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Semester III

Code	Course Title	Contact Hrs./ Wk	Credit
	Theory	**L-T-P**	
BT-301	Cell Biology & Bio-Chemistry	3-1-0	4
BT-302	Microbiology	3-1-0	4
BT-303	Structural Chemistry of Biomolecules	3-1-0	4
BT-304	Industrial Stoichiometry	3-1-0	4
CS-315	Data Structure and Algorithms	3-1-0	4
		15-5-0	20
	Practicals		
BT-391	Bio-Chemistry Lab	0-0-6	3
BT-392	Microbiology Lab	0-0-6	3
CS-383	Data Structure Lab	0-0-3	1.5
		0-0-15	7.5
	Semester Total	15-5-15	27.5

Semester: IV

Code	Course Title	Contact Hrs./ Wk	Credit
	Theory	**L-T-P**	
BT- 401	Thermodynamics and Kinetics	3-1-0	4
BT-402	Industrial Microbiology & Enzyme Technology	3-1-0	4
BT-403	Molecular Biology& rDNA Technology	3-1-0	4
CHE-414	Transfer Operations - I	3-1-0	4
CS – 415	Data Base Management System and Computer Networking	3-1-0	4
		15-5-0	20

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	Practicals		
BT-491	Molecular Biology and Fermentation Technology Lab	0-0-6	3
CHE-482	Chemical Engineering Lab - I	0-0-3	3
CS-483	Data Base Management System Lab	0-0-6	1.5
		0-0-15	7.5
	Semester Total	15-5-15	27.5

Semester: V

Code	Course Title	Contact Hrs./ Wk	Credit
	Theory	**L-T-P**	
BT-501	Immunology	3-1-0	4
BT-502	Bio-reactor Design & Analysis	3-1-0	4
BT-503	Bio-informatics I	3-1-0	4
BT-504	Genetics & Biostatistics	3-1-0	4
CHE-514	Transfer Operations - II	3-1-0	4
	Semester Total	15-5-0	20
	Practicals		
BT-591	Bioinformatics Lab	0-0-3	1.5
CHE-582	Chemical Engineering Lab -II	0-0-6	3.0
	Sessional		
HU-591	Language Lab	0-0-3	1.5
		0-0-12	6.0
	Semester Total	15-5-12	26

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Semester: VI

Code	Course Title	Contact Hrs./ Wk	Credit
	Theory	**L-T-P**	
BT-601	Plant Biotechnology	3-1-0	4
BT-602	Bio-separation Technology	3-1-0	4
BT-603	PollutionControl & Environmental Biotechnology	3-0-0	3
CHE-615	Process Instrumentation and Control	3-1-0	4
		12-3-0	15
	Practicals		
BT-691	Plant Tissue Culture Lab	0-0-6	3.0
BT-692	rDNA & Immunology Lab	0-0-6	3.0
CHE-683	Process Instrumentation and Control Lab	0-0-3	1.5
		0-0-15	7.5
BT-693	*Seminar*	0-0-3	2
	Semester Total	15-4-15	24.5

Industrial Training in a suitable Industry, R & D Organisation or Institute for 4-6 weeks to be arranged during Summer Vacation.

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Semester: VII

Code	Course Title	Contact Hrs./ Wk	Credit
	Theory	**L-T-P**	
BT-701	Animal cell culture and Molecular modelling	4-0-0	4
BT-702	Food Bio-technology	3-1-0	4
BT-703	Elective-I	3-0-0	3.0
HU-714	Industrial Economics and Management	4-0-0	4
		14-1-0	15.0
BT-791	Project Work	0-0-8	4
BT-792	In-Plant Training	4	2
BT- 793	*Seminar*	0-0-3	2
	Semester Total	14-2-15	23

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Semester: VIII

Code	Course Title	Contact Hrs./ Wk	Credit
	Theory	**L-T-P**	
BT-801	Ethics and IPR in Biotechnology	3-0-0	3
BT-802	Medical and Pharmaceutical Biotechnology	3-0-0	3
BT-803	Elective-II	3-0-0	3
ID-814	Elective-III	3-0-0	3
		12-0-0	12
BT-891	Project Work	0-0-12	4
BT-892	*Report and Viva Voce on Project Work*		2
BT-893	*Comprehensive Viva-Voce*		8
	Semester Total	12-0-12	26

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BT 703: ELECTIVE –I	BT 803:ELECTIVE - II	ID 814: ELECTIVE -III
BT 703A Biophysics of Macromolecules	BT 803 A Proteomics and Protein Engineering	ID 814 A Information Technology/ Artificial Intelligence
BT 703 B Renewable Energy Technology	BT 803 B Human Genomics	ID 814 B Post-harvest Technology
BT 703 C Modelling and Simulation of Bio-processes	BT 803 C Bio-safety	ID 814 C Biomaterials
BT 703 D Molecular Modelling and Drug Design	BT 803 D Biomedical Engineering	ID 814 D Bio-metallurgy
BT 703 E Bio-sensors and Diagonistics	BT 803 E Bio-fertilizers and Bio-pesticides	ID 814 E Total Quality Management

Total Credits

1st Semester – 30

2nd Semester – 31

3rd Semester – 27.5

4th Semester – 27.5

5th Semester – 26

6th Semester – 24.5

7th Semester – 23

8th Semester – 26

Total : 211.5

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Detailed Syllabus
3rd Semester

BT-301: Cell Biology & Biochemistry
L-T-P = 3-1-0
At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Fundamental of Cell Biology:

Cell structure of animals and plants, cell division. Cellular organelles, cell membrane, receptor, cellular transport- nutrient transport across cell membrane, signal transduction

Module II: 10L Carbohydrate Metabolism:

Metabolic pathways for breakdown of carbohydrates glycolytic pathway, pentose phosphate pathway, citric acid cycle, electron transport chain, oxidative phosphorylation, gluconeogenesis; glycogen metabolism (glycogenolysis and glycogenesis), photosynthesis.

Module III: 10L Amino acid and protein metabolism:

Catabolism of amino acids – general metabolism of amino acids – catabolism and anabolism, catabolism of Tyrosine, Leucine, Glutamic acid and Arginine. Glucogenic amino acids, ketogenic amino acids, urea cycle, protein degradation and turnover

Module IV: 10L Metabolism of lipid and nucleic acid:

Beta oxidation and omega oxidation of fatty acids – saturated and unsaturated fatty acids – even and odd numbered, catabolism of phospholipids, biosynthesis of fatty acids and phospholipids. Biosynthesis of cholesterol, neucleotide metabolism purine and pyrimidine degradation.

Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials.

Revision: 4L (1 for each module)

Textbook:

1. Lehninger, Nelson & Cox, Principles of Biochemistry, CBS Publishers,1993

Reference books:

1. Bruce Alberts, Molecular Biology of the Cell, 4th ed, Garland Science Publishers,2002
2. Lubert Stryer, Bio chemistry, Freeman & Co, NY
3. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons

4. Baltimore& Lodish, Molecular Cell Biology, 4th ed, Scientific American BooksHames, B.D. (Ed.), Biochemistry, Viva Books

BT 302 – Microbiology
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module-I: Basic Knowledge of various organisms.
Scope and history of microbiology -A short history of the development of Microbiology, contribution of the science towards development of present day biotechnology may be included.
Bacteria (morphology and fine structure- size and shape and arrangement , structure of cell wall - spore and cysts). Moulds (importance- structure- reproduction), yeast (importance- structure- reproduction), algae (importance- structure-reproduction), archaebacteria and extremophiles.
Brief outlines of viruses.

Module-II: Microbial taxonomy and physiology of growth
Taxonomy: The five kingdom classification, criteria for classification, bacterial phylogeny, numerical approach, new approaches – taxonomic implications of DNA base composition, DNA sequencing , RNA fingerprinting and sequencing.
Growth of microorganisms: The mathematical nature and expression of growth principles of nutrition, influence of environmental factors-pH, temperature, oxygen pure culture technique, culture media - enrichment, isolation of organisms.

Module-III: Microbial metabolism
Energy transduction mechanisms specific to prokaryotes, Phosphoketalose pathway, Entner-Doudroff, Glyoxylate pathways, anaerobic respiration, microbial photosynthesis.

Module-IV: Nitrogen and Sulphur metabolism
Nitrogen metabolism -Transformation of organic nitrogen leading to formation of ammonia, Nitrogen fixation, nitrification, denitrification, symbiotic and non symbiotic nitrogen fixation, Genetics of nitrogen fixation - nif genes
Sulfur cycle – assimilation of sulphur, formation of H_2S from sulphate, sulfureta environment
Sulfur metabolism in relation to metabolic activities of various bacteria (*Thiobacillus, Sulfolobus etc.*) and conversion of inorganic sulfur into organic sulfur are to be included.

Textbook:

1. Stanier R. –General Microbiology, 5thed, Macmilan Press ltd.

Reference books:

1. M. Pelczar, E.Chan, N.Kreig, Microbiology, 5thed, MGH
2. Salle.A.J- Fundamental Principles of Bacteriology, Tata Mcgraw Hill
3. Hans G. Schlegel, General Microbiology, 7thed, Cambridge Low Price Edns
4. A.H. Rose, Chemical Microbiology, 3rded, Butterworth World Student Reprints

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BT 303: Structural Chemistry of Biomolecules
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L
Structure of water molecules, basic concepts of pH, buffer, pKa, chemistry of amino acids, carbohydrate, nucleic acids and lipids, chemistry of nucleosides and nucleotides, functions of vitamins, hormones and minerals.

