St. PETER'S UNIVERSITY

St. Peter's Institute of Higher Education and Research
(Declared under section 3 of UGC Act 1956)
Avadi, Chennai – 600 054.

M.Tech. (BIO TECHNOLOGY) PROGRAMME

(I TO IV SEMESTERS)

REGULATIONS AND SYLLABI

(REGULATIONS – 2012)

(Effective from the Academic Year 2012-'13)

M.Tech. (BIO TECHNOLOGY) PROGRAMME

Regulations and Syllabi

(Effective from the Academic Year 2012-'13)

1. **Eligibility:** Candidates who passed a professional degree such as B.Tech. in Biotechnology, Industrial Biotechnology, Chemical Engineering, B.Pharm. or M.B.B.S. or B.Sc. in Agriculture any other post graduate degree in Life Sciences or any other equivalent examination thereto are eligible for admission to Two Year M.Tech.(Bio Technology) Programme.

2. **Duration:** Two Years comprising 4 Semesters. Each semester has a minimum 90 working days with a minimum of 5 hours a day.

3. **Medium:** English is the medium of instruction and examination.

4. **Weightage for Continuous and End Assessment:** The weightage for Continuous Assessment (CA) and End Assessment (EA) be 25:75 unless the ratio is specifically mentioned in the scheme of Examinations.

5. **Credit System:** Credit system be followed with 18 credits for each semester and each credit is equivalent to 25 hours of effective study provided in the Time Table.

6. **Scheme of Examinations**

I Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
112BTPT01	Biochemical Engineering and Fermentation Technology	3	25	75	100
112BTPT02	**Elective – I : Bio chemistry**	3	25	75	100
112BTPT03	**Elective – II : Modern Techniques in Drug Discovery**	3	25	75	100
112BTPT04	**Elective – III :Molecular Biology**	3	25	75	100
112BTPT05	**Elective – IV :Enzyme Technology**	2	25	75	100
112BTPT06	**Elective – V :Environmental Biotechnology**	2	25	75	100
Practical					
112BTPP01	Advanced Biochemistry Lab	1	25	75	100
112BTPP02	Advanced Bioprocess Engineering Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

II Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
212BTPT01	Bioseparation Technology	3	25	75	100
212BTPT02	Advanced Genetic Engineering	3	25	75	100
212BTPT03	Computational Biology	3	25	75	100
212BTPT04	Bioreactor Engineering	3	25	75	100
212BTPT24	**Elective - VI :Immunotechnology**	2	25	75	100
212BTPT27	**Elective - VII :Plant Biotechnology**	2	25	75	100
Practical					
212BTPP01	Advanced Molecular Biology and Genetic Engineering Lab	1	25	75	100
212BTPP02	Advanced Down Stream Processing Lab	1	25	75	100
	Total	**18**	**200**	**600**	**800**

III Semester

Code No.	Course Title	Credit	Marks		
Theory			**CA**	**EA**	**Total**
312BTPT01	Advances in Nanobiotechnology	3	25	75	100
312BTPT02	Stem Cell Technology	3	25	75	100
Project					
312BTPP01	Mini Project	12	25	65	100
	Viva voce			10	
	Total	**18**	**75**	**225**	**300**

***** Candidates who have completed Project work (Phase I) successfully are eligible for Project Work (Phase - II) Examination.

IV Semester

Code No.	Course Title	Credit	Marks		
Project			**CA**	**EA**	**Total**
412BTPP01	Project work	18	25	65	100
	Viva voce			10	
	Total	**18**	**25**	**75**	**100**

LIST OF ELECTIVES

Elective – I*(Semester I)	
112BTPT11	Biochemistry
112BTPT12	Fundamentals of Chemical Engineering
112BTPT13	Engineering Proteins for Biopharmaceutics
Elective – II*(Semester I)	
112BTPT14	Cell Biology and Microbial Techniques
112BTPT15	Mass Transfer and Chemical Reaction Engineering
112BTPT16	Modern Techniques in Drug Discovery
Elective – III*(Semester I)	
112BTPT17	Molecular Biology
112BTPT18	Molecular Cell Biology
Elective - IV* (Semester I)	
112BTPT19	Enzyme Technology
112BTPT20	Unix Operating System and Programming Language C++
Elective - V* (Semester I)	
112BTPT21	Mathematics for Biotechnologists
112BTPT22	Environmental Biotechnology
Elective - VI*(Semester II)	
212BTPT23	Metabolic Process and Engineering
212BTPT24	Immunotechnology
212BTPT25	Advanced Process control
Elective - VII* (Semester II)	
212BTPT26	Food Processing Technology
212BTPT27	Plant Biotechnology

*** Note: One subject is to be chosen by the Student in the Elective group in consultation with the Head of the Department**

7. Passing Requirements: The minimum pass mark (raw score) be 50% in End Assessment (EA) and 50% in Continuous Assessment (CA) and End Assessment (EA) put together. No minimum mark (raw score) in Continuous Assessment (CA) be prescribed unless it is specifically mentioned in the scheme of Examination.

8. Grading System: Grading System on a 10 Point Scale be followed with 1 mark = 0.1 Grade point to successful candidates as given below.

CONVERSION TABLE

(1 mark = 0.1 Grade Point on a 10 Point Scale)

Range of Marks	Grade Point	Letter Grade	Classification
90 to 100	9.0 to 10.0	O	First Class
80 to 89	8.0 to 8.9	A	First Class
70 to 79	7.0 to 7.9	B	First Class
60 to 69	6.0 to 6.9	C	First Class
50 to 59	5.0 to 5.9	D	Second Class
0 to 49	0 to 4.9	**F**	**Reappearance**

Procedure for Calculation

Cumulative Grade Point Average (CGPA) = $\frac{\text{Sum of Weighted Grade Points}}{\text{Total Credits}}$

= $\frac{\sum (CA+EA)\ C}{\sum C}$

Where Weighted Grade Points in each Course = Grade Points (CA+EA) multiplied by Credits

= (CA+EA)C

Weighted Cumulative Percentage of Marks(WCPM) = CGPAx10

C- Credit, CA-Continuous Assessment, EA- End Assessment

9. Pattern of the Question Paper: The question paper for End Assessment will be set for three hours and for the maximum of 100 marks with following divisions and details.

Part A: 10 questions (with equal distribution to all units in the syllabus). Each questions carries 2 marks.

Part B: 5 questions with either or type (with equal distribution to all units in the syllabus). Each question carries 16 marks. The total marks scored by the candidates will be reduced to the maximum prescribed in the Regulations.

