AIDS. **06 Hours**

UNIT 6:

TRANSPLANTATION IMMUNOLOGY

Immunological basis of graft, types of transplantation, mechanism of graft rejection, role of HLA in graft rejection, tissue typing, immunosuppression and immunosuppressive drugs, tumor specific antigens. **06 Hours**

UNIT 7:

MOLECULAR IMMUNOLOGY

Vaccines and their types, production of recombinant-DNA vaccines. Catalytic antibodies, application of PCR technology to produce humanized antibodies (Single chain fragment variable), immunotherapy with genetically engineered antibodies. Brief mention about stem cells and applications to immunology. **06 Hours**

UNIT 8:

IMMUNODIAGNOSIS

Antigen antibody interaction – Precipitation reactions, Agglutination reactions, Blood typing, A, B, ABO & Rh, principles and applications of ELISA, Radio Immuno Assay (RIA), western blot analysis, immuno-electrophoresis, Immunofluorescence, chemiluminescence assay, FACS.

08 Hours

TEXT BOOKS

Immunology – an Introduction by Tizard, Thomson.
Immunology by J Kuby, WH Freeman**.**
Immunology & Immunotechnology by Ashim K Chakravarthy, Oxford University Press.
Immundiagnostics by S C Rastogi, New Age International.

REFERENCE BOOKS

Essential Immunology by Roitt I. Blackwell Scientific Publications, Oxford.
Molecular Immunology By Benjamini E.
Immunology A short course by Benjamini E. and Leskowitz S. Wiley Liss.
The Immune System by Peter Parham, Garland Science.
Understanding Immunology by Peter Wood, Pearson Education.

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GENETIC ENGINEERING & APPLICATIONS

Sub. Code	:	10BT-55	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

Extrachromosomal elements, Construction of recombinant DNA molecules, vectors in rDNA technology, salient features of vectors, types of vectors-plasmids, cosmids, phagemids and viruses. Construction of vectors (BAC, Blue script and YAC) **06 Hours**

UNIT 2:

ENZYMES IN GENETIC ENGINEERING

Exonucleases and Restriction Endonculeases: classification, mode of action. Enzymes in modification - Polynucleotide phosphorylase, DNase, Methylases, phosphatases, polynucleotide Kinase, Ligases, RNase and their mechansim of action. **06 Hours**

UNIT 3:

NUCLEIC ACID HYBRIDIZATION AND AMPLIFICATION

Methods of nucleic acid detection, polymerase chain reaction (PCR) and its applications, variations in PCR and applications, methods of nucleic acid hybridization, probe and target

sequences, Southern and Northern hybridization techniques, nucleic acid mutagenesis *in vivo* and *in vitro*. **08 Hours**

UNIT 4:

CONSTRUCTION OF DNA LIBRARIES

Isolation and purification of nucleic acids (DNA & RNA), quantification, storage, Isolation of plasmids, Construction of genomic and cDNA libraries, screening and preservation.**06 Hours**

PART B

UNIT 5:

GENE TRANSFER TECHNIQUES

Gene transfer techniques in plants, animals and microbes – Transformation, electroporation, microprojectile system, liposome mediated transfer, gene gun etc. Agrobacterium-mediated gene transfer in plants – Ti plasmid: structure and functions, Ti plasmid based vectors - advantages. Chloroplast transformation. **08 Hours**

UNIT 6:

TRANSGENIC SCIENCE AND GENETIC IMPROVEMENT

Transgenic science in plant improvement, biopharming – plants as bioreactors, transgenic crops for increased yield, resistance to biotic and abiotic stresses.

Techniques of gene mapping in plants. Marker-assisted selection and breeding for improvement. Transgenic science for animal improvement, biopharming - animals as bioreactors for recombinant proteins, Gene mapping in farm animals. Marker-assisted selection and genetic improvement of livestock. **08 Hours**

UNIT 7:

OTHER APPLICATIONS

Microbial biotechnology - Genetic manipulation, engineering microbes for the production of antibiotics, enzymes, Insulin, growth hormones, monoclonal antibodies, clearing oil spills. **06 Hours**

UNIT 8:

GENE THERAPY

Introduction. Methods of Gene therapy. Gene targeting and silencing. Gene therapy in the treatment of cancer, SCID, muscular dystrophy, respiratory disease (emphysema), cystic fibrosis, etc., Challenges in gene therapy. Future of gene therapy. **04 Hours**

TEXT BOOKS

Introduction to Genetic Engineering by Nicholl. Cambridge Low Price Edition.

Principles of gene manipulation - An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications.

From Genetics to Gene Therapy – the molecular pathology of human disease by David S Latchman, BIOS scientific publishers.

Genes IX by Benjamin Lewis, Oxford University & Cell Press.

DNA Science by David A Micklos, Greg A Freyer and Dvaid A Crotty, I K International.

REFERENCE BOOKS

Molecular Biotechnology: Principles and Practices by Channarayappa, University Press.

A Text book of Molecular Biotechnology by Ashok Chauhan, IK Intl.

Genetic Engineering Vol. 1-4 (Williamson Edition)**.** Academic Press.

Recombinant DNA by Watson et al., Scientific American Book.

Vectors by Rodriguer and Denhardt, Butterworth Publishers.

Current protocols in molecular biology, Greena Publishing Associates, NY.

Berger S.L. Kimmel A.R. Methods in enzymology, Vol.152, Academic Press.

Molecular cloning Volumes I, II and III. Sambrook J et al. Cold Spring Harbor lab Press.

BIOINFORMATICS

Sub. Code	:	10BT-56	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

DATABASES & TOOLS

Introduction to Bioinformatics, Need for informatics tools and exercises, Bioinformatics resources: NCBI, EBI, ExPASy, RCSB. Significance of databases towards informatics projects. Primary and Secondary Databases. GenBank, DDBJ, EMBL, PIR, Uniprot-KB, SWISS-PROT, TrEMBL, UniParc. Format of databases, Gene bank flat file. Protein Data Bank (PDB) flat file; FASTA Format, PIR Format; Structure file formats, PDBSUM, PDBLite, MMDB, SCOP, Pfam, ProDOM; Database of structure viewers. Specialized databases: NCBI, Pubmed, OMIM, Medical databases, KEGG, EST databases; Genome databases at NCBI, EBI, TIGR, SANGER. Overview of other popular tools for various bioinformatics exercises. **06 Hours**

UNIT 2:

SEQUENCE ALIGNMENT AND DATABASE SEARCHES

Introduction, The evolutionary basis of sequence alignment, the Modular Nature of proteins, Optional Alignment Methods, Substitution scores, substitution matrices, PAM, BLOSUM, Gap penalties, Statistical significance of Alignments, Database similarity searching, FASTA, BLAST, Low-Complexity Regions, Repetitive Elements. Practical Aspect of Multiple Sequence Alignment, Progressive Alignment Methods, CLUSTALW, Motifs and Patterns, PROSITE, 3DPSSM. MeMe, PSI-BLAST, PHI-BLAST, PRATT, Hidden Markov Models (HMMs), and Threading methods. Conceptual numericals. **08 Hours**

UNIT 3:

PHYLOGENETIC ANALYSIS

Introduction to Phylogenetic analysis, rooted and unrooted trees, Elements of phylogenetic Models, Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation, Tree - Building Methods-Distance based and character based methods, Evaluating Trees and Data- Boot strapping (parametric and non parametric), Phylogenetic softwares (CLUSTALW, PHYLIP etc), Conceptual numericals. **06 Hours**

UNIT 4:

PREDICTIVE METHODS

Predictive Methods using Nucleotide sequences: Framework, Masking repetitive DNA, Database searches, Codon Bias Detection, Detecting Functional Sites in the DNA (promoters, transcription factor binding sites, translation initiation sites), Integrated Gene Parsing, finding RNA Genes, Web based tools (GENSCAN, GRAIL, GENEFINDER).