Module II: 10L
Primary, secondary and tertiary structure of protein; enzymes and co-enzymes - their classification, concept of active site, protein folding.

Module III: 10L
Nucleic acid structure and composition: A, B, and Z: forms of DNA, supercoiling of DNA, denaturation and renaturation kinetics, nucleotide sequence composition: unique, middle and highly repetitive DNA, Redundant DNA.

Module IV: 10L
Macromolecular structure determination: Basic concepts and principles of X-ray diffraction, crystallography, spectroscopy –UV-Visible, fluorescence and NMR, circular dichroism, electron microscopy.

Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials.

Revision: 4L (1 for each module)

Textbook:
1. Lehninger Principles of Biochemistry,
2. Van Holde, Principles of Physical Biochemistry, Pearson

Reference books:
1. David Friefelder, Physical Biochemistry,
2. Practical Biochemistry Principles and techniques :Ed Wilson and Walker, Cambridge University Press

BT- 304: Industrial Stoichiometry
L-T-P = 3-1-0
At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

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Module I: Small units and dimensions: 10L
Buckingham Pi-theorem. Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of log-log and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration, Treatment and Interpretation of data, Error analysis in connection with computation.

Module II: 10L Material balance:
Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification such as continuous filtration, batch mixing, crystallizer, distillation column.
Material balance with chemical reaction**:** Stoichiometry of growth and product formation: growth stoichiometry and elemental balances. Material Balance with recycle, bypass and purge streams.

Module III: 10L Energy Balance:
General energy balance equation for steady and unsteady state processes,: Without Chemical Reaction, With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column, Enthalpy change due to reaction: Heat of combustion, Heat of reaction for processes with biomass production, Energy-balance equation for cell culture, for fermentation processes.

Module IV: 10L Combined Material and Energy Balances:
Simultaneous material and energy balances, selected industrial process calculations for bioprocesses.

Textbook :

1. Hougen and Watson, Chemical Process Principles (Part one) : 2nd ed, John Wiley.

Reference books:

1.Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. Prentice Hall,
2. Bhatt & Vora, Stoichiometry , 4th Ed., TM

CS 315: Data Structure and Algorithm
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.
Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L

Linear Data Structures: Sequential representations, Arrays and Lists, Stacks, Queues and D-queues, String and their applications.
Link Representation: Linearly linked lists, Circularly linked lists, Doubly linked lists and applications.

Module II: 10L

Algorithms for creating and manipulating different linear data structures.
Non-linear Data Structure: Trees – Binary Trees, Binary Search Trees, Insertion and Deletion algorithms , Height-balanced and Weight-balanced trees , B–trees .

Module III: 10L

Graph Representations, Breadth first search (BFS) and Depth first search (DFS).
Graph Theoretic Algorithms - Incidence Matrix, Adjacency Matrix, Algorithms for Minimal Spanning Tree (Prim's and Kruskal's Algorithm).

Module IV: 10L

Sorting and Searching Algorithms: Bubble sort, Insertion sort, Quick sort , Merge sort.
File structures: Record & Table Structures, Sequential and Direct access, Indexed Files, Inverted Files, Hashed Files

Revision: 5L

Textbook:

1. Aho Alfred V, Hopperoft John E., Ullman Jeffrey D. , "Data Structures and algorithms", Pearson

Reference books:

1. Horowitz Ellis & Sartaj Sahani , "Fundamentals of Data Structures" , Galgotria Pub.
2. Tenenbaum A. S., "Data Structures using C",Pearson
3. N. Deo, Graph Theory -, PHI.

BT-391: Microbiology Lab
L-T-P = 0-0-6

1. Study of autoclaving and sterilization of media.
2. Preparation of solid basal medium, dilution plating with a known microbial strain; isolation of microorganisms from single colonies
3. Study of a compound microscope, Gram staining and identification of microbes through a microscope.
4. Cell wall staining, endospore staining, and flagella staining.
5. Subculturing of a strain using a synthetic liquid media (auxotrophs and prototrophs)
6. Study of bacterial growth of E.Coli by spectrophotometer/ turbiditimeter.
7. Assay of an antibiotic by ditch method and MIC of antibiotic (ampicillin)
8. Study of biochemical activity of microorganisms by some standard tests like hydrolysis of starch, hydrolysis of casein, IMVIC test (Indole production test, Methylated test, Voges-Proskaeur and Citrate utilization test).

BT-392: Biochemistry Lab
L-T-P = 0-0-6

1. Separation of amino acids/ sugars/ steroids/ vitamins/ alkaloids/antibiotics by Ascending Paper Chromatography.

2. Separation of lipids/steroids/sugars/amino acids/oligo-peptides/ alkaloids athletic doping drugs by Thin Layer Chromatography.
3. Separation and isolation of proteins/aminoacids and oligopeptides by Paper Electrophoresis.
4. Separation of proteins/aminoacids and peptides by Polyacrylamide Gel Electrophoresis (PAGE).
5. pH titration of amino acids: Glycine, Lysine and Glutamic acid
6. Protein estimation
7. Determination of BOD_5 and COD of a sample of waste water
8. a) Subcellular fracationation: Separation of nuclei from goat liver,
   b) Assay of alkaline phosphatase from the supernatant - Kinetics and Determination of Km and Vmax
   c) Inhibition by phosphate – determination of nature of inhibition

CS 383: Data Structure Lab

L-T-P = 0-0-3

Implementation of Array Operations: (using C/C++ languages)
Stacks and Queues: Adding, Deleting elements, Circular Queue: Adding and Deleting elements, Merging Problem.
Implementation of linked lists: Inserting, Deleting , Inverting a Linked List.
Sorting and Searching Algorithms,
Prim's, Kruskal's and Dijkstra's Algorithm.

4th Semester

BT- 401: Thermodynamics & Kinetics
L-T-P = 3-1-0

At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L

Basic Concepts of Thermodynamics: The Ideal Gas, Review of first and second laws of thermodynamics, PVT behaviour of Pure Substances, Virial Equation of State, , Application of the Virial Equations, Cubic Equations of State, Generalized Correlations for Gases and Liquids. The Nature of Equilibrium, the Phase Rule, Duhem's Theorem, Simple model's for Vapour/Liquid Equilibrium, Roult's Law, Henry's law, Modified Raoult's Law, Vapour Liquid Equilibrium

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Module II: 10L

Thermodynamics and its Applications: The Chemical Potential and Phase Equilibria Fugacity and Fugacity Coefficient: for pure species and solution; Generalised correlations for

Fugacity, the Ideal Solution, Property Changes and Heat Effects of Mixing Processes. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

Module III : 10L

Kinetics: Rate of chemical reaction; Effect of Temperature on Rate Constant, Arrehnius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction,Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions

Module IV: 10L

Applications of Kinetics: Interpretation of batch reactor data for simple and complex reactions. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes.– derivation of Michaelis-Menten equation, Briggs-Haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, noncompetitive and uncompetitive.

Revision : 5L
Textbook :

1. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH

Reference books:

1. Richardson, J.F., Peacock, D.G.Coulson & Richardson's Chemical Engineering- Volume 3 ed., First Indian ed. Asian Books Pvt. Ltd. 1998
2. Levenspiel.O., Chemical Reaction Engineering, Wiley Eastern Ltd.
3. Bailey & Olis,Biochemical Engg. Fudamentals, MGH, 1990
4. Physical Chemistry: Castellan, Narosa Publishing.
5. Physical Chemistry, ;Moore, PHI

BT-402: Industrial Microbiology & Enzyme Technology
L-T-P = 3-1-0
At least45hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module-I: 10L Microbial Processes
Basic idea on fermentation process, submerged, stationary, solid and semi-solid – with their merits and demerits, Outlines of all microbial processes like productions of organic acids, solvent, antibiotic, polysaccharide, enzymes, vitamins, lipids, pigments, aroma (without details of fermentation process), Classical process may be discussed in details – [i] Wine and spirits; [ii] Acetone – butanol; [iii] Penicillin/Tetracycline/Streptomycin fermentation; [iv] Alkaline protease/lipase/amylase [v] Citric acid [vi] Dextran ,xanthan gum

Module-II: 10L Commercial Strain Development

Cellular control regulating production of microbial metabolites – Primary and Secondary metabolite – Induced mutation technique – Analogue resistant mutant – Catabolic derepressed mutants – Genetically engineered strain – Protoplast fusion technique.

Module-III: 10L Enzyme Kinetics
Stability of enzyme, strain selection, (thermophilic, halophilic, alkalophilic producer strain), Cloning stable enzyme in mesophile, Protein engineering to improve enzyme stability, Enzyme applications – (Industrial, medical and analytical), Reaction environment rebuilding, Enzyme reaction in non-aqueous medium, Synthesis with hydrolase enzymes, Chemical modification of enzyme to improve physico-chemical properties, Immobilization of enzymes, Various techniques.

Module IV: 10L Transport Phenomena
Similarity of mass, momentum, and energy transfer, Nevier-Stoke's equation, flow analysis using N-S equation for flow down in inclined plane; Application momentum transfer to characterize the rheology of fermentation broths, Application of heat transfer to bioreactor system: with reference to both heat generation and removal, Diffusion through a stagnant film; diffusion with heterogeneous chemical reaction.