10. Effective Period of Operation for the Arrear Candidates : Two Year grace period is provided for the candidates to complete the arrear examination, if any.

Registrar

10. Syllabus

112BTPT01 - BIOCHEMICAL ENGINEERING AND FERMENTATION TECHNOLOGY

1. INTRODUCTION TO BIOPROCESSES:
Historical development of bioprocess technology, An overview of traditional and modern applications of biotechnological processes, general requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes.

2. 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.

3. MEDIA DESIGN FOR FERMENTATION PROCESSES:
Medium requirements for fermentation processes, Carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media. Medium for plant cell culture and animal cell culture. Medium design of commercial media for industrial fermentations – Plackett burman design, response surface methodology, simplex design, continuous cultivation method to determine the kinetic parameters and maintenance coefficient and pulse &shift method of medium optimiuzation. Case studies on each medium design methods.

4. KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION:
Phases of cell growth in batch cultures, Fed batch and continuous cultures. Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms & yeast. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

5. FERMENTATION TECHNOLOGY:
Case studies on production of Lactic acid, Glutamic acid, Pencillin, Microbial Lipase and Protease, Recombinant Insulin. Case studies should deal with strain improvement, medium designs, process optimization etc.,

REFERENCES:

1. Bailey, J.E. and Ollis, D.F. Biochemical Engineering Fundamentals", 2nd ed.,McGraw Hill 1986.
2. Shuler, M.L. and Kargi, F. Bioprocess Engineering : Basic concepts, 2nd ed., Prentice-Hall, 2002.
3. Doran Pauline M, Bioprocess Engineering Principles, Academic Press, 1995
4. Stanbury, P.F., Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

112BTPP01 - ADVANCED BIOCHEMISTRY LAB

1. Preparation of Acetate, Tris and Phosphate Buffer systems and validation of Henderson- Hasselbach equation.

2. Reactions of amino acids – Ninhydrin, Pthaldehyde, Dansyl chloride – measurement using colorimetric and fluorimetric methods.

3. Differential estimations of carbohydrates – reducing vs non-reducing, polymeric vs oligomeric, hexose vs pentose

4. Estimation of protein concentration using Lowrys' method, Dye-binding method

5. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect

6. Separation of lipids by TLC.

7. Enzyme Kinetics: Direct and indirect assays – determination of K_m, V_{max} and K_{cat}, K_{cat}/ K_m

8. Restriction enzyme – Enrichment and unit calculation

9. Ion-exchange Chromatagraphy – Purification of IgG and Albumin

10. Gel filtration – Size based separation of proteins

11. Affinity chromatography – IMAC purification of His-tagged recombinant protein

12. Assessing purity by SDS-PAGE Gel Electrophoresis

13. Chemical modification of proteins – PITC modification of IgG and Protein immobilization

REFERENCE BOOKS

1. Biochemical Methods: A Concise Guide for Students and Researchers, Alfred Pingoud, Claus Urbanke, Jim Hoggett, Albert Jeltsch, 2002 John Wiley & Sons Publishers, Inc,

2. Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Edition, Irwin H. Segel, 1976 John Wiley & Sons Publishers, Inc,

3. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.

112BTPP02 - ADVANCED BIOPROCESS LAB

1. Enzyme kinetics, inhibition, factors affecting reaction ph, temp.
2. Enzyme immobilization studies – Gel entrapment, adsorption and ion exchange immobilisation.
3. Optimization techniques – Plackett burman, Response surface methodology.
4. Batch cultivation – recombinant *E.coli* – growth rate, substrate utilization kinetics, plasmid stability, product analysis after induction, Metabolite analysis by HPLC
5. Fed batch cultivation *E.coli, Pichia pastoris*
6. Continuous cultivation – x - d construction, kinetic parameter evaluation, gas analysis, carbon balancing, Pulse and shift techniques.
7. Bioreactor studies : Sterlisation kinetics, k_{La} determination, residence time distribution
8. Animal cell culture production: T-flask, spinner flask, bioreactor

212BTPT01 BIOSEPARATION TECHNOLOGY

1. INTRODUCTION TO BIOSEPARATION
Characterization of biomolecules and fermentation broth. Guidelines to recombinant protein purification.

2. SOLID-LIQUID SEPARATION AND CELL DISRUPTION
Solid liquid separation- microfiltration and centrifugation – theory and design for scaleup operation. Cell disruption – Homogeniser , dynomill – principle, factors affecting disruption, batch and continuous operation. Cell disruption by chemical methods.

3. CONCENTRATION AND PURIFICATION
Liq- liq extraction – theory and practice with emphasis on Aqueous two phase extraction. Solid liquid extraction. Precipitation techniques using salt and solvent. Separation by ultrafiltration, Dialysis, Electrophoresis.

4. CHROMATOGRAPHY
Theory, practice and selection of media for – Gelfiltration chromatography, Ion exchange chromatography, Hydrophobic interaction chromatography, reverse phase chromatography, Affinity chromatography – Metal affinity chromatography, dye affinity chromatography, immunosorbent affinity chromatography & Expanded bed chromatography. Scaleup criteria for chromatography, calculation of no of theoretical plates and design

5. FINAL POLISHING AND CASE STUDIES
Freeze drying, spray drying and crystallization. Purification of cephalosporin, aspartic acid, Recombinant Streptokinase, Monoclonal antibodies, Tissue plasminogen activator, Taq polymerase, Insulin.

REFERENCES

1. Belter,P.A. et al., Bioseparations: Downstream Processing For Biotechnology, John-Wiley , 1988
2. Janson J.C, & Ryden L. Protein Purification: Principles, High Resolution Methods And Applications, VCH Pub. 1989.
3. Scopes R.K. – Protein Purification – Principles And Practice, Narosa , 1994.

212BTPT02 - ADVANCED GENETIC ENGINEERING

1. CLONING AND EXPRESSION OF GENES:
Cloning vehicles, restriction enzymes, restriction modification, linkers, adaptors, homopolymeric trailing, restriction mapping Expression and purification of recombinant proteins, prokaryotic and eukaryotic expression vectors, in vivo homologous recombination, large scale expression and purification of proteins.

2. LIBRARY CONSTRUCTION:
cDNA & genomic DNA library construction and screening, preparation of DNA, RNA probes immunoscreening and blotting techniques, etc

3. SEQUENCING:
Methodology – Chemical & enzymatic, Automated sequence, Genome sequencing methods – top down approach, bottom up approach.