Predictive Methods using Protein sequences: Protein Identity based on composition, Physical properties Based on sequence, secondary structure and folding classes, specialized structures or features, tertiary structure. Related web based software (JPRED, PROSEC, NNPREDICT, SOPMA, DSSP, STRIDE) **06 Hours**

PART B

UNIT 5:

PLASMID MAPPING AND PRIMER DESIGN

Restriction mapping, Utilities, DNA strider, MacVector and OMIGA, gene construction KIT, Vector NTI, Web based tools (MAP, REBASE); Primer design – need for tools, Primer design programs and software (PRIME3). Conceptual numericals. **06 Hours**

UNIT 6:

GENOME BIOINFORMATICS

Sequencing methods, Bioinformatics tools and automation in Genome Sequencing, analysis of raw genome sequence data, Utility of EST database in sequencing, Bioinformatics in detection of Polymorphisms, SNPs and their relevance**,** Bioinformatics tools in microarray data analysis. Tools for comparative genomics: BLAST2, AVID, Vista, MUMmer, COG, VOG. Qualitative discussions on Machine Learning Tools (Artificial Intelligence, Genetic algorithm and neural networks). **06 Hours**

UNIT 7:

MOLECULAR MODELING & VIZUALIZATION

Scope and applications of insilico modeling in modern biology. Comparative modeling, Constructing an initial model, refining the model, manipulating the model; molecular superposition and structural alignment, concept of energy minimization, different types of interactions and formulation of force fields. Basic MD algorithm, its limitations, treatment of long range forces. Structure Visualization and Graphical representation of molecular structures: small molecules (low molecular weight – peptides, nucleotides, disaccharides, simple drugs molecules) and macromolecules (high molecular weight molecules - proteins, DNA, RNA, membranes). Usages of visualization software available in public domain like VMD, Rasmol, Pymol, SpdbViewer, Chime, Cn3D and GRASP. Rotameric Structures of Proteins (Conformational Flexibility), Canonical DNA Forms (DNA Sequence Effects). **08 Hours**

UNIT 8:

INSILICO DRUG DESIGN

Molecular modeling in drug discovery, deriving bioactive conformations, molecular docking, quantitative structure-activity relationship (QSAR), deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Ligand - Receptor Interactions: Docking-softwares (AUTODOCK, HEX) Calculation of Molecular Properties, Energy Calculations (no derivation). Conceptual numericals. **06 Hours**

TEXT BOOKS

BIOINFORMATICS by Andreas D Baxevanis. Wiley Interscience.
Essentials of Bioinfomatics, Jin Xinog, Texas A & M University, Cambridge University press.
BIOINFORMATICS: by David W Mount, cold spring harbor.
Introduction to Bioinformatics by Arthur Lesk, III edition, Oxford Publications.
Structural Bioinformatics by Philip E Bourne, John Wiley & Sons.
BIOINFORMATICS: Stuart M Brown, NYU Medical Center, NY USA.
DISCOVERING GENOMICS, PROTEOMICS & BIOINFORMATICS BY A M CAMPBELL & L J HEYER, PEARSON EDUCATION.
Fundamental Concepts of Bioinformatics by D E Krane & M L Raymer, Pearson.

REFERENCE BOOKS

Computational methods for macromolecular sequence analysis: R F Doolittle. Acad. Press.
Computational methods in Molecular Biology. S.L.Salzberg, D B Searls, S Kasif, Elsevier.
BIOINFORMATICS – METHODS AND APPLICATIONS: GENOMICS, PROTEOMICS AND DRUG DISCOVERY BY S C RASTOGI, N MENDIRATTA & P RASTOGI, PHI.
The molecular modeling perspective in drug design by N Claude Cohen, Academic Press.
Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.
Introduction to Bioinformatics by ANNA TRAMONTANO, TAYLOR & FRANCIS
BIOINFORMATICS by Des Higgins & Willie Taylor Oxford.

GENETIC ENGINEERING & IMMUNOTECHNOLOGY LABORATORY

Sub. Code	:	10BTL-57	I.A Marks	:	25
Hours/week	:	03	Exam Hrs.	:	03
			Exam Marks	:	50

1. Preparation of DNA for PCR applications- Isolation, purity & quantification
2. Introduction to PCR – working of PCR equipment, programming, preparation of reagents and buffer
3. Isolation of total RNA from plant/animal sources
4. Gene/ DNA amplification by random primers-RAPD
5. DNA amplification by specific primer
6. Southern hybridization (Demo)
7. Gene Transformation Gene Cloning-PCR product/GUS gene
8. Agglutination Technique: Blood group identification
9. Bacterial Agglutination Technique-Widal test (Tube / slide agglutination)
10. Ouchterlony Double Diffusion (ODD) and Radial Immunodiffusion (RID)
11. ELISA- Microtitre plate
12. Countercurrent immunoelectrophoresis (CCIEP)
13. Rocket immunoelectrophoresis (RIEP)
14. SDS PAGE and Western blot
15. Separation of lymphocytes from peripheral blood.

TEXT/REFERENCE BOOKS

Introduction to Genetic Engineering by Nicholl. Cambridge Low Price Edition.
Principles of gene manipulation - An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications.
From Genetics to Gene Therapy – the molecular pathology of human disease by David S Latchman, BIOS scientific publishers.
Genes IX by Benjamin Lewis, Oxford University & Cell Press.
DNA Science by David A Micklos, Greg A Freyer and Dvaid A Crotty, I K International.
Molecular Biotechnology: Principles and Practices by Channarayappa, University Press.
A Text book of Molecular Biotechnology by Ashok Chauhan, IK Intl.
Genetic Engineering Vol. 1-4 (Williamson Edition). Academic Press.
Recombinant DNA by Watson et al., Scientific American Book.
Vectors by Rodriguer and Denhardt, Butterworth Publishers.
Current protocols in molecular biology, Greena Publishing Associates, NY.
Berger S.L. Kimmel A.R. Methods in enzymology, Vol.152, Academic Press.
Molecular cloning Volumes I, II and III. Sambrook J et al. Cold Spring Harbor lab Press.
Laboratory manual for Genetic Engineering. John Vennison, PHI Ltd.
Immunology & Immunotechnology by Ashim K Chakravarthy, Oxford University Press.
Immundiagnostics by S C Rastogi, New Age International.
Current protocols in molecular biology, Greena Publishing Associates, NY.
Berger S.L. Kimmel A.R. Methods in enzymology, Vol.152, Academic Press.
DNA Science by David A Micklos, Greg A Freyer and David A Crotty, I K International.
Molecular cloning Volumes I, II and III. Sambrook J et al. Cold Spring Harbor lab Press.
Introduction to Genetic engineering by Sandhya Nair, IK Publishers.

BIOINFORMATICS LABORATORY

Sub. Code	:	10BTL-58	I.A Marks	:	25
Hours/week	:	03	Exam Hrs.	:	03
			Exam Marks	:	50

1. Bibliographic search from PUBMED, SCIRUS, MEDMINER and Sequence retrieval from Nucleic acid and Protein databases.
2. Sequence (FASTA and BLAST) searches – Retrieval of homologs, paralogs, orthologs, and xenologs
3. Pair wise comparison of sequences – Analysis of parameters affecting alignment.
4. Multiple alignments of sequences and pattern determination using PROSITE
5. Evolutionary studies / Phylogenetic analysis – Analysis of parameters affecting trees
6. Identification of functional sites in Genes / Genomes.
7. Secondary structure prediction of proteins and nucleic acid (DNA/RNA)
8. Study of posttranslational modifications using relevant tools
9. Restriction mapping: Analysis of maps for suitable molecular biology experiment.
10. Primer Design: Factors affecting primer design.
11. PDB structure retrieval and visualization: Analysis of homologous structures.
12. Comparative Modeling of homologous sequences and validation of modeled structures.
13. Determination of ligand-protein interactions using SPDBV/ LIGPLOT
14. Superposition of structures – Calculation of RMSD.
15. Docking studies – Analysis of substrate / ligand binding using homologous structures
16. Derivation of pharmacophore patterns for selective ligands.