Text Book:

1. W. Crueger, Annelise Crueger, Biotechnology: A Textbook of Industrial Microbiology, Sinauer Assoc. Inc

References:

1. Prescott's and Dunn's, A. Industrial Microbiology, 4th edition. CBS Publishers, New Dehli, India, 1987.
2. 2.L.E. Cassida.Jr, Industrial Microbiology, New Age International Publisher
3. Atkinson.B and Marituna.F, Biochemical Engineering and Biotechnology Handbok, The Nature Press, Macmillan Publ. Ltd.4
4. Bailey & Olis, Biochemical Engineering Fundamentals, MGH.5
5. R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot: Transport phenomenon, John Wiley & Sons Inc. Asian students Edition.6
6. J. R. Welty, C. E. Wics and R.E. Wilson Fundamental of Momentum, Heat and Mass transfer, 3rd ed, John Wiley & Sons.

BT-403: Molecular Biology & rDNA Technology
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Expression of genes in prokaryotic and eukaryotic systems
Transcription and translation machinery in prokaryotic and eukaryotic systems, concept of genetic code.

Module II: 10 L Regulation of Gene Expression:

Gene expression – concept of operon (lac and ara), hormonal control of gene expression in eukaryotes (steroid and non steroid), post transcriptional processing of mRNA, Regulation of translation in eucaryotic system

Module III: 10L Tools of rDNA technolgy:
Restriction endonucleases and DNA modifying enzymes, gene cloning – genomic DNA library, cDNA library, screening of recombinant clones, Southern, Northern and Western hybridization, sequencing of DNA (Maxam Gilbert and Sanger method), DNA fingerprinting.

Module IV: 10L Application of rDNA technology
Polymerase chain reaction, site directed mutagenesis, expression of cloned gene in recombinant cells – production of insulin, human growth factor, antisense and ribozyme technology – gene therapy, Human genome project and its application

Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials.

Revision: 4L (1 for each module)

Textbook:

1. Old and Primrose, Principles of Gene Manipulation, 3rd Ed, Blackwell Scientific Publishers.2
2. Watson et al, Molecular Biology of the Gene 3rd ed, Pearson

Reference books:

1. Watson, J.D., Gilman, M., Witkowski, J., Zoller, M. - Recombinant DNA, Scientific American Books, New York, 1992. Glick and Pasternwck, Molecular Biotechnology.
2. Benjamin Lewin, Genes VIII, International edition, Pearson.

CHE 414: Transfer Operations -I

At least 45 hrs/sem

L-T-P = 3-1-0

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Basic concepts of Fluid Mechanics :
Dimensional Analysis: Buckingham Pi-theorem, Dimensionless groups, Conversion of equations. Basic equations of Fluid Flow, Hagen Poiseville equation, Bernoulli Equation, Fluid Friction. Friction in flow through packed beds, fundamentals of fluidisation.

Module II: 10L Flow measurements and machineries:

Flow through pipes and open channels, Orifice and Venturi meters, Pitot Tube, Weirs, Rotameters and other types of meters, Transportation of fluids, Pipe Fittings and valves,

Pumps – classification, centrifugal and positive displacement type - peristaltic. Blowers and Compressors (oil-free).

Module III: 10L Heat transfer:

Classification of heat flow processes, conduction, Thermal conductivity. Heat flow in fluids by conduction and convection. Countercurrent and parallel flow. Enthalpy balance in heat exchange equipment. Individual heat transfer coefficients, overall coefficient, Heating and cooling of fluids, Heat transfer equipm ent. Unsteady state heat transfer, Radiation

Partial differential equations and its applications: Introduction, linear and nonlinear equation of first order; examples; homogeneous linear equations with constant coefficients; nonlinear equation of second order, Separation of variables, formulation and solution of wave equation; one dimensional heat flow equation and solution; two dimensional heat flow equation and solution.

Module IV: 10L Mechanical Operations:

Principles of comminution, Types of comminuting equipment, Energy and power requirement, Crushers, Grinders, Mixing and Agitations, Power consumption in mixing, Mechanical separation, Screening, Types of screen, Filtration, Principle, Constant pressure and constant rate filtration, Settling classifiers, Floatation, Centrifugal Separations.

Revision: 5L

Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

Reference books :

1. Geankopolis, Transport Processes & Unit operations: 3rd edition, PHI.
2. Coulson & Richardson, Chemical Engineering, Vol-I & II:, Butterworth Heinemann
3. D.Q. Kern, Heat Transfer, MGH
3. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
4. Foust, A.S., Wenzel, L.A, et.al. Principles of Unit Operations, 2nd edition, JWS
5. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH
6. E. Kreyszig, Advanced Engineering Mathematics, 5th Edn, Wily.
7. B. S. Grewal, Higher Engineering Mathematics, 1997
8. Gupta and Kapoor, Fundamental Concepts of Mathematical Statistics, S.Chand.
9. N.G.Das, Statistical Methods, M.Das & Co.
10. Sneddon, Elements of partial Differential Equation, MGH,1985

CS 415:Database Management System & Computer Networking

L-T-P = 3-1-0

At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Introduction:

Database System Concepts & Architecture, Data Models, Scheme and Instances , Data Independence, Database Languages, Database Manager, Database Administrator, Database Users, E/R diagram, Relational Data model and Languages : Relational Data Model Concepts, SQL Data Definitions / Queries and Updates in SQL.

Module II: 10L

Example of DBMS ORACLE : Basic Architecture, Data Definitions, Data Manipulation, DBA Functions, SQL, PL SQL, Concurrent operations on the Database : Basic Concepts, A Simple Transaction Model, A Model with Read and Write only.

Module III: 10L

Computer Networking: LAN/MAN/WAN, OSI 7 layer Model, Communication Techniques, TCP/IP Protocol Stacks.

Module IV: 10L

Inter Networking, WWW, URLs, Search Engines, Electronic Mails, Distributed System, Distributed Database System Concepts, Application: Genome Data Management.

Revision : 5L

Textbooks:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts, 4th ed, Mc.Graw Hill, Computer Science Series.

Reference books:

1. Elmasri Ramez and Novathe Shamkant,"Fundamentals of Database Systems", Pearson.
2. Ramakrishnan: Database Management System, McGraw-Hill
3. Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman Publishers.
4. Jain: Advanced Database Management System, CyberTech
5. Date C. J., "Introduction to Database Management", Vol. I, II, IIIPearson.
6. Ullman J. D., "Principles of Database Systems", Galgottia Publication
7. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
8. Ramez Elmasri, Shamkant B.Navathe "Fundamentals of Database Systems", Pearson
9. Arun K.Majumdar, Pritimay Bhattacharya "Database Management Systems", Tata McGraw Hill

BT491: Molecular Biology and Fermentation Technology Lab
L-T-P = 0-0-6

1. Protein analysis by SDS-PAGE.
2. Isolation of genomic DNA and quantitation
3. Spectroscopic analysis of RNA

3. Isolation of plasmid – agarose gel electrophoresis
4. Restriction digestion of plasmid – agarose gel electrophoresis
5. Bacterial transformation using plasmid having antibiotic resistant marker and some other genetic markers
6. Induced mutation by: (a) acridine (b) Ultraviolet light.
7. Induction of beta-galactosidase in E. coli – time course induction.
8. Function of bioreactor.

a) Sterilization of air and calibration of DO electrode.
b) Calibration of pH electrode and pH regulation.
c) Manipulation of DO with air flow and stirrer speed regulation.
d) Preparation of inoculum and production of ethanol by *S. cerevisiae.*
e) Enzymatic method.for analysis of ethanol.

CHE 482: Chemical Engineering Lab– I
L-T-P = 0-0-3

1. Experiments on Reynold's Apparatus-Determination of flow regime and construction of friction factor against $N_{Re.}$
2. Experiments on flow measuring device—in closed conduit using (a) Venturimeter, (b) Orifice meter (c) Rotameter.
3. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
4. To study the working characteristics of a Jaw Crusher, calculate the energy consumption as a function of size reduction and compare it with the actual energy requirements.
5. To study the working characteristics of a Ball Mill, calculate the energy consumption as a function of size reduction and determine the critical speed.
6. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube.
7. To study the characteristics of film-wise / drop-wise condensation.

CS 483: Database & Computer Networking Lab
L-T-P = 0-0-3

Familiarization with ORACLE Package, Table design, creation & manipulation with SQL.
Sharing resources in a LAN, Internet Connection, Web – browsing, Search Engines, Downloading.

Reference book:

1. Oracle 9i Complete Reference – Oracle Press.

5th Semester

BT: 501 Immunology
L-T-P = 3-1-0
At least 45 hrs/sem

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Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module 1: 10L
The origin of Immunology: History and evolution of immune system; Innate immunity; Acquired immunity; Humoral and cell-mediated immunity; Passive transfer of immunity; Primary and secondary lymphoid organs; Structure and function of Antigen; Concept of Epitope, B cell and T cell: Biogenesis or Maturation; Macrophage and other Antigen Presenting Cells (APCs).

Module II: 10L Molecular basis of Immunology:
Structure and function of Antibody; Concept of Isotype, Allotype and Idiotype; Molecular basis of antibody diversity: DNA rearrangements; variations arising out of V,D,J joining; somatic hypermutation; Class switching; Primary and secondary immune response; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction, Basic concepts of Immunodiffusion, RIA and ELISA.