4. PCR AND MUTAGENESIS
PCR principle, applications, different types of PCR, mutagenesis and chmeric protein engineering by PCR, RACE, Kuntels' method of mutagenesis.

5. GENE TRANSFER & GENE THERAPY
Introduction of foreign genes into plant and animal cells, creation of transgenic plants and animal knockouts, gene therapy, types and vectors.

REFERENCES:

1. Primrose S.B.., Twyman R.H. and Old R.W. Principles of Gene Manipulation, 6th ed., Blackwell Science, 2001
2. Winnacker E.L. Frome Genes to clones : Introduction to Gene Technology, Panima, 2003
3. Glick B.R. and Pasternak J.J. Molecular Biotechnology: Principles and applications of recombinant DNA, 3rd ed., ASM Press, 2003
4. Lemonie, N.R. and Cooper, D.N. Gene therapy, BIOS Scientific, 1996

212BTPT03 - COMPUTATIONAL BIOLOGY

1. INTRODUCTION TO COMPUTATIONAL BIOLOGY:
Molecular sequences. Sequence analysis. Dynamic programming. Pairwise and multiple sequence alignment and motifs. Applications.

2. DATABASES.
Scoring matrices, heuristic methods of database searching: BLAST family of programs, FASTA. Phylogenetic trees.

3. INTRODUCTION TO GENOMICS AND PROTEOMICS:
Functional, structural and comparative genomics. Gene finding and annotation. Protein structure. Homology modeling. Differential gene expression.

4. MACHINE LEARNING TECHNIQUES:
Hidden Markov models, Neural nets, Decision trees and their application in computational biology. Eukaryotic and prokaryotic gene finding. DNA Computing.

5. INTRODUCTION TO PERL:
Variables, Data types, control flow constructs, arrays, lists and hashes, String manipulation, File handling.

LAB:

Sequence analysis	: Pairwise and multiple sequence alignment. Tools available for sequence analysis. Motif generation.
Databases	: Exploring biological databases
Database searching	: Using BLAST, PSIBLAST and PHIBLAST, FASTA.
Gene finding	: Using Genscan, HMMGene etc.
Protein structure Prediction	: Tools for protein structure prediction.
Annotation	: Functional annotation. Writing utilities using Perl.

REFERENCE BOOKS:

1. Gusfield, Dan. Algorithms on strings Trees and Sequences, Cambridge University Press.
2. Baldi, P., Brunak, S. Bioinformatics: The Machine Learning Approach, 2nd ed., East West Press, 2003
3. Mount D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2001.
4. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002
5. Tisdall, James, Beginning PERL for Bioinformatics, O'Reilley, 2001.6. Durbin, R. et al., Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1998.

212BTPT04 - BIOREACTOR ENGINEERING

1. TRANSPORT PROCESS IN BIOREACTOR

Gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates, mass transfer for freely rising or falling bodies, forced convection mass transfer, Overall kla estimation and power requirements for sparged and agitated vessels, mass transfer across free surfaces, other factors affecting kla, non Newtonian fluids, Heat transfer correlations, thermal death kinetics of microorganisms, batch and continuous heat, sterilisation of liquid media, filter sterilisation of liquid media, Air. Design of sterilisation equipment batch and continuous.

2. MONITORING OF BIOPROCESSES

On-line data analysis for measurement of important physico-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry; Flow injection analysis for measurement of substrates, product and other metabolites; State and parameter estimation techniques for biochemical processes. Case studies on applications of FIA and Microbial calorimetry.

3. MODERN BIOTECHNOLOGICAL PROCESSES

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Modelling of recombinant bacterial cultures; Bioreactor strategies for maxmising product formation; Case studies on high cell density cultivation and plasmid stabilization methods. Bioprocess design considerations for plant and animal cell cultures. Analysis of multiple interacting microbial populations – competition:survival of the fittest, predation and parasitism: Lotka Volterra model.

4. DESIGN AND ANALYSIS OF BIOLOGICAL REACTORS

Ideal bioreactors-batch, fed batch, continuous, cell recycle, plug flow reactor, two stage reactors, enzyme catalyzed reactions. Reactor dynamics and stability. Reactors with non ideal mixing. Other types of reactors-fluidized bed reactors, packed bed reactors, bubble column reactors, trickle bed reactors.

5. SCALEUP OF REACTORS

Scaleup by geometry similitude, oxygen transfer, power correlations, mixing time

REFERENCES:

1. Moser, Anton, Bioprocess Technology: Kinetics and Reactors, Springer Verlag, 1988.
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd ed., McGraw Hill, 1986
3. Lee, James M. Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors, Blanch,H.W. Clark, D.S. Biochemical Engineering, Marcel Decker, 1999

212BTPP01 - ADVANCED MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB

Preparation of Genomic DNA
PCR amplification of gene from the genomic DNA
Preparation of plasmid DNA
Restriction Digestion of the vector and Insert
Ligation and Transformation to E.coli
Lysate PCR confirmation.
Restriction & gel elution of DNA fragments
Electroporation to Yeast
Induction experiments in E.coli using IPTG, salt etc
SDS-PAGE analysis of expression
Western blot confirmation of expressed protein (anti his)
ELISA (anti his) – Quantification of expressed protein.
RNA Isolation
cDNA preparation from RNA
Site directed mutagenesis
Southern hybridization experiment

212BTPP02 - ADVANCED DOWNSTREAM PROCESSING LAB

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, French pressure cell
3. Cell disruption techniques – dyno mill – batch and continuous
4. Precipitation – ammonium sulphite precipitation
5. Ultra filtration separation
6. Aqueous two phase extraction of biologicals
7. High resolution purification – affinity chromatography
8. High resolution purification – ion exchange chromatography
9. Product polishing – gel filtration chromatography
10. Product polishing, spray drying, freeze drying
11. Cell disruption methos: Chemical lysis and Physical methods

312BTPT01 - ADVANCES IN NANOBIOTECHNOLOGY

UNIT I NANOSCALES
What is meant by Nanoscale – Nanoscale Processes – Physical and Chemical Properties of Materials in the Nanoscales - Nanoscale Measurements .

UNIT II PROPERTIES AND MEASUREMENTS OF NANOMATERIALS:
Optical Prperties – Absorption and Fluroscence – Microscopy measurements – SEM – TEM - AFM and STM. Confocal and TIRF Imaging

UNIT III NANOBIOLOGY :
Properties of DNA and motor proteins – Measuremnts of Conductivity of DNA nanowires and angular properties of motor -- Lessons from Nature on making nanodevices.