TEXT/REFERENCE BOOKS

BIOINFORMATICS by Andreas D Boxevanis. Wiley Interscience.

BIOINFORMATICS by David W Mount, cold spring harbor.

BIOINFORMATICS: A biologists guide to biocomputing and the internet. Stuart M Brown, NYU Medical Center, NY USA.

ESSENTIALS OF BIOINFORMATICS, Jin Xinog, Texas A & M University, Cambridge University press.

Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

DISCOVERING GENOMICS, PROTEOMICS & BIOINFORMATICS BY A M CAMPBELL & L J HEYER, PEARSON EDUCATION.

Fundamental Concepts of Bioinformatics by D E Krane & M L Raymer, Pearson.

Computational methods in Molecular Biology. S.L.Salzberg, D B Searls, S Kasif, Elsevier.

BIOINFORMATICS – METHODS AND APPLICATIONS: GENOMICS, PROTEOMICS AND DRUG DISCOVERY BY S C RASTOGI, N MENDIRATTA & P RASTOGI, PHI.

Introduction to Bioinformatics by Arthur Lesk, Oxford Publications.

Structural Bioinformatics by Philip E Bourne, John Wiley & Sons

VI SEMESTER

BIOPROCESS CONTROL & AUTOMATION

Sub. Code	:	10BT-61	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

UNIT 1:

INSTRUMENTATION

Instrumentation - principles, Introduction to flow, pressure, temperature and liquid level measurements, measurement of important physico-chemical and biochemical parameters, methods of on-line and off-line biomass estimation, flow injection analysis for measurement of substrates, products and other metabolites. **08 Hours**

UNIT 2:

FIRST ORDER SYSTEMS

Process characteristics, Laplace transforms, first order systems – examples, mercury in glass thermometer, liquid level system, linearization, response of first order system for step, pulse, impulse and sinusoidal changes in input, conceptual numericals. **06 Hours**

UNIT 3:

FIRST ORDER SYSTEMS IN SERIES

Interacting and non-interacting systems and their dynamic response to step, pulse and impulse inputs; conceptual numericals. **04Hours**

UNIT 4:

SECOND ORDER SYSTEMS

Second order systems with transfer functions (spring-damper, control valve, U-tube manometer), response of second order system to step, pulse / impulse and sinusoidal input – Overdamped, underdamped and critically damped condition of second order system, transportation lag.

08 Hours

PART B

UNIT 5:

CONTROLLERS AND FINAL CONTROL ELEMENTS

Actuators, Positioners, Valve body, Valve plugs, Characteristics of final control elements, controllers – two position control, proportional control, derivative control, integral control, P-I (proportional-integral) control, P-D (proportional- derivative) control, P-I-D (proportional-integral-derivative) control, conceptual numericals. **05 Hours**

UNIT 6:

CLOSED LOOP CONTROL SYSTEMS

Block diagrams for servo and regulatory problems. Transient response of first and second order processes for set point changes and load changes with proportional and PI controllers, conceptual numericals. **05 hours**

UNIT 7:

CONTROLLER DESIGN AND STABILITY

Criteria for stability, Routh test; Root locus (basics), Introduction to frequency response, Qualitative discussion about Bode criteria and Nyquist criteria; Conceptual numericals.

10 Hours

UNIT 8:

BIOPROCESSES DYNAMICS AND CONTROL

Dynamics and control of bioreactors & sterilizers. On-line data analysis for state and parameter estimation techniques for biochemical processes. **06 Hours**

TEXT BOOKS

Process System analysis and Control by Donald R Coughanowr, McGraw-Hill.
Chemical Process Control by George Stephanopoulos, Prentice-Hall of India.

REFERENCE BOOKS

Process dynamics and control by D E Seborg, T F Edger, John Wiley.
Process Control by Wayne C. Bequette, Pearson Education Asia**.**
Essentials of Process Control by Luyben and Luyben**.** McGraw-Hill Education.
Process Modeling, Simulation and Control by William Luyben**,** McGraw-Hill Education.
Biochemical Engineering Fundamentals by Bailey and Ollis, Mcgraw Hill.
Bioprocess Engineering by Shule and Kargi, Prentice Hall.
Bioprocess Engineering Principles by Pauline M. Doran, Academic Press.
Rate controlled separations by Wankat P.C, Elsevier.

CLINICAL & PHARMACEUTICAL BIOTECHNOLOGY

Sub. Code	:	10BT-62	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

DRUG MANUFACTURE AND FORMULATION

Introduction to pharma industry, Biotechnology and Drug design, Basic concepts and applications, composition, preparation, physicochemical considerations in manufacture of current biotech products & herbal medicines. Need of formulation and formulation development considerations. Concept & testing of preformulations & their parameters. Tablets: compressed, granulation, coatings, pills, capsules. Parental preparations, herbal extracts, Oral liquids, Ointments. Overview of Process Validation for pharmaceutical industries, Pilot Plant, Scale-Up Techniques. **08 Hours**

UNIT 2:

ANALYSIS OF PHARMACEUTICALS

Analytical methods and tests for various drugs -Physicochemical and bioanalytical considerations. Validation of analytical methods. packaging techniques- Glass containers, plastic containers, film wrapper, bottle seals; Quality assurance and control- storage and stability of biotech products. **04 Hours**

UNIT 3:

PHARMACOKINETICS AND PHARMACODYNAMICS

Pharmacodynamics and Pharmacokinetics of protein based drugs. Basic concepts, ADME definitions , Need of pharmacokinetic study. Interpretations from pharmacokinetics parameters. Examples of Pharmacodynamic parameters of various drugs. Evolution of Drug Metabolism Phase I Metabolism (microsomal oxidation, hydroxylation, dealkylation) Phase II Metabolism (Drug conjugation pathway) CYP Families. **07 Hours**

UNIT 4:

PHARMACOTHERAPY

Classification of drugs based on therapeutic actions using suitable examples Special emphasis on Vitamins, cold remedies, laxatives, analgesics, non-steroidal contraceptives, external antiseptics, antacids, antibiotics, biologicals, herbal products. Pharmacotherapy of migraine, cancer, TB, diabetes and male sexual dysfuntion. Hormone replacement therapy. **07 Hours**

PART-B

UNIT 5:

CLINICAL BIOTECHNOLOGY

The philosophy behind and organization of clinical research. Disease target identification and selection, receptor-based approaches, agonists, antagonists, enzyme inhibitors, Pre-clinical development to support testing in humans: In vitro and in vivo testing of new compounds, Relationship between animal and human pharmacology. Safety testing – acute, sub acute toxicology, immunotoxicology. Concepts of pharmacovigilance. **07 Hours**

UNIT 6:

BIOTHERAPY

Biotherapeutics: Clinical importance of Therapeutic Proteins: Therapeutic Antibodies and Enzymes; Hormones and Growth Factors used as therapeutics (erythropoietin & insulin as examples). Interferons, Interleukins and additional Regulatory Factors. Preservation and clinical use of blood and blood components, principles and safety guide lines for blood transfusion. Advanced Sustained Release, Advanced drug Delivery Systems: Liposomes and Nanoparticles, biodegradable drug delivery system (hydrogel based). **08 Hours**

UNIT 7:

STEM CELLS IN HEALTH CARE

Types and identification of stem cells, Fate Mapping of Stem Cells, Use of stem cells in therapy of neurological, hematopoetic, hepatic, pancreatic disorders. Applications of epidermal stem cell in Tissue engineering. Hematopoietic Stem Cells, Classification and clinical manifestations of hematopoietic stem cell disorders. **06 Hours**

UNIT 8:

CLINICAL RESEARCH

General principles and guide to data sources, types of epidemiology study designs, ecological (correlation) studies, case reports, prevalence surveys or cross-sectional studies, case control studies, Clinical trials-informed consent, Placebo Responses, Clinical Registries. Clinical Research Institutes, Data Management, Clinical Research from Pharmaceutical Industry Perspective. **05 Hours**

TEXT BOOKS

Biochemistry and Biotechnology by Gary Walsh, John Wiley & Sons Ltd.