Module III: 10L Major Histocompatibility Complex (MHC):
Antigen processing and presentation; synthesis of antibody and secretion; HLA; laws of graft rejection; graft versus host reaction; Development of Inbred mouse strain; Blood group classification and Rh factor, Cytokines and other co-stimulatory molecules.

Module IV: 10L Immune response and tolerance:
Regulation of immune response; Immune tolerance; T cell anergy and T cell elimination; Hypersensitivity; Autoimmunity with respect to Myasthenia gravis and Rheumatoid arthritis; AIDS and immunodeficiency; Tumour immunology; vaccines.

Revision: 5L
Textbook:

1. Roitt, Immunology, 6th ed 2001, Mosby Publications.

Reference books:

1. Essential Immunology, Roitt, I.M., 9th Ed. (1997), Blackwell Scientific, Oxford, UK
2. Immunology, Kuby, J. 3rd Ed. (1997), Freeman, W.H,Oxford,UK
3. Weir, Immunology, 8th ed, W.B. Saunders& Co.
4. K.A. Abbas, Immunology, 4th ed, W.B. Saunders& Co.

BT-502 Bioreactor Design & Analysis
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

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Module I: 10L Basic Principles:
Recapitulation - Principles of kinetics for chemical and biochemical reactions. Fundamentals of homogeneous reactions for batch, plug flow, semi-batch, stirred tank/ mixed reactors.

Module II: 10L Reactor Design:

Types of reactors – batch, plug low reactor (PFR), continuous stirred rank reactors (CSTR), fluidized bed reactor bubble column, air lift fermenter etc.

Module III: 10L Analysis of Non-ideal Reactor Analysis:

Concept of ideal and non-ideal reactor; residence time distribution; models of non-ideal reactors – plug flow reactor for microbial processes; Mass transfer in biochemical processes; Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells; three – phase fuidized bed trickling bed reactor; Design and analysis of the above reactor systems; Gas liquid reactors.

Module IV: 10L Unconventional bioreactors:

Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plant cell culture.

Advanced Concepts: Scale up concepts, Bioprocess control and computer coupled bioreactors; Growth and product formation by recombinant cells.

Revision : 5L

Textbook:

1. Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.

Reference books :

1.Bailey & Olis, Biochemical Engg. Fudamentals, MGH, 1990
2. Atkinson, B., Biological Reactors, Pion Ltd., London,1974

BT-503 Bioinformatics - I
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module 1:
Different sub areas (Genomics, Proteomics etc) of bioinformatics- a general view about application relating biological research and application to biotechnology.
NCBI different modules: ORF, GenBank, Blast, OMIM, Taxonomy browser, PubMed.

Module 2:
Vi editor, Shell Scripts, Perl program, How to operate EMBOSS.

Module 3:

Sequence analysis: Introduction to sequence analysis, local and global alignment, pair wise and multiple alignment, sequence alignment algorithm: Dot matrix, Needleman and Wunsch algorithm, Smith-Waterman, Substitution Matrix (introduction: PAM, BLOSUM), BLAST, FASTA algorithms.

Module 4:

Motif identification- Pfam,Prosite, Prediction of ORF, Promoter. A brief introduction of gene prediction, Bio-perl .

Textbook:

1. Auther M Lesk, Introduction to bioinformatics-, OUP
2. David W. Mount., Bioinformatics Sequences and Genome Analysis,2nd edition 2004 ,CBS Publishers and Distributors (First Indian Edition, 2005)

Reference books:

1. Cynthia Gibas and Per Jambeck, Introduction to Bioinformatics computer Skills, 2001 SPD
2. Atwood, Introduction to Bioinformatics, Person Education
3. James Tisdall, Beginning Perl for Bioinformatics, SPD
4. Smith, D.W, Biocomputing : informatics and Genome Project,.,1994, Academic Press, NY.
5. Baxevanis, A.D, Quellette. B.F.F, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, , John Wiely & Sons.
6. Guy H. Grant and W. G. Richards, Computational Chemistry,OUP.
7. Andrew Leach, Molecular Modelling: Principles and Applications,Pearson Education.

BT-504: Genetics & Biostatistics
L-T-P = 3-1-0
At least 45 hrs/sem

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L Classical Genetics:

Mendelian inheritance physical basis of inheritance, gene interaction, multiple alleles, complementation, linkage, recombination and chromosome mapping, sex determination; extrachromosomal inheritance, special types of chromosomes, Chromosomal Variations: Numerical – euploidy and aneuploidy : structural – deletion, duplication, inversion and translocation.

Module II: 10L Biostatistics:

Population genetics: equilibrium, changes of gene frequency, continuous variation: human genome, chromosomal abnormalities and genetic disorders, Mean, median; mode; standard deviation, variance, random variable; discrete and continuous probability distributions: distribution and density function, mathematical expectancy; standard probability models—Binomials, Poisson, and Normal; Correlation and regression; curve fitting—least square method.

Module III: 10L Molecular Genetics:

Revised Syllabus of B.Tech in Biotechnology(To be followed from the academic session,July 2006 ,i.e. for the students who were admitted in Academic Session 2005-2006)

The biochemical basis of inheritance, DNA as the genetic material, the central dogma, supercoiling, replication in procaryotes and eukaryotes, molecular basis of mutation, DNA repair, basic concepts of transcription, translation, genetic code.

Module IV: 10L Bacterial Genetics:
Transformation, transduction, conjugation (1L each), plasmids, bacteriophage genetics-lambda, M13, T4 and T7 (1 L each)

Tutorials: Problem-solving exercises related to the 4 modules. Each module: 4 tutorials.

Revision: 4L (1 for each module)

Textbook:
1. M.W.Strickberger: Genetics, Pearson.

Reference books:

1. H.K. Das, Text Book of Biotechnology, 1st ed, 2004, Wiley Publishers
2.Brown, T.A., Genetics a Molecular Approach, 4th Ed. Chapman and Hall, 1992
3.Principles of Genetics. E J Gardner, M J Simmons and D P Snustad. 8th Edition. New York: John Wiley, 1991.
4.Stratchan & Read: Human Molecular Genetics
5.David Freifelder: Microbial Genetics, Jones and Bartlett Publisher Inc. 1987
6.Statistical Methods: N.G. Das
7. Sneddon; Elements of partial Differential Equation: Biostatistics, MGH

CHE 514 Transfer Operations– II
L-T-P = 3-1-0
At least 45 hrs/sem
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: 10L
Introduction to Mass Transfer: Molecular diffusion in fluids. Diffusivity, Mass Transfer Coefficients, Interphase Mass Transfer, Gas Absorption, countercurrent multistage operation, Packed Tower.

Module II: 10L Distillation:

Vapour-liquid equilibrium, Rayleigh's Equation, Flash and Differential distillation, continuous rectification, McCabe-Thiele Method, bubble cap and sieve distillation column.

Module III: 10L Extraction, Drying and Crystallization:

Liquid–liquid equilibrium. Liquid extraction, Stage wise contact; Liquid-solid equilibria, Leaching; Batch drying and mechanism of batch drying, Principle and operation of a spray drier, Preliminary idea of Crystallization,

Module IV: 10L Advanced Separation Processes:

Dialysis, ultrafiltration, reverse osmosis, pervaporation, electrodialysis and membrane separation.
Revision: 5L

Textbook:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition

Reference book:

1. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
2. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
3. Treybal, R.E., Mass-Transfer Operations, MGH
4. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

BT 591: Bio-informatics Lab
0-0-4
(2 credits, contact hrs, 0-0-4):

Biological literature search, sequence analysis (EMBOSS, NCBI tools), Structure viewer and analysis, linux vi editor, Perl programming, Prediction of secondary structure of protein. Prediction of tertiary structure (homology modelling). Molecular Dynamics using GROMACS.

CHE- 582- Chemical Engineering Lab II
L-T-P = 0-0-

1. To verify Rayleigh's equation.
2. To draw the vapour-liquid equilibrium diagram from Othmer Still.
3. To study the performance of a Rectification Column.
4. To determine the gas-liquid mass transfer coefficient (Wetted Wall column or Stirred Cell).
5. To study the drying characteristic curves under constant drying condition in rotary and tray dyers.

HU 591: Technical Report Writing & Language Practice Laboratory L-T-P = 0-0-3
Topics to be covered and number of hours required for it:

1. Introductory lecture is to be given to the students so that they get a clear idea of the syllabus and understand the need for having such a practice lab in the first place (3 hours).
2. Conversion practice is done on given situation topics. The students are also made to listen to pre-recorded cassettes produced by British Council and also by the Universities of Oxford and Cambridge (6 hours).
3. Group Discussions:- The students are made to understand the difference between the language of conversion and group discussion. Strategies of such discussions are to teach to them. It is also helpful to use videocassettes produced by the U.G.C. on topics like group-discussion. After wards the class is divided into groups and the students have to discuss on given topics on current socio-economic-political-educational importance (12 hours)

4. Interview sessions-students are taught the do's and don'ts of facing a successful interview. They then have to face rigorous practices of mock-interviews. There simulations of real life interview sessions where students have to face an interview panel(12 hours)
5. Presentations: The secrets of an effective presentation are taught to the students. Then each and every student has to make lab presentations with the help of the Overhead projector/ using power point presentation and other audio-visual aids in the laboratory. They also have to face the question answer sessions at the end of their presentation (12 hours)
6. Classes are also allotted to prepare the students for competitive examinations like the T.O.E.F.L. by making the students listen to specially produced C.D. cassettes of such examinations (3 hours)

The overall aim of this course is to inculcate a sense of confidence in the students and help them to become good communicators in their social as well as professional lives.