UNIT IV BIOCONJUGATION OF NANOMATERIALS TO BIOLOGICAL MOLECULES: Reactive Groups on biomolecules (DNA & Proteins) - Conjugation to nanoparticles
(ZnS- Fe_3O_4) - Uses of Bioconjugated Nanoparticles

UNIT V NANO DRUG DELIVERY:
Various Drug Delivery Systems – aerosol - Inhalants - Injectibles – Properties of Nanocarriers – Efficiency of the Systems.

REFERENCES:

1.Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor) Chad A. Mirkin (Editor), Wiley-VCH; 1 edition , 2004.
2. NanoBioTechnology: BioInspired Devices and Materials of the Future by Oded Shoseyov and Ilan Levy, Humana Press; 1 edition 2007.
3. NanoBiotechnology Protocols (Methods in Molecular Biology) by Sandra J Rosenthal and David W. Wright , Humana Press; 1 edition , 2005.

312BTPT02 - STEM CELL TECHNOLOGY

UNIT I FUNDAMENTALS OF STEM CELL BIOLOGY

Embryogenesis - Developmental stages - properties of stem cells - pluripotency - totopotency. Definitions and molecular mechanisms factors that dictate stem cell behaviour. Identification and characteristic of pluripotent stem cells in animal and humans; sources of pluripotentcells - blastocysts, parthenogenesis, nuclear transfer, IPS.

UNIT II TYPES OF STEM CELLS

Germ Line Stem Cell Determination of the Germ Line; Identification, Characterization and Purification of Germ Line Stem cells; Germ Line Stem cell Niche; Establishment of Germ Line cells in vitro - Properties of Germ Line Stem cells. Embryonic Stem Cells In vitro fertilization - culturing of embryos - isolation of human embryonic stem cells - growing ES cells in labs - stimulation ES cells for differentiation - identification – properties of ES cells. Adult stem cell Somatic stem cells - test fro identication of adult stem cells - adult stem cell differentiation – transdifferentiation - plasticity - different types of adult stem cells - properties of adult stem cell

UNIT III REPRESENTATIVES OF STEM CELL

Neuronal stem cells, mesenchymal and cardiac stem cells Hematopoietic stem cells, Epithelial stem cells (Skin, intestine, breast) and cancer stem cells

UNIT IV GENE THERAPY, APPLICATION AND REPARATIVE MEDICINE 9 hrs.

Gene therapy - stem cells and animal cloning, introduction to modeling cell behaviour unique characteristic of stem cell and modeling of signal transduction. Mechanisms for stem cell manipulation in controlled microenvironments. Therapeutic applications and reparative medicine - parkinson disease - neurological disorder - limb amputation – heart disease - spinal cord injuries - diabetes - burns-HLA typing - Alzheimer's Disease

UNIT V STEM CELL – BASED TISSUE REGENERATION AND ETHICAL ISSUE

Tissue engineering application - productio of complete organ - kidney - eyes - heart - brain. Establishment of human stem cell bank. Stem cell policy and ethics, stem cell research: Hype, hope and controversy.

REFERENCE BOOKS:

1. Kursad Turksen, Embryonic Stem cells - Protocols, 2nd Edition, Humana Press, 2002.
2. Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research. National Academic press, 2002.

ELECTIVES-I

112BTPT11 - BIOCHEMISTRY

UNIT I

Structure of Water, pH, pK, Acids and Bases, Buffers. Principles of Thermodynamics. Principles of Bioenergetics, Carbohydrates - Classification, Structure and biological importance. Glycolysis and catabolism of hexoses, Citric acid cycle and pentose phosphate pathway – glycogen metabolism - regulation of carbohydrate metabolism.

UNIT II

Amino acids and their classification, general properties. The peptide bond and Ramachandran plot. Proteins, classification, denaturation and renaturation, orders of protein structure, protein sequencing. Classification, nomenclature and characteristics of enzymes. Mechanism and kinetics of single-substrate and multisubstrate enzyme catalyzed reactions. Mechalis Menton equation - Derivation and significance.

UNIT III

Lipids – classification and biological significance. Metabolism of fatty acids and cholesterol. Structure of nucleic acids – DNA and RNA. DNA forms, properties of DNA - buoyant density, viscosity, hypochromicity, denaturation and renaturation– the cot curve. DNA sequencing– chemical and enzymatic methods. Chemical synthesis of DNA. RNA– types and biological role. Secondary, tertiary structures of RNA.

UNIT IV

Oxidative Phosphorylation - Electron-Transfer Reactions in Mitochondria-ATP Synthesis. PhotophosphorylationThe Central Photochemical Event: Light-Driven Electron Flow- ATP Synthesis. Mechanism of light reaction and carbon fixation, C3, C4 and CAM pathways. Bacterial Photosynthesis

UNIT V

Regulation of Metabolic Pathways - Coordinated regulation, Hormonal Regulation and Integration of fuel Metabolism, Inborn errors of metabolism-diagnosis and treatment. Metabolic Control Analysis: Quantitative Aspects. Tissue-Specific Metabolism - Assays for Tissue Damage. Application of enzymes in medicine and industry. Biotechnological applications of enzymes- rDNA technology and bioinformatics.

REFERENCE BOOKS:

1. David.L.Nelson and Michael M.Cox., Lehninger Principles of Biochemistry 5th Edition, Macmillan Publishers, Newyork, 2009.
2. Robert K. Murry, Victor W. Rodwell, David Bender, Kathleen M. B Botham, P. Antony Weil, Peter. J. Kennelly, Harper's Illustrated Biochemistry, 28th Edition, McGraw-Hill Publisher, 2009.
3. Donald Voet and Judith G. Voet, Biochemisty, John Wiley & sons, 3rd Edition, 2005.
4. Lippincott's Illustrated Reviews: Biochemistry, Pamela C.Champe and Richard A.Harvey, Lippincott Williams & Wilkins Publication, 4th Edition, 2007.

112BTPT12 - FUNDAMENTALS OF CHEMICAL ENGINEERING

UNIT 1 INTRODUCTION:

Introduction to chemical engineering sciences and its role in the design & analysis of chemical processes. Overview of unit operations and processes in the chemical industry. Units and conversion factor. Introduction to Dimensional analysis.