Principles and Practice of Clinical Research by J. I. Gallin and F. P. Ognibene, Elsevier Publication.

Hematology by William J. Williams, Ernest Beutler, Allan JU. Erslev, Marshall A. Lichtman, IK Publishers.

Stem Cell Biology by Marshak, Cold Spring Harbour Symposium Pulblications.

Current Trends in Pharmacology by Arunabha Ray & Kavitha Gulati, IK Intl.

An Introduction to Synthetic Drugs by Singh & Rangnekar, Himalaya publishing House.

Biopharmaceuticals, Biochemistry and Biotechnology by Gary Walsh, Wiley Pub.

Principles of Medicinal Chemistry by Foye, Lippincott Williams & Wilkins Publishers.

Industrial Pharmaceutical Biotechnology by Heinrich Klefenz, Wiley-VCH edition.

Biopharmaceutical Drug Design and Development by S Wu-Pong, Y Rojanasakul, and J Robinson.

Pharmaceutical Biotechnology by K Sambamurthy & Ashutosh Kar, New Age.

Pharmaceutical Biotechnology by S P Vyas and V K Dixit, CBS Publishers.

REFERENCE BOOKS

Basic & Clinical Pharmacology by Bartram G. Katzung, Mc Graw Hill.

The Theory & Practice of Industrial Pharmacy by Leon Lachman, Herbert A. Lieberman & Joseph & Kanig, Vergese Publishing House Bombay.

Enzyme Technologies for pharmaceutical and biotechnological applications by Herbert A Kirst, Wu-Kuang Yeh, Milton J. Marcel Dekker Publications.
Developmental Biology, by Scott F. Gilbert, Wiley Publications.
Current Trends in Pharmacology by Arunabha Ray & Kavitha Gulati, IK Intl.
Developmental Biology, Scott F. Gilbert**,** Cambridge University Press.
Molecular Biology of the Cell, by Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson, Garland Science.
Text book of Medical Biochemistry by R L Nath, New Age Publishers.
Pharmaceutical Biotechnology by K Sambamurthy & Ashutosh Kar, New Age Publishers.
ICH guideline Q6B, Freelance Publishing.
Basic & Clinical Pharmacology by Bartram G. Katzung, Mc Graw Hill.

ENZYME TECHNOLOGY & BIOTRANSFORMATION

Sub. Code	:	10BT-63	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

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. **06 Hours**

UNIT 2:

BIOCATALYSTS

Advantages of enzymes vs chemical catalysts, Isolated Enzymes versus whole cell systems, enzymes in fermentation, Biocatalytic Application, Enzyme catalysis (Acid-base, Covalent, Metal ion catalysis, Substrate strain & entropy effects) Mechanism of coenzymes (NAD/NADP, FAD/FADH2, PLP, Coenzyme A, TPP, Biotin) **08 Hours**

UNIT 3:

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, **06 Hours**

UNIT 4:

ENZYMATIC TECHNIQUES

Enzyme and isoenzyme measurement methods with two examples (fixed incubation and kinetic methods); Methods for investigating the kinetics of Enzyme catalysed reactions – Initial velocity studies, rapid-reaction techniques. Standardization and optimization methods, stability of enzymes. **06 Hours**

PART B

UNIT 5:

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. **08 Hours**

UNIT 6:

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. **06 Hours**

UNIT 7:

MEDICAL APPLICATIONS

Importance of enzymes in diagnostics, Enzyme pattern in diseases like Myocardial infarctions (SGOT, SGPT & LDH). Isoenzymes (CK, LD, ALP). Use of isozymes as markers in cancer and other diseases. Enzymes in immunoassay techniques. Therapeutic enzymes. Inborn errors of metabolism. **06 Hours**

UNIT 8:

INDUSTRIAL APPLICATIONS

Enzymes used in detergents, use of proteases in food, leather and wool industries; methods involved in production of glucose syrup from starch (using starch hydrolyzing enzymes), production of maltose and sucrose, glucose from cellulose, uses of lactase in dairy industry, glucose oxidase and catalase in food industry; Restriction enzymes and DNA ligases. **06 Hours**

TEXT BOOKS

Fundaments of Enzymology by Nicholas C Price and Stevens, Oxford Press.
Enzymes – Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer, Horwood Publishing Limited.
Biotransformations in Organic Chemistry by Kurt Faber, Springer Berlin Heidelberg.
Enzymes in Industry: Production and Applications by W. Gerhartz, VCH Publishers.
Enzyme Technology by M.F. Chaplin and C. Bucke, Cambridge Press.

REFERENCE BOOKS

Enzyme Technology by Messing, Wiley, New York
Purifying Proteins for Proteomics by Richard J Simpson, IK International.
Proteins and Proteomics by Richard J Simpson, IK International.
Enzymes by Dixon and Webb, IRL Press.
Principles of Enzymology for technological Applications by Butterworth Heinemann,
Oxford University Press.
Biocatalyst for Industry by J.S. Dordrick, Plenum press, New York.
Enzymes in Industry: Production and Applications by W. Gerhartz VCH Publishers**.**
Fundaments of Enzymology by Prices and Stevens, Oxford Press.

GENOMICS & PROTEOMICS

Sub. Code	:	10BT-64	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

Genes and Proteins, Polymorphisms – types of polymorphism, genome sequences and database subscriptions, Prediction of new genes and their function by databases. **04 Hours**

UNIT 2:

SEQUENCING & GENOME PROJECTS

Early sequencing efforts. Methods of preparing genomic DNA for sequencing, DNA sequencing: Sanger Dideoxy method, Fluorescence method, shot-gun approach. Genome projects on *E.coli*., Arabidopsis and rice; Human genome project and the genetic map. **06 Hours**

UNIT 3:

GENOMICS

Gene variation and Single Nucleotide Polymorphisms (SNPs), Expressed sequenced tags (ESTs), Gene-disease association, diagnostic genes and drug targets, genotyping tools - DNA Chips and their application, diagnostic assays; comparative genomics. Functional genomic studies with model systems such as Drosophila, Yeast or *C. elegans*. **08 Hours**

UNIT 4:

GENOME MANAGEMENT IN EUKARYOTES

Cell differentiation and gene regulation. Inheritance pattern in eukaryotes, Mutations, Regulation of transcription, transcription factors and the co-ordination of gene expression, translation and post-translational modification in eukaryotes. Interference RNA, RNA silencing, SiRNA: Applications in Functional genomics, Medicine and Gene Knockdown. **08 Hours**

PART B

UNIT 5:

STRUCTURAL GENOMICS

General architecture of prokarytoc and eukaryotic genome. C-Values of genomes. Organization of genome within nucleus, mitochondrial and chloroplast genome. **04 Hours**