Textbooks:

1. Sharma—Business Correspondence & Report Writing, TMH
2. Prasad—Group Discussion & Interview (With Audio Cassette) , TMH

Reference book:

1. Sashi Kumar—Spoken English (with Cassette) , TMH

6th Semester

BT – 601: Plant Biotechnology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0
At least 45hrs/sem

Module I: 10L Plant tissue culture – theory and methods:
Brief history of Plant tissue culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement, micropropagation – somaclonal variation and haploid culture, cell suspension culture: continuous culture, techniques for immobilization of plant cells

Module II: 10LPlant tissue culture – product and recovery:
Primary and secondary metabolic products (phytochemicals) of plant cells, biosynthesis of secondary metabolites of biotechnological importance (alkaloids), biotransformation for product development and selection of cell culture (only plant tissue culture products), process technology with salient features for specific products (diasgenin).

Module III: 10L Plant genomes:
Structure and organisation of plant genome, regulation of plant genome expression, transcriptional, translational and post transcriptional regulation of plant genome, plant growth regulator. Transposons, chloroplast and mitochondrial genome. (Arabidopsis should be taken as the model for study of plant genome).

Module IV: 10L Plant tissue culture – genetic engineering:
Transfer of nucleic acid to plant cells
- Direct transformation by electroporation and particle gun bombardment.
- Agrobacterium, Ti plasmid vector
Theory and techniques for the development of transgenic plants, conferring resistance to herbicide (Basta), pesticide (Bt gene), plant pathogens PR-Proteins.
Plant engineering towards development of enriched food products – Golden rice
Tansgenic plant for molecular farming (Plantibody)

Textbooks:

1. H.S.Chawla, Introduction to Plant Biotechnology, Oxford &IBH Publishing co.Pvt..Ltd
2. Slater.A.,Nigel W.S,Flower.R.Mark , Plant Biotechnology: The Genetic Manipulation of Plants, 2003, Oxford Univesity Press.

Reference books:

1. Buchaman, Gursam, Jones, Biochemistry and Molecular Biology of Plants, 1ed, 2000, L.K.International.
2.Hammond,Plant Biotechnology,Springer
3 Bhozwani and Razdan –PlantTissue Culture: Theory and Practice 1996 Elsevier
4. Butterworth & Heineman, Invitro Cultivation of Plant Cells, Biotol Series.
5. H.E Street(ed): Tissue culture and Plant science, Academic press, London, 1974
6. Gamborg O.L.,.Phillips G.C, Plant Cell, Tissue and Organ Culture, Narosa Publishing House
7. Das.H.K. Text Book of Biotechnology-First Edition 2004,Wiley Dreamtech.

BT – 602: Bioseparation Technology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I: 10L
Basic Concepts
Basic concepts of Bio-separation Technology, Separation characteristics of proteins and enzymes – size, stability, properties; purification methodologies Characteristics of bio-products; Flocculation and conditioning of broth, overview of reaction processes involved in separation, numerical examples illustrating the process. Mechanical separation processes; Filtration at constant pressure and at constant rate; empirical equations for batch and

continuous filtration, centrifugal and cross-flow filtration, Centrifugation: basic principles, design characteristics; ultracentrifuges:: principles and applications.

Module II: 10L
Techniques Involved in Separation Processes
Foam-fractionation; Solvent extraction of bio-processes, aqueous two-phase extraction, adsorption-desorption process; Salt precipitation; Chromatographic separation based on size, charge hydrophobic interactions and metal ion affinity. Affinity chromatography, inhibitors: their preparation and uses, method of linkages, Electrophoresis SDS-PAGE (Polyacrylamide Gel), horizontal and vertical type, methods, case studies.

Module III: 10L
Membrane based separation processes
Micro-filtration, Reverse osmosis, Ultrafiltration and affinity ultrafiltration, concentration polarization, rejection, flux expression, membrane modules, dead-ended and cross-flow mode, material balances and numerical problems, biological applications.

Module IV: 10L
Industrial Applications
Industrial aspects of separation of biomolecules, Material balances, mathematical analysis and modeling, relative advantages and disadvantages of separation methods, Case studies.

Textbook :

1. Schuler & Kargi, Bio-process Engg. PHI

Reference books:

1. Bailey & Olis, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
2. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.
3. Muni Cheryan, Handbook of Ultrafiltration
4. Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill
5. Ho, W.S.W. & K. K. Sirkar, Membrane Handbook, Van Nostrand Reinhold, N.Y. (1992)

BT - 603: Pollution Control & Environmental Biotechnology
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 45 hrs/sem**

Module I: Air Pollution Control Methods and Equipment
Primary and secondary air pollutants, Effects of air pollutants on health, Air Pollution laws - EPA & US clean air act and Standards, sampling, basic ideas of air pollution control equipments, Bag Filter, Electrostatic Precipitators, cyclone separators, Wet-scrubbers, Bio-scrubbers, Electrostatic precipitators, High volume sampler, RSPM Sampler, Control of specific gaseous pollutants, Numerical Problems of the control equipments.

Module II: 10L Water Pollution: Sampling & Analysis
Water pollution; Sources -- Municipal Sewer and Industrial Wastewater and classification of pollutants, B.O.D, C.O.D, D.O, S.S., MLSS and MLVSS, T.D.S, Oil and grease, Metals, Nitrogen and Chloride, Water pollution Laws - EPA & US clean air act and Standards, Sampling methods; Estimation methods, Bacteriological measurements, Numerical Problems on parameters and their determination methods.

Module III: 10L Wastewater Treatment Processes
Overview of treatment principles: Primary, Secondary, Tertiary. Theory of aeration, Principles, operation and performance evaluation of sewage and wastewater treatment processes: Activated Sludge process, Extended Aeration, Trickling Filter, Mechanically aerated lagoons, Concepts of Waste stabilization ponds, Aquatic plant systems, Upflow anaerobic sludge blanket(UASB) .Common effluent treatment plant-case studies. Membrane based wastewater treatment processes – case studies. Ranking of wastewater treatment processes. Numerical problems on parameters and their determination methods.

Module IV: 10L Environmental Biotechnology: Specialized aspects
Oil pollution – treatment with micro-organisms, Bioremediation—recovery of metals from waste water and sludge, Preliminary ideas of xenobiotics, degradative capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polyaromatic hydrocarbons, Persistent Organic Pollutants (POP), Anaerobic and aerobic composting, Bio-degradation of plastics, Vermiculture, Concept of Biodiversity, Diversity indices.

Textbook:

1. S. P. Mahajan, Pollution Control in Industries, TMG

Reference books:

1.Omasa,Air pollution & plant biotechnology,Springer

2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 4th ed., TMG

3.Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999

4.Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH

5.Sincero & Sincero, Environmental engineering,

CHE - 615 Process Instrumentation and control.
Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.
L-T-P = 3-1-0 **At least 45 hrs/sem**

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Module I: 10 L
Module I: 10 L
Introduction, Principles of measurement, Error Analysis, Static and dynamic characteristics of instruments, Process Instrumentation:Recording, indicating and signaling instruments , Transmission of instrument readings, Instrumentation diagram

Industrial instruments for measurement

a. Temperature: Filled system Thermometer, Thermocouples, resistance thermometers, radiation and optical pyrometers
b. Pressure: Manometers, elastic deformation and electrical type gauges. Vacuum gauges – mechanical, electrical and ionization types.
c. Flow: Head flow meters, area flow meters, positive displacement flow meters, mass and magnetic flow meters.
d. Level: Direct and inferential type

Measurement of density and specific gravity, humidity, viscosity and composition. Analytical principles involving emission spectrometry, I R, Spectroscopy, Gas chromatography, Polarography, X-ray and pH.

Module II: 10 L

Simple system analysis:
Laplace transform, block diagram, Forcing function, Concept of transfer function, Transient response of first, second and higher order systems. Linearization, Transportation lag, Lumped and distributed parameter system.
Feed back control: Control loop and its components, servo and regulator control, Principle of automatic control with reference to proportional, integral and derivative modes.

Module III: 10 L
Stability Concepts: Routh-Hertwitz method, root-locus method and Bode diagrams
Controller tuning : Zigler Nicols method and Process reaction curve

Module IV: 10 L
Control hardware: Measurement elements and dynamics, final control elements – sizing and characteristics. Pneumatic and electronic controller. Elementary idea of feed forward, cascade, ratio, adaptive and digital computer control, Control of complex processes such as distillation column , heat exchanger and bioreactor.

Textbooks
1.D. R. Coughanowr , Process system analysis & Control , 2nd Ed–MGH.

References books:
1.G. Stephanopoulus , Chemical Process Control –PHI.
2.B. C. Nakra & K. K. Chaudhury , Instrumentation, Measurement and Analysis, TMH.
3. B. C. Kuo, Automatic process control, 4th ed
4.Smith & Carripio , Instrumentation and Control
5.Roffel,Advanced Process Control,Springer

BT- 691:
Plant Tissue culture lab
1) Explant selection sterilization and inoculation
2) Various media preparations: MS, B5, SHPCL2

3) Callus and cell suspension culture; induction and growth parameters
4) Chromosomal variability in callus culture
5) Plant regeneration from embryo, meristem and callus culture.
6) Androgenesis: Anther and pollen culture: Isolation and culture of protoplasts.