UNIT II MATERIAL AND ENERGY BALANCES:

Overall and component material balances - Material balances without chemical reactions - Chemical reactions -stoichiometry - conversion and yield - Material balance calculations with chemical reactions – combustion calculations - recycle operations. Energy balances - Entropy - Latent heat - Chemical reactions - combustion. Concepts of chemical thermodynamics, the relation to VLE, solution thermodynamics and reaction thermodynamics.

UNIT III FLUID MECHANICS:

Properties of fluids; Fluid statics – forces at fluid surfaces, Pressure and measurement of pressure differences; Fluid flow concepts and basic equations of fluid flow – continuity equation and Bernoulli's equation; shear stress relationship and viscous effects in fluid flow; non newtonian fluids; significance of dimensionless groups in fluid flow operations.

UNIT IV TRANSPORTATION OF FLUIDS:

Different types of pumps, compressors and valves. Measurement of fluid flow using hydrodynamic methods, direct displacement method. Types of agitators, flow patterns in agitated vessels, calculation of power consumption – applications in bioreactor design

UNIT V. HEAT TRANSFER:

Nature of heat flow - Conduction, convection, radiation. Steady state conduction, Principles of heat flow in fluids, Heat transfer by forced convection in laminar and turbulent flow. Heat exchange equipments- principles and design.

REFERENCES:

1. Bhatt B.I., Vora S.M. Stoichiometry.3rd ed., Tata McGraw-Hill, 1977.
2. McCabe W.L., et al., Unit Operations In Chemical Engineering. 6th ed., McGraw-Hill Inc., 2001.
3. Geankoplis C.J. Transport Processes And Unit Operations. 3rd ed., Prentice Hall India, 2003.

112BTPT13 - ENGINEERING PROTEINS FOR BIOPHARMACEUTICS

UNIT I INTRODUCTION TO PHARMACEUTICALS

History & Definition of Drugs. Sources of Drugs - Plant, Animals, Microbes and Minerals. Different dosage forms. Routes of drug administration.

UNIT II PHARMACODYNAMICS & PHARMACOKINETICS

Pharmacodynamics: Physico-Chemical Principles, Mechanism of drug action, drug receptors, and Physiological receptors: structural and functional families. Pharmacokinetics- Drug absortion, factors that affect the absortion of drugs, Distribution of drugs, Biotransformation of drugs, Bioavailability of drugs.

UNIT III

Methods for isolation purification and characterization of enzymes. Immobilization of enzymes and their applications, An overview of common genetic techniques related to protein engineering. Abzymes and their applications Enzyme electrodes, biosensors and their applications, ELISA, EMIT

UNIT IV

Site-specific and multiple amino acid substitutions. Functional and structural consequences and limitations Strategies and approaches. Application of molecular modeling and structure predictions to protein engineering Molecular modeling Molecular mechanical calculations and geometry optimization Overview of current methods in prediction of secondary and tertiary structure from sequence.

UNIT V

Engineering with unnatural amino acid analogs Site-specific incorporation of amino acid analogs by in vitro methods. De novo protein design & artificial proteins: Approaches used in designing and constructing novel proteins Use of scaffold proteins Energy status of a protein molecule. protein databases, designer enzymes.

REFERENCE BOOKS:

1. Gary Walsh, Biopharmaceuticals: Biochemistry & Biotechnology, John Wiley & Sons Ltd. 1998.
2. Remington's Pharmaceutical sciences, 17th Edition, Mark Publications & Company, 1985.
3. Leon Lachman, Lea & Febiger U.S, Theory and Practice of Industrial Pharmacy, 3rd Edition, 1986.

ELECTIVES-II

112BTPT14 - CELL BIOLOGY AND MICROBIAL TECHNIQUES

UNIT I INTRODUCTION

Components in cell cycle control, Check points in cell cycle, intracellular control of cell cycle events- phase dependent cyclic CDK complexes eg. Yeast, Abnormalities in Cell Cycle – Cancer, Mechanics of Cell Division- An over view of M-Phase, Different stages of mitosis, Microtubules in spindle assembly, Structure of kinetoshore, centrosomes and its functions, Cytokinensis actin & myosin in the generation of contractile ring,

Meiosis – Significance, Chiasma formation - Synaptonemal complex, Recombination during meiosis - Recombination nodules

UNIT II CELL STRUCTURE AND METHODS IN CELL BIOLOGY

Cell: structural and functional organization. Cell motility. Ultrastructure and Electron microscopy. Fractionation of subcellular organelles. Microscopy, Morphometry, Cell counting.

UNIT III Plastids - biogenesis, structure and types, photosynthesis, Mitochondria - biogenesis, structure, Electron transport system, Endoplasmic reticulum, Golgi complex, Lysosome

UNIT IV INDUSTRIAL APPLICATIONS OF MICROBIOLOGY

Basic principles in bioprocess technology; Media Formulation; Sterilization; Thermal death kinetics; Batch and continuous sterilization systems; Primary and secondary metabolites; Extracellular enzymes; Biotechnologically important intracellular products; exo-polymers; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH.

UNIT V

Microbial processes-production, optimization, screening, strain improvement, factors affecting down stream processing and recovery; Representative examples of ethanol, organic acids, Enzyme Technology-production, recovery, stability and formulation of bacterial and fungal enzymes-amylase, protease, penicillinacylase, glucose isomerase; Immobilised Enzyme and Cell based biotransformations-steroids, antibiotics, alkaloids, enzyme/cellelectrodes. Biofilms

REFERENCE BOOKS:

1. Pelczar M J Jr., Chan E C S and Kreig N R., Microbiology, 6th Edition,Tata McGraw Hill, 1993.
2. Maloy SR, Cronan JE Jr., and Freifelder D, Microbial Genetics, Jones Bartlett Publishers 2nd Ediiton, Jones & Bartlell Publisher, 1994.
3. Crueger and A Crueger, A Textbook of Industrial Microbiology, Sinauer Associates Inc, 2nd Edition, 2001.
4. Darnell J, Lodish H, Baltimore D, "Molecular Cell Biology", W.H.Freeman;

112BTPT15 MASS TRANSFER AND CHEMICAL REACTION ENGINEERING

UNIT I

Molecular diffusion in fluids and solids; Inter phase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon. Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers

UNIT II

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABETHIELE & PONCHON-SAVARIT Principles, L-L equilibria, batch, Staged and continuous extraction, Leaching Principles.

UNIT III

Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Drying curves-Time of Drying; Batch and continuous dryers.Design of tray dryers,rotary dryers.

Rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions.