UNIT 6:

GENOME ANALYSIS

Genetic and physical maps: Breeding requirements for mapping. Molecular markers - RFLP, RAPD, AFLP, microsatellites and SNPs. Methods of molecular mapping, Marker assisted selection. Map-based cloning, T-DNA and transposon tagging. Differential display via RT-PCR. Micro-array in functional genomics. Bioinformatics analysis – clustering methods. Approaches to Physical mapping, FISH - DNA amplification markers; Telomerase as molecular markers. Genome mapping approaches for microorganisms. **07 Hours**

UNIT 7:

PROTEOMICS

Introduction to proteins, Methods of protein isolation, purification, quantification, Large scale preparation of proteins and peptides, Merrifield Synthesis of peptides, use of peptides as probes. Proteomics databases, proteins as drugs; Proteome functional information, two hybrid interaction screens. **05 Hours**

UNIT 8:

PROTEOME ANALYSIS

Mass-spec based analysis of protein expression and post-translational modifications. "Protein Chip" - interactions and detection techniques. Methods of measurement of mRNA expression, DNA array hybridization, Non-DNA array hybridization, Two dimensional PAGE for proteome analysis, Image analysis of 2D gels, High throughput proteome analysis by stable isotope labeling, Automation in proteomics, Applications of proteome analysis to drug development and toxicology, Phage antibodies as tools for proteomics, Glycoanalysis in proteomics, Proteomics as tool for disease diagnostics and plant genetics. **10 Hours**

TEXT BOOKS

Introduction to Genomics by Arthur M Lesk, Oxford University Press.

Plant Genome Analysis. Edited by Peter M Gresshoff, CRC Press.
Genetic Analysis – Principles, Scope and Objectives by JRS Finchman, Blackwell Science.
DISCOVERING GENOMICS, PROTEOMICS & BIOINFORMATICS BY A M CAMPBELL & L J HEYER, PEARSON EDUCATION.
Protein Arrays, Biochips and Proteomics by J S Albala & I Humprey-Smith, CRC Press.
Genomics & Proteomics by Sabesan, Ane Books.
Purifying Proteins for Proteomics by Richard J Simpson, IK International.
Proteins and Proteomics by Richard J Simpson, IK International.

REFERENCE BOOKS

Biocomputing Informatics and the Genome Projects by Smith D.W., Academic Press.
Genes IX by Benjamin Lewis. Oxford University & Cell Press.
BIOINFORMATICS – METHODS AND APPLICATIONS: GENOMICS, PROTEOMICS AND DRUG DISCOVERY BY S C RASTOGI, N MENDIRATTA & P RASTOGI, PHI.

BIOPROCESS EQUIPMENT DESIGN & CAED

Sub. Code	:	10BT-65	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	04
Total Hours	:	52	Exam Marks	:	100

UNIT 1:

INTRODUCTION TO DESIGN

a) Types of joints (welded)
b) Types of pipe fittings
c) Types of valves- ball and safety **10 Hours**

UNIT 2:

PROCESS EQUIPMENTS DESIGN USING CAED

Detailed process and mechanical design of the following equipments

a) Fermentor vessels (bioreactor)
b) Double pipe heat exchanger
c) Shell and tube heat exchangers
d) Distillation column (packed bed)
e) Condenser (vertical condenser) **42 Hours**

TEXT BOOKS

Process equipment design by M V Joshi, Macmilan Indian Limited.
Unfired pressure vessel I S Code 2825, JAICO Publishing House.
Shell and tube heat exchanger specifications, I S Code 4503, Gulf Publishing Company.
Chemical engineers hand book by Perry and Green, McGraw-Hill.

REFERENCE BOOKS

Process equipment and mechanical aspect by V C Bhattachary, CBS Publishers.
Mechanical equipment design, Brownell and Young, Wiley Publishing.
Fermentation and biochemical engineering hand book, Principles, process design and equipment. H C Vogel, & Noyes Edition. William Andrew Publishing.
Chemical Engineering by Coulson and Richardson, Elsevier Science.
Equipment design by Atkins, Macmillan Publishing.

ELECTIVE A

ANIMAL BT

Sub. Code	:	10BT-661	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

History and development of animal tissue culture. Equipment and materials (culture vessels, CO_2 incubator, inverted microscope, cell counters). Principles of sterile techniques. Sources of tissues, types of tissues - epithelial, muscle, connective, nerve and blood. Introduction to balanced salt solutions. Cell culture media - components of the medium, physical, chemical and metabolic functions of media. Role of serum and supplements, serum-free media, features and specifications of MEM, DMEM, RPMI and Ham's medium. Role of antibiotics in media.

08 Hours

UNIT 2:

TECHNIQUES

Measurement of cell number - hemocytometer, coulter counter. Measurement of cell viability and cytotoxicity. Dye exclusion and inclusion tests, colonigenic assay, macromolecular estimation, MTT based assay. Measuring parameters of growth – growth curves, PDT, Plating efficiency and factors influencing growth. **05 Hours**

UNIT 3:

CELL LINES

Primary culture – Mechanical and enzy0matic mode of desegregation, establishment of primary culture. Subculture - passage number, split ratio, seeding efficiency, criteria for subculture. Cell lines - definite and continuous cell lines, characterization, authentication, maintenance and preservation of cell lines. Contamination - bacterial, viral, fungal and mycoplasma contaminations, detection and control, cell transformation – normal v/s. transformed cells, growth characteristics of transformed cells. Viral and chemical-mediated methods of cell immortalization. **08 Hours**

UNIT 4:

CELL CULTURE

Scale-up of animal cell culture – Factors to be considered. Scale-up of suspension cultures - Batch reactor, continuous culture, perfusion systems. Scale-up of monolayer cultures – roller bottles, Nunc cell factory, microcarrier cultures, organotypic culture, matrices, factors affecting culture and perspectives. **05 Hours**

PART B

UNIT 5:

INVITRO FERTILIZATION & CLONING

Conventional methods of animal improvement, predominantly selective breeding and cross-breeding. Embryo biotechniques for augumentation of reproductive efficiency and faster multiplication of superior germ plasm. Super ovulation Oestrus synchronization. Embryo collection, evaluation and transfer. *Invitro* maturation of oocytes. *Invitro* fertilisation and embryo culture. Embryo preservation. Micro manipulation and cloning. Artificial insemination, preparation of foster mother, surgical and non-surgical methods of embryo transfer, donor and recipient aftercare. Cloning - concept of nuclear transfer, nuclear reprogramming and creation of Dolly. Stem cells - embryonic and adult stem cells, plasticity and concept of regenerative medicine. **10 Hours**

UNIT 6:

HUMAN GENOME

Human genome - complexicity of the genome, outlines of human genome project, human disease genes. Molecular biological techniques for rapid diagnosis of genetic diseases. Chemical carcinogenesis, transfection, oncogenes and antioncogenes. Cryo preservation and transport of animal germ plasm (i.e. semen, ovum and embryos). Genetherapy - *ex vivo* and *in vivo* gene therapy methods, applications. **06 Hours**

UNIT 7:

TRANSGENICS

Tansgenic animals - retroviral, microinjection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals - biopharming, disease models, functional knockouts. **04 Hours**

UNIT 8:

OTHER APPLICATIONS

Application of animal cell culture - Vaccine production, specialized cell types. Concepts of tissue engineering - skin, liver, kidney, bladder and heart. Principles and species suitable for aquaculture (Indian major carps and prawns). Genetic status of culture stocks. Chromosome manipulations - Production of all male and sterile populations, Hypophysation in fishes and prawns. Pearl culture - pearl producing mollusks, rearing of oysters, nucleation for pearl formation and harvesting of pearls. Probiotics and their significance in aquaculture. Molecular tools for the identification of diseases in aquatic species. **06 Hours**

TEXT BOOKS

Culture of Animal Cells by R Ian Fredhney, Wiley-Liss Publications.
Animal Cell Biotechnology by Spier, RE and Griffith, JB Academic Press, London.
Animal Biotechnology by Murray Moo-Young, Pergamon Press, Oxford Press.
Animal Cell Technology: Principles and Practices by Butter M, Oxford Press.
Molecular Biotechnology by Sandy B. Primrose, Blackwell Scientific Publishers.
An Introduction to Molecular Biotechnology by MICHAEL WINK, WILEY.
Molecular Biotechnology: Principles and Practices by Channarayappa, University Press.