BT – 692:
rDNA Technology and Immunology lab

1) Staining of Blood film
2) Blood grouping.
3) Preparation of O and H antigen
4) Quantitative VIDAL test
5) Immunodiffusion in Agar gel
6) ELISA- qualitative
7) Western blot technique.
8)

CHE – 683 Process Instrumentation & Control Lab

1.0 Temperature Measurement using Resistance Temperature Detector (RTD), Thermocouple.
2.0 Pressure gauge calibration using Dead Weight Tester
3.0 Liquid-Level Measurement using Air-Purge Method
4.0 Measurement using Load Cell
5.0 Study on Responses of First and second-Order Interacting and non-interacting Systems
6.0 Studies on Characteristics of Control Valve
7.0 Studies on the Stability and tuning of a Flow Controller
8.0 Response of a P & PI Controller
9.0 Demonstration of Bourdon tube, diaphragm gauge, etc.

7th Semester

BT – 701: Animal Cell Culture and Molecular modelling

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 4-0-0 **At least 45 hrs/sem**

Module I: 10L

History scope and prospect of animal cell culture

History of animal cell culture and development, Development of primary culture, Development of cell line by enzymatic disaggregation, Culture media and growth conditions. Cell type and characterization, origin of animal cell line, maintenance and characterization of different cell lines, Marker gene characterization,

Module II: 10 L

Growth and scale up

Cell growth characteristics and kinetics, Micro-carrier attached growth, Cell culture in continuous, perfusion and hollow fibre reactor, Mass transfer in mammalian cell culture.

Module III: 10L

Protein Secondary Structure Prediction: Chou-Fasman algorithm (detail procedure of his work). A brief idea of neural-network and HMM and their use in structure prediction.
Docking (a brief idea- 1L), Drug design: QSAR (a brief idea, 1L).
Protein tertiary Structure Prediction: Threading, Comparative modeling

Module 4: 10L

Protein classification, fold libraries, Protein-ligand interactions. Force field, Introduction to different simulation method (Molecular Dynamics and Monte Carlo).

Textbook:

1. Auther M Lesk., Introduction to bioinformatics- OUP
2. David W. Mount, Bioinformatics,

Reference books :

1. Cynthia Gibas and Per Jambeck, Introduction to Bioinformatics - Computer Skills, 2001 SPD
2. Atwood , Introduction to Bioinformatics, , Person Education
3. James Tisdall , Beginning Perl for Bioinformatics, , SPD
4. Smith, D.W, Biocomputing : Informatics and Genome Project, 1994, Academic Press, NY.
5. Baxevanis, A.D., Quellette, B.F.F.,Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons.
8. Guy H. Grant and W. G. Richards Computational Chemistry, OUP
9. Andrew Leach Molecular Modelling: Principles and Applications, Pearson Education.
10. M.K. Sateesh, Biotechnology-5, New Age Int Publishers, 2003
11.Morgan, Animal Cell Culture-Biotol Series,1993
12 Davis.J.M Basic Cell Culture Second Edition, Oxford University Press. (First Indian Edition, 2005)
13.Das.H.K. Text Book of Biotechnology, First Edition 2004,Wiley Dreamtech.
12. Immune biotechnology,

BT – 702: Food Biotechnology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0
At least 45 hrs/sem

Module-I : Preservation Technology

Spoilage of food – Food poisoning – Microbiology of water, milk, meat, vegetables – Preservation of food by canning, dehydration, irradiation, sterilization *etc*

Role of lactic acid in preservation in sauerkraut.

Module-II: Food Production Technology
Fermented and semi-fermented food – Production of single cell protein – Yeast, mushroom – SCP for cattle feed .

Genetically modified crop, safety aspects of genetically modified crops.

Module-III: Technology for Improved Process
Enzymes in bakery and cereal products
Enzymes in fruit juice production
Enzymes in fat/oil production
Enzymes in cheese making and beverage production
Utilization of food waste.

Module-IV :Analysis of major food ingredients
Analysis of preservative, natural and synthetic- Food colour – Food flavour enhancing agents
Chemical safety measurement – Heavy metal, fungal toxins, bacterial toxins, herbicide, Pesticide. detection, Quality control tests explained in brief.

Textbook:

1. Jay, Modern Food Microbiology, CBS Publishers, 1987

References books:

1. Frazier, Food Microbiology
2. G. Reed, Prescott and Dunn's Microbiology, CBS Publishers, 1987
3. Desrosier, Technology of food preservation, CBS Publisher

HU 714: Industrial Economics and Management

L-T-P = 4-0-0 **At least 45 hrs/sem**

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

Module I: Economic environment of Business, Economic planning in India, Industrial policy, Industry and natural environment, Environment policy, Impact on Environment, Green industry. 10L

Module II: Principles and functions of management, Line and staff organization, Motivation, Attitude and behaviour, Elements of Production management, Productivity, Quality and materials management. 10L

Module III: Elements of Financial management, Concept of cash-flow and ratio analysis, Capital structure of a firm, Analysis of Balance sheet, working capital management. 10L

Module IV: Concept of Project, Preparation of Project Report, Feasibility studies, Detail Project Report (DPR), Project appraisal, Payback period, Rate of return, Monitoring techniques of Project, Concept of HRD, Recruitment, Selection, Appraisal and Training, Industrial relations. 10L

Reference Books:

1. N.K. Sengupta: Government & Business. Vikas Publishing
2. R. Dutt & K.P.M Sundaram: Indian Economy. S. Chand & Co.
3. Ramchandran: Accounting & Financial Management for MBA and MCA students, Scitech.
   P. Gopalkrishnan & M. Sundaram: Materials Management, An Integrated Approach. Tata McGraw Hill Publishing.

BT 703A

Biophysics of Macromolecules:
Module1: 10L

Introduction to biophysics, Strong and weak interactions in biomolecules, dielectric properties of biomolecules, electronic properties of biomolecules – condctivity, photoconductivity and piezoelectric effect, conformation and configuration of biomolecules

Module 2: 10L

Conformation of proteins and enzymes, effect of amino acids on the structure of proteins, energy status of a protein molecule, helix coil transformation of proteins, structure-function relations of enzymes, cooperative properties of enzymes, dynamics of protein folding

Module 3: 10L

Conformation of nucleic acids, helix coil transformation, thermodynamics of DNA denaturation, Changes in nucleic acid structures during biochemical processes

Module 4: 10L- Advanced discussion

Methods for study of biomolecule structure -- X-ray crystallography, optical, uv and ir spectroscopy, luminescence, fluorescence, magnetic resonance and electron microscopy

Textbook:

1. Biophysical Chemistry Vol 2; Cantor & Schimmel, Oxford University Press

References books:

1. Physical Biochemistry: David Friefelder, 5th Ed, PHI
2. Physical Biochemistry: Kensal E van Holde. PHI
3. Practical Biochemistry Principles and techniques: Editor Wilson and Walker, Cambridge University Press
4. Proteins: Structure and Function: David Whitford: John Wiley &Sons

BT 703B Renewable Energy Technology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I
Biological fuel generation: Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes; conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and / or fermentation processes.

Module II
Sources of biomass; biogas from anaerobic digestion; thermal energy from biomass combustion; ethanol from biomass.

Module III
Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xantham gum), biosurfactants.

Module IV:
Solar energy: solar collectors, solar pond, photovoltaic cells, chemical storage. Geothermal energy and wind energy: Use of geothermal energy, operating principles of different types of wind energy mills. Nuclear energy: nuclear reactions and power generating tidal wave energy.

Reference books :

1) J.E. Smith – Biotechnology, 3rd ed. Cambridge Univ Press
2) S. Sarkar – Fuels and combustion, 2nd ed., University Press

BT – 703C Modelling and Simulation of Bioprocesses

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I:
Approach to modeling, Unstructured and structured modeling, Deterministic and stochastic models, Segregated and unsegregated models, Shu's segregated models for Lactic acid fermentation.

Module II:
Structured kinetic models: Compartmental models (two and three),
Product formation, Unstructured and structured models, Genetically structured models.

Module III:

Stochastic model for thermal sterilization of the medium, Modelling for activated sludge process, Model for anaerobic digestion, Models for lactic acid fermentation and antibiotic production.

Module IV:
Process simulation techniques, Equation oriented approach, Equation oriented simulators (SPEED UP, ASCEND, FLOWSIM, QUASILIN, DYNSIM), simulation programs based on Euler's methods, Newton – Raphsen methods, Runga – Kutta methods, Simulation of biochemical system models.

TextBook:

1. J.E. Bailey and D.F. Ollis, Biochemical Engg Fundamentals, 1986, McGraw Hill Book Company

Reference books:

1) G. Francis, Modelling and Simulation
2) A. Haerder and J. A. Roels " Application of simple structured I Bioengineering, and P55 in Advances In Biochemical engineering Vol21, A. Fiechts (ed) Spring –Verlag , Berlin, 1982.