UNIT IV

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor system. Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

UNIT V FIXED BED AND FLUID BED REACTORS

Gas Liquid reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

TEXT BOOKS

1. Treybal R.E. Mass Transfer Operations.3rd edition. McGraw-Hill, 1981.
2. Geankoplis C.J. Transport Processes and Unit Operations. 3rd edition, Prentice Hall of India, 2002.
3. Levenspiel O. "Chemical Reaction Engineering", 3rd Edition. John Wiley.1999.
4. Fogler H.S. "Elements Of Chemical Reaction Engineering", Prentice Hall India.2002

REFERENCE

1. Coulson and Richardson's Chemical Engineering. Vol. I & II, Asian Books Pvt. Ltd, 1998.
2. Missen R.W., Mims C.A., Saville B.A. "Introduction To Chemical Reaction Engineering And Kinetics", John Wiley.1999.

112BTPT16 - MODERN TECHNIQUES IN DRUG DISCOVERY

UNIT I QUANTUM CHEMISTRY & THERMODYNAMICS

Basic concepts in molecular modeling -internal parameters- Z-matrix –introduction to quantum chemistry – basic postulates –Schrodinger wave equation – derivation – hydrogen atom – Born - Oppenheimer approximation- Laws of thermodynamics- entropy – enthalpy - free energy calculations-chemical potential.

UNIT II MOLECULAR MECHANICS &VISUALIZATION

Molecular geometry- conformational parameters- Potential energy Surface- Molecular mechanics: empirical forces fields- bond stretching- angle bending- torsional terms – non-bonded and electrostatic interaction-types of force fields - energy minimization- simplex – sequential univariate method - steepest descent-

conjugate gradient method -Newton–Raphson method – Conformational analysis- Molecular visualization - Molecular graphics – Rendering - Rasmol.

UNIT III MOLECULAR DYNAMICS

Molecular Dynamics(MD) simulation of biopolymers- time steps- Setting up MD- energy conservation in MD Simulation - continuous potentials and constraint dynamics- MD at constant temperature and pressure- incorporating solvent effects- examples-random number generator - Monte Carlo simulation of biological macromolecules- MD softwares.

UNIT IV STRUCTURE PREDICTION

Prediction of secondary structure - membrane prediction – Comparative Modeling. -Sequence Alignment Homologs- analogs- Homology modeling- steps in homology modeling– side chain modeling – loop modeling – fold recognition – ab initio prediction – Predicting Protein Structures by 'Threading protein folding – active site/binding site prediction– tools – databases - CASP.

UNIT V DRUG DESIGN

Drug Design: Role of Bioinformatics in drug design - Drug discovery cycle - physiochemical principles of drug action- lead discovery - lead modification - optimization - Docking – docking algorithms - Structure based Drug Design -Rational Design- pharmacophores - QSAR- ADME - drug delivery.

REFERENCE BOOKS:

1. Leach A.R., Molecular Modelling - Principles and Applications, 2nd Edition. Prentice Hall, 2001.
2. Prasad R.K. - Quantum Chemistry, Halsted Press, 1992.
3. Ramachandran K. I., Deepa G., Namboori K., Computational Chemi Chemistry and Molecular Modeling: Principles and Applications, Springer, 2008.
4. McCammon, J.A. and Harvey, S.C. - Dynamics of Proteins and Nucleic Acids, Cambridge University Press, Cambridge, 1987.
5. Young, D.C.- Computational Chemistry: A Practical Guide for Applying Techniques to Real-World Problems, Wiley-Interscience, 2001.

ELECTIVES-III

112BTT17 - MOLECULAR BIOLOGY

UNIT I CLASSICAL GENETICS

Mendelian genetics, linkage, crossing over, test cross, classical experiments – Hershey and Chase, Avery McLeod & McCarty.Bacterial conjugation, transduction and transformation.

UNIT II STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION

Conformation of DNA and RNA; replication in prokaryotes, D-loop and rolling circle mode of replication, replication of linear viral DNA. Organisation of eukaryotic Chromosome – cot value, replication of telomeres in eukaryotes

UNIT III TRANSCRIPTION

In prokaryotes and eukaryotes, features of promoters and enhancers, transcription factors, nuclear RNA splicing, mRNA surveillance- ribozyme.

UNIT IV TRANSLATION

Elucidation of genetic code, mechanism, codon usage, decoding the codons- molecular basis of mutations - suppressor mutation.

UNIT V REGULATION OF GENE EXPRESSION

Lac and trp phage life cycle, mutation and repair of DNA, operon.

TEXT BOOKS

1. Friefelder David, "Molecular Biology", 2nd edition Narosa Publ. House. 1999
2. Lewin Benjamin," Gene VIII", Pearson Education,2004.
3. Watson JD., "Molecular Biology of the Gene", 5th edition,Pearson Education, 2004.

REFERENCE

1. Weaver , R.F ," Molecular Biology", 3rd edition , Mc Grraw Hill, 2005.

112BTT18 MOLECULAR CELL BIOLOGY

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES

Eukaryotic and prokaryotic cells, principles of membrane organisation, membrane proteinselectrical properties of membrane, cytoskeletal proteins and its organization, extra cellular matrix - Cell-Cell junctions, Cell-ECM junctions, Introduction to necrosis, Senescence Apoptosis- programmed cell death, Mechanisms of Apoptosis and its regulation. Apoptosis in plants.

UNIT II TRANSPORT ACROSS CELL MEMBRANES

Passive & active transport, permeases, sodium potassium pump, Ca2+ ATPase pumps, lysosomal and vacuolar membrane ATP dependent proton pumps, co transport symport, antiport, transport into prokaryotic cells, endocytosis and exocytosis. Entry of viruses and mechanism of entry of toxins into cells.

UNIT III RECEPTORS AND MODELS OF EXTRA CELLULAR SIGNALLING

Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine models of action, quantitation and characterisation of receptors.

UNIT IV SIGNAL TRANSDUCTION

Signal amplification, different models of signal amplifications, cyclic amp, role of inositol phosphates as messengers, biosynthesis of inositol tri phosphates, cyclic GMP and g proteins, role in signal transduction, calcium ion flux and its role in cell signaling, current models of signal amplification, phosphorylation of protein kinases, regulation of protein kinases, serine –threonine kinases, tumor necrosis factor receptor families.