REFERENCE BOOKS

Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods Ed. JP Mather and D Bames. Academic Press.
Fish & Fisheries of India by V. G. Jhingram, Central Publishing House.
Living resources for Biotechnology, Animal cells by A. Doyle, R. Hay and B.E. Kirsop, Cambridge University Press.
Animal Cell Culture – Practical Approach, Edition: John RW. Masters, Oxford Press.
Animal Cell Culture Techniques, Edition: Martin Clynes, Springer.
Cell Culture Lab Fax. Editors: M Butler & M Dawson, Bios Scientific Publications Ltd. Oxford.

PLANT BT

Sub. Code	:	10BT-662	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

Introduction to cell and tissue culture. Tissue culture media (composition and preparation). Organogenesis, somatic embryogenesis. Embyo culture. Androgenesis and gynogenesis. Endosperm culture. Protoplast culture and selection of cybrids. Cryopreservation. **04 Hours**

UNIT 2:

PLANT GENETIC ENGINEERING

Induction to Plant Genetic Engineering: Types of plant vectors and their use - Particle bombardment, electroporation, microinjection. Agrobacterium mediated transformation – Technique and applications. Ti and Ri-plasmids as vectors. Screening and selection of transformants – PCR and hybridization methods. Viruses as a tool to delivery foreign DNA. Transformation of monoctos. Mechanism of transgene interaction - Transgene stability and gene silencing. Generation and maintenance of transgenic plants. **08 Hours**

UNIT 3:

PLANTS FOR BIOTIC AND ABIOTIC STRESSES

Introduction to biotic stresses, types. Application of plant transformation – bt genes, Structure and function of Cry proteins – mechanism of action, critical evaluation. Non-bt like protease inhibitors, alpha amylase inhibitor, Transgenic technology for development of virus, bacterial and fungal resistance plants. Abiotic stress – Introduction to drought and salinity stresses, transgenic strategies for development of drought resistant plants, case studies **08 Hours**

UNIT 4:

IMPROVEMENT OF VARIETIES

Post-harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, barstar and barnase systems. Herbicide resistance - phosphoinothricin, glyphosate, atrazine; insect resistance. Biosafety regulations and evaluation of transgenics contained conditions. Implications of gene patents. **06 Hours**

PART B

UNIT 5:

MOLECULAR FARMING AND APPLICATIONS

Plant metabolic engineering and industrial products: Molecular farming for the production of industrial enzymes, biodegradable plastics, polyhydroxybutyrate, antibodies, edible vaccines. Metabolic engineering of plants for the production of fatty acids, industrial oils, flavonoids etc., Engineering of carotenoid and provitamin biosynthetic pathways. **06 Hours**

UNIT 6:

NITROGEN FIXATION AND APPLICATIONS

Nitrogen fixation and biofertilizers - Diazotrophic microorganisms, nitrogen fixation genes. Two component regulatory mechanisms. Transfer of *nif* genes and *nod* genes – structure, function and role in nodulation; Hydrogenase - Hydrogen metabolism. Genetic engineering of hydrogenase genes. **06 Hours**

UNIT 7:

SIGNAL TRANSUCTION IN PLANTS

Signal transduction in plants: Mechanism, plant hormone signaling- Molecular mechanism of Auxins, Gibberlins, Cytokinins, Abscisic acid and ethylene, transduction, light perception and signaling network in higher plants, calcium and sphingolipids signaling. **06 Hours**

UNIT 8:

ALGAL TECHNOLOGIES

Blue-green algae and Azolla - Identification of elite species and mass production for practical application. Mycorrhizae - importance in agriculture and forestry. Algae as a source of food, feed, single cell protein, biofertilizers; industrial uses of algae. Mass cultivation of commercially valuable marine macroalgae for agar agar, alginates and other products of commerce and their uses. Mass cultivation of microalgae as a source of protein and feed. **08 Hours**

TEXT BOOKS

Plant Cell Culture : A Practical Approach by R.A. Dixon & Gonzales, IRL Press.
Plant biotechnology in Agriculture by K. Lindsey and M.G.K. Jones, Prentice hall, New Jersey.
Plant Biotechnology, Prakash and Perk, Oxford & IBH Publishers Co.
Plant Biotechnology by J Hammond, P McGarvey and V Yusibov, Springer Verlag.
Biotechnology in Crop Improvement by HS Chawla, Intl Book Distributing Company.
Biodegradation and Detoxification of Environmental Pollutants by Chakrabarthy AM. CRC Press.
Practical Application of Plant Molecular Biology by RJ Henry, Chapman and Hall.

REFERENCE BOOKS

Molecular Biotechnology: Principles and Practices by Channarayappa, University Press.
Plant Tissue Culture: Applications and Limitations by S.S. Bhojwani, Elsevier, Amsterdam.
Plant Cell and Tissue Culture for the Production of Food Ingredients by TJ Fu, G Singh and WR Curtis (Eds): Kluwer Academic Press.
Biotechnology in Agriculture by MS Swamynathan, McMillian India Ltd.
Gene Transfer to Plants by Polyykus I and Spongernberg, G.Ed. Springer Scam.
Genetic Engineering with Plant Viruses by T Michael, A Wilson and JW Davis, CRC Press.
Molecular Approaches to Crop Improvement by Dennis Liwelly Eds. Kluwer. Academic Publishers.
Plant Cell and Tissue Culture- A Laboratory manual by Reinert J and Yeoman MM, Springer.
Plant Tissue Culture by Sathyanarayana BN, IK Intl. Publishers.

MICROBIAL BT

Sub. Code	:	10BT-663	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART - A

UNIT 1:

INTRODUCTION

Study of Prokaryotes & Eukaryotes, Classification and Identification of Microorganisms, classification and identification of fungi. **02 Hours**

UNIT 2:

MICROBIAL PROCESS ENGINEERING

Introduction to microbial process development. Scale - up of microbial processes -Analysis of experimental data. Design & optimization of fermentation media. Kinetics of cell growth. Sterilization of air and media. Modes of cell culture. Bioreactor systems including utilities. Mass transfer in Microbial processes. Instrumentation and control of process parameters.**08 Hours**

UNIT 3:

MICROBIAL BIOTECHNOLOGY

Production of protein in bacteria-Cloning techniques, expression of cloned genes in bacteria, Recovery and purification of expressed proteins. Introduction of DNA into yeast cells, yeast

cloning vectors, expression of foreign genes in yeast, expression of foreign gene products in secreted form. **04 Hours**

UNIT 4:

INDUSTRIAL MICROBIOLOGY

Strain improvement and screening of industrially important microorganisms. Industrial production of Vitamins (VitB12 & riboflavin), Antibiotics (β-lactam antibiotics, Aminoglycosides) , organic acids (Citric acid, acetic acid) and Enzymes (amylases, proteases). Impact of Biotechnology on vaccine development; sub unit vaccines, DNA vaccines, recombinant vaccines, peptide vaccines. Bioinsecticides-*Bacillus thuringinesis*, *B.sphaericus*, *B.popilliae*, Baculoviruses. Production of Microbial enzymes, strain, medium, fermentation processes. Large scale application of Microbial enzymes - starch processing, textile designing, detergents, cheese industry, leather industry and wood pulp industry. **12 Hours**