BT – 703D Molecular modeling and Drug Designing

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I: 10L

Introduction to molecular Simulation Techniques-Monte Carlo Methods-Metropolis Monte Carlo Algorithm, Flow calculations in Metropolis Monte Carlo Algorithm with examples-Ising Lattice, Gibbs Ensemble Monte Carlo Simulations
Molecular Dynamics Methods-different methods for the integration of Dynamical Equations, Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles, Structural information from M.D.

Module II: 10L

Molecular mechanics,Energy minimization, intra molecular interactions, Physicochemical parameters in drug design-Ionization constants, chelation, solubility and partition Co-efficient. Over view of Molecular Descriptors.

Module III: 10L

Rational basis of drug designing, criteria for synthesizing drugs, Drug designing approaches-Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction, Structure based drug design process of Structure based design, Receptor based design-drug designing using known receptor structure, design of energy inhibitors,

Module IV: 10L

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools, scoring and Docking mode, QSAR principles and Methods in drug designing. Current research in drug designing- a case study.

Textbooks:

1. ARLeach-Molecular Modelling, .Principles and application 2nd edition–Prentice Hall.
2. Krogsgaard,L-Text Book of Drug Design and Discovery-2002 Taylor and Francis,London

Reference books:

1. G.Walsh-Biopharmaceuticals-Biochemistry and Biotechnology-2003, Wiley
2. Scolnick.J.(2001) Drug Discovery and Design .Academic Press, London
3. N. R. Cohen, Editor. *Guidebook on Molecular Modeling in Drug Design.* Academic Press, San Diego, 1996.

BT – 703E Biosensors and Diagnostics

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I:
Introduction –Immobilization key to biosensor construction, Biosensors diversification.

Module II:
Redoxmediated systems, FET's (Field Effect Transistors), Thermistors, Conductimeters, Piezoelectric crystals, Optoelectric biosensors.

Module III:
Variations on the biological biochemical component, Bioaffinity principles, whole cell biosensors.

Module IV:
Applications and uses of biosensors, Clinical chemistry, medicine and health care, Veterinary, Agriculture and Food production, Environmental control and pollution monitoring.

Reference books:

1. Biosensors : Tran Minh Canh, Chapman & Hall
2.Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
3.D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

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8th Semester

BT – 801 - Ethics and IPR

Note1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-0-0 **At least 45 hrs/sem**

Module 1 **10L (4-0-0)**

Setting the scene (2L)

Introduction to ethics and bioethics, roots of honours and integrity in science; the responsible conducts of biotechnological research; research with human beings; societal obligation of a biotechnologist

Applications (8L)

Biotechnology/ biomedicine application – ethical consideration; ethics and the natural world: environmental ethics (protecting public health and environment; genetically modified foods – the ethical and social issue. Ethical issues in genetical engg. / biomedical science, egentic enhancement, eugenic genetic engg., genetic information – use and abuse; patenting human genes – ethical and policy issue, ethics in cloning, genetic testing and screening, human gene therapy and genetic modification – ethical and public consideration, legal implication of somatic cell, gene therapy- germ line gene therapy

Module II **10L (4-0-0)**

Juriprudential definition and concept of property rights, duties and their correlations, history and evaluation of IPR – like patent design and copy right. Distinction among the various forms of IPR, requirements of a patentable invention like novelty, inventive step and prior art and state of art

Module III **10L (4-0-0)**

All regulations

Regulations on ethical principles in biomedical/ biotechnological practice: The Nuremberg code, declaration of Helsinki; the Belmont report, cooperational guidelines – WHO, guidelines of DBT (India), Guidelines of an informed consent

Module IV **10L (4-0-0)**

Rights/ protection, infringement or violation, remedies against infringement, civil and criminal, Indian patent act 1970 and TRIPS major changes in Indian patent system, post-TRIPS effects.

Contents of patent specification and procedure for patents

a) obtaining patents
b) geographical indication
c) WTO

Detailed information on patenting biological products: Biodiversity Budapest

Textbook:

1.F. H. Erbisch and K. M. Maredis, Intellectual Property Rights in Agricultural Biotechnology, Bios Publishers

Reference Books :

1. P.K. Gupta, Biotechnology and Genomics, Rastogi Publications

BT – 802: Medical and Pharmaceutical Biotechnology

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module 1: 10L

Drug Development in Pharmaceutical Process

- Production of pharmaceuticals by genetically engineered cells (hormones, interferrons)
- Microbial transformation for production of important pharmaceuticals (steroids and semi-synthetic antibiotics)
- Techniques for development of new generation antibiotics
- Protein engineering, drug design, drug targeting

Module II: 10L

Disease Diagnosis and Therapy

- ELISA and hybridoma technology
- DNA vaccine
- Gene Therapy
- Toxicogenomics

Module III: 10L

Proteomics in Drug Development

- Role of Proteomics in Drug Development
- Diagnosis of disease by Proteomics
- Separation and identification techniques for protein analysis
- Development of antibody based protein assay for diagnosis

Module IV: 10L

Diagnosis and Kit Development

- Use of enzymes in clinical diagnosis
- Use of biosensors for rapid clinical analysis
- Diagnostic kit development for microanalysis

Textbooks

1. Biopharmaceuticals- Biochemistry and Biotechnology : Gary Walsh; John Wiley & Sons
2. S. P. Vyas, V. Dixit, Pharmaceutical Biotechnology, CBS Publishers

Reference Books

1. Pharmaceutical Biotechnology ; Sambhamurthy & Kar , NewAge Publishers

.2. Epenetos A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London

3. V.Venkatesharalu -Biopharmaceutics and Pharmacokinetics-Pharma Books Syndicate

BT 803 A:

Proteomics and protein engineering

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0
L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I: 10L
Introduction to protemics and protein engineering
- Protein prefractionation and sample preparation
- Two dimensional electrophoresis (2-D PAGE)
- Protein identification
- Post translational modification

Module II: 10L
Functional and Genomics
- Proteomics and drug delivery
- Reverse genetics
- Transcription and replication of negative strand viruses

Module III: 10L
Protein engineering and transfer RNA world
- Essential requirements for protein synthesis
- Role of messenger RNA
- SNIJRPS and Introns
- Translation

Module IV: 10L
Protein folding
- Hierarchic protein folding
- Defective protein folding
- Molecular chaperones
- The HSP 70 chaperone system
- Proteasomes, Prions, Polyketides and non-ribosomal peptides
- Combinational manipulation of polyketides and non ribosomal peptides

Textbooks
1. R.M. Twyman ; Principles of Proteomics, Bioscientific Publishers
2. Daniel C. Liebler, Introduction to Proteomics: Tools for the New Biology, Humana Press

Reference Books

1. B.Alberts,D.Bray, J.Lewis et al, Molecular Biology of the Cell, Garland Pub. N.Y 1983

2. Richard J. Simpson, Proteins and Proteomics, I.K. International Pvt Ltd

BT 803 B:
Human genomics

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I: 10L

- Patterns of genome organization
- Structural genomics
- Functional genomics
- Reverse genetics
- Gene patenting

Module II: 10L

- Electronic PCR
- Genome mapping and genome sequencing
- Specialized database in molecular biology

Module III: 10L

Human genome project

- Human genome progress
- Genes in health and disease
- Genomic disorders and molecular medicine
- Minimal cell Genome

Module IV: 10L

- Transfer of Genes to Humans
- Nucleic acids and Protein sequences database
- Pharmacogenomics
- Gene bank
- Legal status of gene bank

Textbook:

1. T. A. Brown , Genomes, John Wiley & Sons

Reference Books

1. Singer.M, and Berg.P, Genes and genomes, Blackwell Scientific Publication, Oxford ,1991
2. Beebe.T, and Burke.T, Gene Structure and Transcription, 2nd edition,1992, Oxford Univ Press

3. Glick and Pasteurneck, Molecular Biotechnology, Principles and Applications of Recombinant DNA technology, ASM Press
4. Strachan & Reed, Human Molecular Genetics, Garland Science.
5. Cantor & Smith, Genomics, John Wiley & Sons

BT 803 C
Biosafety

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**
Module I

Introduction to safety in biotechnology:
Problems of organism pathogencity during manufacture of vaccines or diagnostic reagents; Risk assessment studies

Module II

Classifications of microorganisms according to pathogencity; classification by European Federation of Biotechnology; characteristic feature of those organism (allergic reactions, food poisoning etc)

Module III

Release of genetically manipulated organism to the environment; genetic modifications and food uses; Ethical concerns relating to the food use of certain transgenic organism; genetic engineering of the animals (e.g. application of transgenic growth hormones into animals to improve meat quality) serve moral opposition.

Module IV

Areas of public concern on human genome research: genetic testing and screening; commercial exploitation of human genome; Eugenic pressures; effects of germslike gene therapies on later generations; Regulations to super use medical safety; legal implication and public concern.

Text book

1. Jan Peter Nap, Ed, Genomics for Biosahfety in Plant biotechnology, Bios

Reference Books :

1. S. P. Denyer, Norman Hodges, S.P. Gorman, Pharmaceutical Microbiology, Blackwell Publishers

BT-803D Biomedical Engineering

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

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L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I

Introduction to cell structure and components, protein structure, cell membranes, chromosomes, cytoskeleton, actin filaments, microtubules, cell signaling and ECM, biomenmbrane and action potentials.

Transducers ans electrodes, types of transducers and their selection for biomedical applications, biosensors based on electrochemical transducers

Module II

Cardiovascular systems, the heart ad other cardiac systems, circulation and blood flow, blood pressure, cardiac output, cardiac rate, cardiac shock and response to exercise, magnet cardiography, cardiac pacemaker, computer applications.