UNIT V CELL CULTURE

Techniques for the propagation of eukaryotic and prokaryotic cells. Cell line, generation of cell lines, maintenance of stock cells, characterization of cells, immunochemistry, morphological analysis techniques, in cell culture, ex-plant cultures primary cultures, contamination, differentiation, three dimensional cultures, role of matrix in cell growth. Tumor cells and onset of cancer. Proto-oncogenes and Tumor suppressor genes-Mutation.

TEXTS PRESCRIBED:

1. Darnell J, Lodish H, Baltimore D, "Molecular Cell Biology", W.H.Freeman;
2. Kimball T.W., "Cell Biology", Wesley Publishers;

REFERENCES:

1. De Robertis & De Robertis, "Cell Biology".
2. James D.Watson, "Molecular Biology of the Cell".

ELECTIVES-IV

112BTT19 ENZYME TECHNOLOGY

UNIT I KINETICS AND MECHANISM OF ENZYME ACTION

Classification of enzymes; quantification of enzyme activity and specific activity. Estimation of Michaelis Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition. Modeling of rate equations for single and multiple substrate reactions.

UNIT II IMMOBILISED ENZYME REACTIONS

Techniques of enzyme immobilisation-matrix entrapment, ionic and cross linking, column packing; Analysis of mass transfer effects of kinetics of immobilised enzyme reactions; Analysis of Film and Pore Diffusion Effects on Kinetics of immobilized enzyme reactions; calculation of Effectiveness Factors of immobilized enzyme systems; Bioconversion studies with immobilized enzyme packed -bed reactors.

UNIT III MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS

Analysis of film and Pore diffusion Effects on kinetics of immobilised enzyme reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors

UNIT IV APPLICATION OF ENZYMES

Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Industrial production of enzymes. Use of enzymes in analysis-types of sensing-gadgetry and methods. Case studies on application - chiral conversion, esterification etc.,

UNIT V ENZYME BIOSENSORS

Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment.

REFERENCES:

1.Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
2.Lee, James M. Biochemical Engineering, PHI, USA.
3.Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
4. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.

112BTT20 - UNIX OPERATING SYSTEM AND PROGRAMMING LANGUAGE C++

1. UNIX OPERATING SYSTEM

Introduction to Operating Systems, Basic Commands in Unix, vi editor, filters, input/output redirection, piping, transfer of data between devices, shell scripts.

Programming Language C++

2. INTRODUCTION TO C++

Programming methodologies- Introduction to Object Oriented Programming - Comparison of Procedural and Object Oriented languages - Basics of C++ environment, Data types, Control Flow Constructs, Library functions, Arrays

3. CLASSES

Definition-Data members-Function members-Access specifiers-Constructors-Default constructors-Copy constructors-Destructors-Static members-This pointer-Constant members-Free store operators-Control statements.

4. INHERITANCE AND POLYMORPHISM

Overloading operators-Functions-Friends-Class derivation-Virtual functions-Abstract base classes-Multiple inheritance.

5. TEMPLATES AND FILE HANDLING

Class templates-Function templates-Exception handling- File Handling

LAB: Exercises for all the topics.

REFERENCES:

1. Kochen, S.J. & Wood, P.H. Exploring the Unix System, Techmedia, 1999
2. Bach M.J., The design of Unix operating systems, Prentice Hall of India, 1999.
3. Lippman S.B., The C++ Primer, Addison Wesley, 1998.
4. Deitel and Deitel, C++ How to Program, Prentice Hall, 1998.
5. Balagurasamy E. , Object-Oriented Programming using C++, Tata McGraw- Hill, 2002.

ELECTIVES-V

112BTPT21 MATHEMATICS FOR BIOTECHNOLOGISTS

UNIT – I PARTIAL DIFFERENTIAL EQUATIONS

First order and second order-application to biology.Lagrange's method and Charpits method.

UNIT – II PROBABILITY AND STATISTICS

Probability –Addition theorem, Multiplication theorem and conditional probability-Baye's theorem. Binomial distribution, Poisson distribution and Normal distribution.

UNIT – III CURVE FITTING

Curve fitting –fitting a straight line and second degree curve. Correlation and Regression. Fitting a non linear curve. Bivariate correlation application to biological sciences.

UNIT – IV

Sampling distributions-Large samples and Small samples. Testing of Null hypothesis-Z test, t test and □2 test. Type I and Type II errors. Fisher's F Test. Goodness of fit.

UNIT -V

Design of Experiments –One way, Two way classifications – Randomied Block Designs-Latin Square Designs.

TEXT BOOKS:

1. Higher Engineering Mathematics 37th Edition. By Grewal.
2. Comprehensive Statistical Methods By P.N.Arora, Sumeet Arora, S.Arora. S.Chand & Co

REFERENCES:

1. Probability and Statistics for Engineers 6th Edition. Prentice Hall By R.A.Johnson.
2. Statistical Quality control for the Food Industry. By MERTON R .HUBBARD Mathematical Statistics By V.C.Kapoor and Gupta.

112BTPT22 ENVIRONMENTAL BIOTECHNOLOGY

UNIT I -OVERVIEW

Microbial flora of soil, growth, ecological adaptations, interactions among soil microorganisms, biogeochemical role of soil microorganisms. Environmental monitoring – sampling, physical,chemical and biological analysis, monitoring pollution

UNIT II - BIOLOGICAL WASTEWATER TREATMENT

Waste water characteristics, The activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, nitrification, secondary treatment using a trickling biological filter, anaerobic digestion, mathematical modeling of anerobic digestor dynamics, anaerobic denitrification, phosphate removal

UNIT III - BIOREMEDIATION

Introduction, Inorganic wastes, petroleum based wastes, synthetic organic compounds, phytoremediation, gaseous wastes, desulphurisation of coal and oil.

UNIT IV - TREATMENT OF INDUSTRIAL WASTES

Dairy, pulp, dye, leather, hospital and pharmaceutical industrial waste management. Solid waste management.

UNIT V - MOLECULAR BIOLOGY

Latest elements, developements pertaining to environmental biotechnology.

REFERENCES:

1. Stanier R.Y., Ingraham J.L., Wheelis M.L., Painter R.R., General Microbiology, Mcmillan Publications, 1989.
2. Foster C.F., John Ware D.A., Environmental Biotechnology , Ellis Horwood Ltd., 1987.
3. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series , Vol.1, Gulf Publications Co., London, 1989.
4. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
5. Alan Scragg., Environmental Biotechnology, Longman

ELECTIVES-VI

212BTPT23 - METABOLIC PROCESS AND ENGINEERING

UNIT I - REVIEW OF CELLULAR METABOLISM

An Overview of Cellular Metabolism, Transport processes, Fuelling reactions: glycolysis, Fermentative pathways, Biosynthetic reactions, polymerization ,cellular energetics

UNIT II - MATERIAL BALANCES AND DATA CONSISTENCY

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems- identification of gross measurement errors

UNIT III - METABOLIC FLUX ANALYSIS

Theory, overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis.