PART – B

UNIT 5:

MICROBIAL BY PRODUCTS

Bacterial Polysaccharides – structure & role in nature. Xanthan Gum - structure, production & Biosynthesis polyesters. Microbial transformation of steroids & sterols. Industrial production of ethanol and amino acids (glutamic acid) **06 Hours**

UNIT 6:

ENVIRONMENTAL MICROBIOLOGY

Contamination in air, water and soil, Waste water microbiology, Microbiological Degradation of xenobiotics. Biomagnification. **04 Hours**

UNIT 7:

BIOREMEDIATION AND BIOLEACHING

Bioremediation: use of bacteria and biodegradation of hydrocarbons, *in situ* and *ex situ* Bioremediation, Granular sludge consortia for bioremediation, crude oil degradation by bacteria, Immobilization of microbes for bioremediation, PCB dechlorination, Genetic engineering of microbes for bioremediation. Phytoremediation – plants capable of assimilating heavy metals. Biomethanation: application of microorganisms of biomethanation and cellulose degradation-Methanotrophs and other orgnisnms. Bioleaching: direct and indirect mechanisms, microorganism in mineral recovery, recovery of copper by dump leaching, Sulfur Leaching by Thermophilic microorganisms, Microbial coal solubilization. **10 Hours**

UNIT 8:

FOOD MICROBIOLOGY

Microbial spoilage of food and its control; food preservatives; fermented foods; single cell protein (SCP) and single cell oil (SCO); food borne infections and their control. **06 Hours**

TEXT BOOKS

Microbial Biotechnology by Alexander N Glazer and Hiroshi Nikaido, W H Freeman & Company Newyork.

Fundamentals of Biotechnology by Edited by Paule Prave, Uwe Faust, Wolfgang Sitting and Dieter A Sukatsch, VCH Publishers.

Principles of fermentation Technology by P.F. Stanbury and A. Whitaker, Pergamon Press.

A textbook of Industrial Microbiology by Wulf Cruegar and Anneliese Cruegar, Panima Publishing Corporation.

Molecular Biotechnology– Principles and Applications of recombinant DNA by Bernard R Glick & Jack J pasternak , ASM Press.

Industrial Microbiology by Prescott and Dunn, CBS Publishers & Distributors.

Industrial Microbiology- An introduction by Michael J Waites, Neil L Morgan, Blackwell science.
Food microbiology by William C Frazier and Westhoff Dennis C, Tata McGraw Hill publication.
Industrial Microbiology by L.E Casida, New Age International.

REFERENCE BOOKS

Microbiology by Bernard Davis & Renato Dulbecco, Lippincott Company, Philadelphia.
Principles of Microbe & Cell Cultivation by SJ Prit, Blackwell Scientific co.
Basic Biotechnology by Colin Ratledge & Bjorn Kristiansen, Cambridge University Press.
Applied Bioremediation and Phytoremediation by A Singh & O P Ward, Springer.

PERL PROGRAMMING

Sub. Code	:	10BT-664	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

INTRODUCTION

An overview of Perl: Getting started, interpreted vs compiled source code, documentation in perl, statement blocks, ASCII and Unicode, Escape sequences, whitespaces, numerical data type, strings in perl, alternative delimiters, conversion between numbers and strings, Arithmetical operators, bitwise operators, Boolean operators, string operators, string comparison, operator precedence, variables, modifying a variable, autoincrement and autodecrement operators, multiple assignments, scoping, special variables, regular expression variables, input/ output variables, filehandle / format variables, error variables and system variables variable interpolation. **08 Hours**

UNIT 2:

LISTS, ARRAYS AND HASHES

Introduction to lists, simple lists, complex lists, accessing list values, list slices, ranges, combining ranges and slices, arrays, assigning arrays, scalar vs list context, adding elements to an array, accessing single and multiple elements from an array, running through arrays, array functions (pop, push, shift, unshift, and sort); Introduction to Hashes, creating a hash, working with hash values, adding, changing and taking values from a hash, accessing multiple values.

06 Hours

UNIT 3:

ARRAY MANIPULATIONS

Introduction, Changing Array Size, Interacting Over an Array by Reference, Extracting Unique Elements from a List, Computing Union, Intersection, or Difference of Unique Lists, Appending One Array to Another, Reversing an Array, Processing Multiple Elements of an Array, Finding All Elements in an Array Matching Certain Criteria, Sorting an Array Numerically. **06 Hours**

UNIT 4:

REGULAR EXPRESSION

Introduction to regular expressions, patterns, interpolation, escaping special characters, anchors, character classes, word boundaries, posix and Unicode classes, detecting repeating words, well-defined repetition, back reference variables, match operator, substitution operator and transliteration operator, binding operators, meta-characters, changing delimiters, modifiers, usage of split and join keywords, inline comments and modifiers, grouping and alternation, grouping with back references. **06 Hours**

PART B

UNIT 5:

FILES AND REFERENCES

Introduction to Filehandle, STDIN, STDOUT, STDERR file handles, reading lines, creating filters, line separator, reading paragraphs, reading entire files, writing to files, writing on a file handle, accessing filehandle, writing binary data, selecting a filehandle, buffering, file permissions, opening pipes, piping in, piping out, file tests, reading directories and globbing, introduction to references, lifecycle of a reference, anonymous reference, dereferencing, reference modification, array and hash referencing, reference counting and destruction.

08 Hours

UNIT 6:

SUBROUTINES AND MODULES

Introduction to subroutines, difference between subroutines and modules, defining subroutines, order of declaration, subroutines for calculations, return values, caching, context, subroutine prototypes, scope, global variables, lexical variables, runtime scope, aliases, passing references , arrays, hashes and filehandles to a subroutine, modules, usage of keywords do, require and use, changing @INC, package hierarchies, exporters, standard modules in perl. **06 Hours**

UNIT 7:

RUNNING AND DEBUGGING PERL

Examining syntax errors, runaway strings, brackets around conditions, missing semicolons, braces, commas and barewords. Diagnostic modules, use warnings, scope of warnings, use strict, strict on variables, references, subroutines, use diagnostics, perl command line switches, usage of –e, -n, -p, -c, -I, -M, -s, -I, @INC, -a, -F and –T switches, Debugging techniques, usage of print, comments, context, scope and precedence in debugging, Defensive programming. **06 Hours**

UNIT 8:

BIOPERL

Overview, Bioperl Objects, Brief descriptions (Seq, PrimarySeq, LocatableSeq, RelSegment, LiveSeq, LargeSeq, RichSeq, SeqWithQuality, SeqI), Location objects, Interface objects and implementation objects, Representing large sequences (LargeSeq), Representing changing sequences (LiveSeq), Using Bioperl: Accessing sequence data from local and remote databases, Accessing remote databases (Bio::DB::GenBank, etc), Indexing and accessing local databases Bio::Index::*, bp_index.pl, bp_fetch.pl, Bio::DB::*), Transforming sequence files (SeqIO), Transforming alignment files (AlignIO); **06 Hours**

TEXT BOOKS

Beginning Perl by Simon Cozens, Peter Wainwrigth, Wrox press.
Perl cook book by Tom Christiansen and Nathan Torkinton, O'Reilly & Associates, USA, 1998.
Programming Perl by Larry Wall, Tom Christiansen and Jon Orwant. O'Reilly Media.
Learning Perl by Randal L, Schwartz, Tom Phoenix, O'Reilly Media.