Measurement of electrical activities activities in muscles and brain; electromyography, electroencephelographs and their interpretation.

Module III

Membrane transport, kidney and nervous system in the control of arterial pressure, kidney function, functional problems in kidney, artificial kidney, dialysis, haemodialysis, blood transfusion, prosthetics- medical application of biopolymers, artificial intelligence in medical diagnosis (soft computing and genetic algorithm).

Module IV

Biomedical tests; Measurement of sugar, pH, sodium potassium ions, haemoglobin, oxygen and carbon dioxide concentration in blood, Medical imaging, ultrasound imaging, radiography, biotelemetry, biophysics of signal transmission and reception of biological signals, telemedicine.

References

1. Khandpur .R. S Handbook of biomedical Instrumentation.
2. Manz and Becker ,Ed,Micriosystem technology in Chemistry and Life Sciences
3. Webster J.S Medical Instrumentation Application and Design

BT 803 E
Bio-fertilizers and Bio-pesticides

Note 1: There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2: Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I

Definition of Bio-fertilizers, bacterial suspensions/ inoculants as bio-fertilizers and bio-control agents to fight insect pests, weeds or diseases in plants; Atmospheric nitrogen fixing soil bacteria (Rhizobium, Azotobacter, Acetibacter) and several cyanobacteria;

Module II

Mechanism of soil bacteria and cyanobacteria for enhanced nitrogen fixation; Role of water fern Azola as biofertilizers; advantage of biofertilizers over chemical fertilizers; activity to control insect pests.

Module III

Free – living and symbiotic nitrogen fixers; nif genes to other soil micro-organism; Endophytic diazotrophs; NIF gene transfer; Nodulation by Rhizobium; Rhizobium management; Rhizo-sphere engineering.

Module IV

Biopesticide definition: Types (Bioinsecticides and biofungicides); Protein antipest materials such as Bacillus Thuringiensis; Development of biopesticides, advantages over chemical pesticides (biodegradability, specificity)

Textbook

1. Stacey, Burris and Evans (ed), Biological Nitrogen Fixation, Chapman & Hall, 1992

References :

1. J K Ladha, M B Peoples, Management of Biological Nitrogen Fixation for the Development of More Productive and Sustainable Agricultural Systems, Springer

2. P.S. Nutman, Symbiotic Nitrogen Fixation in Plants, Cambridge University Press

Sushil K Khetan, Microbial Pest Control, Marcel Dekker

3. Opender Koul, G S Dhaliwal, Microbial Biopesticides, Taylor & Francis

ID:814 – Elective II

ID 814A Information Technology/ Artificial Intelligence

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

ModuleI

Review of digital, logic & circuits; instrumentation sets, multiprocessors versus single processors; peripheral devices; hard disks, CDs, video display monitors, device controllers, input/output; operating systems—functions, unix/linux or windows, process management, memory and file system management.

Module II

Basic network components, HUB, switches, and media; for LAN/WAN network cards, protocols, telecommunication devices, different methods of communications, network, applications; topologies and protocols; installation and operation of bridges, routers and gateways.

Module III

Network performance analysis; privacy, security and security; installation and configuration of LAN and WAN networks; Internet working, www, web browsing, URLs, file transfer, email, search engines, client server computation.

Module IV

Distributed databases, distributed and hierarchical control of processes, computer based instrumentation and control.

References :

1) Mano – Digital computer architecture, PH-I
2) A.S.Tanenbaun - Computer network , PH-I

ID 814 B
Post-harvest Technology:

Module I
Physico-chemical properties of grain, psychometry: Dry bulb and wet bulb temp, humidity, heat capacity of humid air. Grain drying: drying curves and their rates: methods of grain drying; grain dryers. Parboiling of paddy and wheat: Physico-chemical changes during parboiling; effects of parboiling on the quantity of grains.

Module II
Grain millings: cleaning and separation methods; Husking/Hulling machines; machine used in cereal grinding. Hydrothermal treatment of cereal grains; changes in physico-thermal and biochemical properties. Rice milling: cleaning machines, husking machines, types and characteristics, millings of corn, wheat and pulses: dry millings and wet millings; Flour milling, modern methods of pulses milling.

Module III
Processing of oil seeds and Rice bran: Production and refining of cotton seed oil, solvent extraction of soyabean oil, Extraction of sunflower oil, coconut oil, Methods of utilization of rice bran: wet heat treatment, rice bran stabilization; refining of crude rice bran oil with edible grade oil.

Module IV
Storage of food grain: grain storage principles; changes occurring in food grain---chemical, physical and biological. Grain storage, pests and their control; control of stored food grain pests by fumigation; rodent control, rodenticides for rats and mice. Food grain storage structures; bag and bulk storage; economics of storage and processing of rice.

References:

1) A. Chakraborty--- Post harvest technology of cereals, pulses and oil seeds, 1995
2) Boumans, G., Grain Handlings and storage, Development in Agricultural Engg., 4. Elsevier, Tokyo, 1985.

ID 814C
Biomaterials
Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0
L-T-P = 3-1-0 **At least 45 hrs/sem**

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Module I
Definition of biomaterials – biologically derived materials or materials compatible with biology.
Common biomaterials: some proteins, many carbohydrates and some specialized polymers.
Collagen (protein in bone and connective tissues): Structure production and its use.
Fibroin (protein in silk): Production a and its use.
Production of these proteins by conventional cloning methods.

Module II:
Carbohydrates: Modified carbohydrates actin gas lubricants for biomedical applications; Polydextrose made from bacteria; Carbohydrates modified from enzymes; artificial wood.

ModuleIII:
Biopolymers: Synthesis from a simple biological monomer (eg hyaluronate polymers); Dextrans (used in chromatography columns); Rubberllike materials produced by bacteria and fungi (Polyhydroxybutyrate PHB), Polycaprolactone(PCL); Production of a copolymer of PHB and PHV(polyhydrovaleric acid), sold as Biopol by fermentation on Alcaligenes eutrophus; Biodegradable polymers

Module IV:
Industrial biopolymers: Production of polyphenol resins by the enzyme soybean peroxidase; Evaluation of the properties of biopolymers to make good biomaterials; Tensile strength(both elasticity and breaking strength); Hydration, visco – elastic properties; viscosity.

References:

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

ID 814 D Biometallurgy

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I
Introduction to Biotechnology applied to Raw Material processing, Biogeochemical reactions – chemical mechanisms and controlling factors, Microbial interventions, Nature and characteristics of Biogeochemically important micro-organisms.

Module II
Kinetics of bioleaching; Applications of biogeochemical processes in mining and metallurgy, dump, heap and in-situ leaching.

Module III

Reactor modeling for leaching, beneficiation of ores and process residues: recovery of gold and silver, beneficiation of sulfidic tailings from tin processing; purification of ferroginous sand.

Module IV

Beneficiation of bauxite, applications of sulphate reducing bacteria; applications of sulphate reducing bacteria.

Environmental pollution control: accumulation of metals by microbial cells; growth of microbial cells in water flowing pipelines; microbial degradation of water-based metal working fluids.

References :

1. M.E. Curtin, Microbial mining and metal recovery biotechnology (1), pp 229-235, 1983
2. Woods D, Rawling D.E., Bacterial bleaching and biomining in marx J.L. (ed), Revolution in biotechnology, Cambridge University Press

ID 814 E Total Quality Management

Note 1 : There will be one compulsory objective type question comprising ten numbers spread over the entire syllabus and each carrying one mark.

Note 2 : Two questions are to be set from each module out of which five questions are to be answered taking at least 1 from each module. All questions carry equal marks.

L-T-P = 3-1-0 **At least 45 hrs/sem**

Module I

Quality-Concept, need ,Objective and benefit, inter-relation between Quality and Productivity,Quality of Design,Quality of Conformance, Quality of Performance, Reliability,Statistical Quality Control,Types and criteria of Inspection, Control charts

Module-2

Evolution of Quality Management, Cost of Quality,Quality Audit,Quality circle (QC),ISO 9000-2000 Standard,its requirement ,Application and benefit,Steps in ISO 9000 Registration .

Total Quality Management(TQM)-Concept,features,need for TQM, cost of TQM,benefit of TQM , Application of TQM in India.Instruments like Kaizen,Kyodo,PDCA Cycle,7QC tools and ,5s Concept

Module-3

Product Quality designing--Quality Function Deployment (QFD),Value Analysis and Value Engineering,Failure Mode And Effect Analysis (FMEA),Fault tree Analysis.

Control of Process Quality--Quality Assurance,Statistical Process Control.,Zero defect programme,Total Productive Maintenance (TPM),Six sigma, Flexible manufacturing Systems (FMS)

Module-4

Total Quality in Service Sector, Quality Models—TQM model, CII Model ,Malcolm Baldridge Model
Benchmarking—Meaning,need,type and process
Re-engineering—Meaning,need, Process for Re-designing

Reference books:

1.Evan,J.R: Total Quality Management ,Excel Book
2.Mitra,K & S.K.Ghose :Total Quality Management ,OPH
3. Hansan,B.L. & P.M.Ghare :Quality Control & Application ,PH1
4. Mohanty & Lakhe :Hand book of TQM ,Jaico
5. Juran ,J.M.& frank M Gryna :Quality Planning &Analysis,TMH