UNIT IV - METABOLIC CONTROL ANALYSIS

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations

UNIT V - ANALYSIS OF METABOLIC NETWORKS

Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests and experimental validation.

REFERENCES:

Stephanopoulas, G, *et al*., Introduction to Metabolic engineering – Principles and Methodologies. Elsevier Science, 1996.

212BTPT24 IMMUNOTECHNOLOGY

UNIT I - INTRODUCTION

Cells of the immune system and their development; primary and secondary lymphoid organs; humoral immune response; cell mediated immune responses; complement.

UNIT II - ANTIBODIES:

Monoclonal antibodies and their use in diagnostics; ELISA; Agglutination tests; Antigen detection assay; Plaque Forming Cell Assay.

UNIT III - CELLULAR IMMUNOLOGY

PBMC seperation from the blood; identification of lymphocytes based on CD markers; FACS; Lymphoproliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha.; HLA typing.

UNIT IV - VACCINE TECHNOLOGY

Basic principles of vaccine development; protein based vaccines; DNA vaccines; Plant based vaccines; recombinant antigens as vaccines; reverse vaccinology

UNIT V - DEVELOPMENT OF IMMUNOTHERAPEUTICS: Engineered antibodies; catalytic antibodies; idiotypic antibodies; combinatorial libraries for antibody isolation.

REFERENCES:

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997
2. Roitt I., Brostoff J. and Male D. Immunology, 6th ed. Mosby, 2001
3. Goldsby , R.A., Kindt, T.J., Osbome, B.A. and Kerby J. Immunology, 5th ed., W.H. Freeman, 2003
4. Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997

212BTPT25 - ADVANCED PROCESS CONTROL

UNIT I - ANALYSIS AND DESIGN OF FEEDBACK CONTROL SYSTEM:

Dynamic behaviour, stability analysis, design of feedback controllers, design of feedback control systems using frequency response techniques, PID controller for multicapacity processes.

UNIT II - OPTIMUM CONTROLLER SETTING:

Optimum settings from the plant response, continuous cycling method, damped oscillation method, reaction curved method.

UNIT III - ANALYSIS AND CONTROL OF ADVANCED CONTROL SYSTEMS:

Feedback control of systems with large dead time, control systems with multiple loops, feed forward and ratio control, adaptive and inferential control systems.

UNIT IV -AUTOMATIC CONTROLLERS

Electronic, controllers, operational amplifier, electronic controller input and output, PID and on-off control models, microprocessors, general architecture, algorithms, applications in chemical process control.

UNIT V - PROCESS CONTROL USING DIGITAL COMPUTERS:

Characteristics and performance of control computers, signals-types, signal transmission, analog feedback control systems. The direct digital control concept, advantages of DDC, computer process interface for data acquisition and control, computer control loops.

REFERENCES:

1. George Stephanopolous – Chemical Process Control, An introduction to Theory and Practice, prentice Hall of India Pvt.Ltd., New Delhi 1990.
2. Emanule S. Savas _ Computer control of industrial processes, McGraw Hill, London, 1965.
3. Peter Harriot – Process Control, Tata McGraw Hill Publishing Co, New Delhi 1977.

ELECTIVES-VII

212BTPT26 - FOOD PROCESSING TECHNOLOGY

UNIT I - FOOD CHEMISTRY

Constituent of food – contribution to texture, flavour and organoleptic properties of food; food additives – intentional and non-intentional and their functions; enzymes in food processing.

UNIT II FOOD MICROBIOLOGY

Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases – infections and intoxications, food spoilage – causes.

UNIT III FOOD PROCESSING

Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations – mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

UNIT IV FOOD PRESERVATION

Use of high temperatures – sterilization, pasteurization, blanching, asceptic canning; frozen storage – freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods.

UNIT V - MANUFACTURE OF FOOD PRODUCTS

Bread and baked goods, dairy products – milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

REFERENCES:

1. Coultate T.P. Food – The chemistry of its components, 2nd ed., Royal society, London, 1992
2. Sivasankar B. Food processing and preservation, Prentice Hall of India Pvt., New Delhi, 2002
3. Fennema O.R. ed. Principles of food science : Part I, Food chemistry, Marcel Dekker, NY, 1976.
4. Frazier W.C. and Westhoff D.C. Food Microbiology, 4th ed. McGraw-Hill Book Co., NYk, 1988
5. Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.V. Food engineering operations, 2nd ed., Applied Sciences Pub.ltd., London,1979
6. Pyke, M. Food Science and Technology, 4th ed., John Murray, London, 1981

212BTPT27 - PLANT BIOTECHNOLOGY

UNIT I - INTRODUCTION TO PLANT MOLECULAR BIOLOGY

Genetic material of plant cells – nucleosome structure and its biological significance; transposons, recombinant DNA techniques; outline of transcription and translation.

UNIT II CHLOROPLAST & MITOCHONDRIA

Structure, function: Light and dark reaction and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins.

UNIT III PLANT METABOLISM AND METABOLIC ENGINEERING

Nitrogen fixation, Nitrogenase activity, nod genes, nif genes, bacteroids, plant nodulins, production of secondary metabolites, flavanoid synthesis and metabolic engineering.

UNIT IV AGROBACTERIUM & PLANT VIRUSES

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – T-DNA, importance in genetic engineering. Plant viruses and different types, Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits, Molecular diagnosis of plant diseases.

UNIT V - APPLICATIONS OF PLANT BIOTECHNOLOGY

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming , theraputic products, functional genomics, whole genome sequencing project eg: Arabidopsis, RNAi

REFERENCES:

1. Grierson D. and Covey, S.N. Plant Molecular Biology, 2nd ed., Blackie,1988
2. Slater A et al. Plant Biotechnology : The Genetic Manipulation of Plants, Oxford University Press, 2003
3. Gamburg O.L., Philips G.C. Plant Tissue & Organ Culture: Fundamental Methods. Narosa , 1995.
4. Heldt, Hans-Walter, Plant Biochemistry & Molecular Biology, Oxford University Press, 1997
5. Wilkins M.B .Advanced Plant Physiology , ELBS, Longman, 1987

Date: **Registrar**