REFERENCE BOOKS

Perl by Example by Ellie Quigley, Prentice Hall.
Perl in a Nutshell by O'Reilley O'Reilly Media.
Perl: The programmer Companion by Nigel Chapman, Wiley.
BioPerl by O'Reilly & Associates, O'Reilly Media
Bioperl from Beginning Perl for Bioinformatics by James Tisdall, O'Reilly Media.

TRANSPORT PHENOMENA

Sub. Code	:	10BT-665	I.A Marks	:	25
Hours/week	:	04	Exam Hrs.	:	03
Total Hours	:	52	Exam Marks	:	100

PART A

UNIT 1:

MOMENTUM TRANSFER AND OVERALL BALANCES

Fluid Statics, General molecular transport equations for momentum, heat and mass transfer, Viscosity of fluids, Overall balances: mass balance/continuity equation, energy balance, momentum balance, shell momentum balance and velocity distribution in laminar flow, design equation for laminar and turbulent flow in pipes, compressible flow of gases. **06 Hours**

UNIT 2:

MOMENTUM TRANSFER – PRINCIPLES AND APPLICATIONS

Flow past immersed objects, packed and fluidized beds, Non-Newtonian fluids, Differential equations of continuity, momentum transfer (motion), use of these equations, other solution methods for differential equation of motion, boundary layer flow and turbulence, dimensional analysis in momentum transfer. **08 Hours**

UNIT 3:

STEADY STATE HEAT TRANFER

Mechanisms of heat transfer, conduction – through solids in series, steady state conduction and shape factors, Forced convection - heat transfer inside pipes, heat transfer outside various geometries, natural convection heat transfer, boiling and condensation, heat exchangers, radiation heat transfer (basic and advanced), heat transfer to non-Newtonian fluids, special heat transfer coefficients, dimensional analysis in heat transfer, numerical methods for steady state heat transfer in two dimensions. **06 Hours**

UNIT 4:

UNSTEADY STATE HEAT TRANSFER

Derivation of basic equation, simplified case for systems with negligible internal resistance, unsteady state heat transfer in various geometries, finite difference methods, chilling and freezing of food and biological materials, differential equation of energy change, boundary layer flow and turbulence in heat transfer. **06 Hours**

PART B

UNIT 5:

MASS TRANSFER

Mass transfer and diffusion, molecular diffusion in gases, liquids, biological solutions and gels, and solids, numerical methods for steady state molecular diffusion in two dimensions. **06 Hours**

UNIT 6:

UNSTEADY STATE AND CONVECTIVE MASS TRANSFER

Unsteady state diffusion, convective mass transfer coefficients, for various geometries, mass transfer to suspensions of small particle, molecular diffusion plus convection and chemical reaction, diffusion of gases in porous solids and capillaries, numerical methods for unsteady state molecular diffusion, dimensional analysis in mass transfer, boundary layer flow and turbulence in heat transfer. **09 Hours**

UNIT 7:

SEPARATION PROCESSES-1

Evaporation, Drying, Humidification, Absorption, Distillation. **05 Hours**

UNIT 8:
SEPARATION PROCESSES-2
Adsorption, Ion Exchange, Leaching, Crystallization, Membrane processes, Settling, Centrifugation and Size Reduction. **06 Hours**

TEXT BOOK
Transport Processes and Separation Process Principles by C. J. Geankoplis, Prentice. Hall.
Momentum, Heat and Mass Transfer by Bennett and Myers, Tata Mcgraw Hill.
Introduction to Transport Phenomena by William J. Thomson, PHI.
Transport Phenomena, Bird, Stewart, Lightfoot, JWI
Fundamentals of momentum, heat and mass transfer by Welty, Wicks and Wilson, Wiley India.
Fundamentals of FLUID MECHANICS by SAWHNEY GS, IK Publishers.
REFERENCE BOOKS
Unit Operations of Chemical Engg. by McCabe & Smith, M G H Publications.
Principles of Unit Operations in Chemical Engg. by Geankoplis. Prentice Hall.
Fluid Mechanics by K L Kumar, S.Chand Publishers.
Mechanics of fluids by B.S. Massey, Kluwer Academic Publishers.

BIOPROCESS CONTROL & AUTOMATION LAB

Sub. Code	:	10BTL-67	I.A Marks	:	25
Hours/week	:	03	Exam Hrs.	:	03
			Exam Marks	:	50

1. Characteristics of Transducers (Temperature).
2. Characteristics of Transducers (Pressure).
3. Characteristics of Transducers (Flow).
4. Measurement of OD and DO for microbial cultures
5. Dynamics of First order system (mercury thermometer) for step input and impulse input.
6. Non-interacting system responses to step input
7. Non-interacting system responses to pulse input
8. Interacting System responses to step input
10. Interacting System responses to pulse input
11. Temperature controller – responses to set point / load change
12. pH controller – responses to set point / load change
13. Tuning of Flow controller (ZN and CC methods) and responses of tuned P, PI and PID controllers
14. Tuning of Pressure controller (ZN and CC methods) and responses of tuned P, PI and PID controllers
15. Control of DO (dissolved oxygen level)
16. Control of Agitation (to monitor DO since they are interlinked)

TEXT / REFERENCE BOOKS
Process System analysis and Control by Donald R Coughanowr, McGraw-Hill.
Chemical Process Control by George Stephanopoulos, Prentice-Hall of India.
Bioprocess Engineering by Shule and Kargi, Prentice Hall.
Bioprocess Engineering Principles by Pauline M. Doran, Academic Press.
Wolf R. Vieth, Bioprocess Engineering – Kinetics, Mass Transport, Reactors and Gene Expression. A Wiley - Interscience Publication.

BIOKINETICS & ENZYME TECHNOLOGY LAB

Sub. Code	:	10BTL-68	I.A Marks	:	25
Hours/week	:	03	Exam Hrs.	:	03
			Exam Marks	:	50

1. Batch Growth Kinetics.
2. Mixed Flow Reactor Analysis.
3. Plug Flow Reactor Analysis.
4. Batch Reactor Analysis
5. RTD in PFR
6. RTD in MFR
7. Preparation of standard curve for maltose and assay of amylase activity. Calculation of amylase specific activity
8. Isolation of amylase from saliva/sweet potato. Ammonium sulfate fractionation
9. Isolation of pappain/protease from papaya and assay of pappain/protease using calorimetric method
10. Time course of amylase activity and effect of pH on amylase activity
11. Effect of temperature on amylase activity
12. Effect of substrate concentration on amylase activity (Km & Vmax determination)
13. Effect of inhibitors on enzyme activity
14. Effect of organic solvents on enzyme activity
15. Enzyme Immobilization Techniques and Kinetics.
16. Determination of molecular weight by SDS PAGE

TEXT/REFERENCE BOOKS

Biochemical Engineering Fundamentals by Bailey and Ollis, Mcgraw Hill.
Bioprocess Engineering by Shule and Kargi Prentice Hall.
Wolf R. Vieth, Bioprocess Engineering – Kinetics, Mass Transport, Reactors and Gene Expression. A Wiley – Interscience Publication.
Smith J.M. Chemical Engineering Kinetics, McGraw Hill.
Carbery J A. Chemical and Catalytic Reactor Engineering, McGraw Hill.
Enzymes in Industry: Production and Applications : W. Gerhartz, VCH Publishers, New York.
Enzyme Technology by M.F. Chaplin and C. Bucke, Cambridge University Press, Cambridge.
Enzymes: Dixon and Webb. IRL Press.
Principles of Enzymology for Technological Applications by B Heinemann Ltd, Oxford Press.