Biotechnology Syllabus (Old)

West Bengal University of Technology
B. Tech. in Biotechnology

Semester III

Code	Course Title	Contact Hrs./ Wk	Credit
A	**Theory**	**L-T-P**	
BT-301	Cell Biology & Bio-Chemistry	3-1-0	4
BT-302	Process Calculations, Thermodynamics & Bio-Chemical Reaction Engg.	3-1-0	4
BT-303	Microbiology	3-1-0	4
BT-304	Structural Chemistry of Bio-molecules	3-1-0	4
M-315	Mathematics III	3-1-0	4
		15-5-0	**20**
B	**Practical**		
BT-391	Bio-Chemistry Lab	0-0-6	4
BT-392	Microbiology Lab	0-0-6	4
		0-0-12	**8**
	Semester Total	**15-5-12**	**28**

B. Tech. in Biotechnology

Semester: IV

Code	Course Title	Contact Hrs./ Wk	Credit
A	**Theory**	**L-T-P**	
BT-401	Genetics	3-1-0	4
BT-402	Industrial Microbiology & Enzyme Technology	3-1-0	4
BT-403	Molecular Biology	3-1-0	4
CHE-414	Unit Operations of Chemical Engg.I	3-1-0	4

Biotechnology Syllabus (Old)

CS-415	Data Structure and Algorithms	3-1-0	4
		15-5-0	**20**
B	**Practical**		
BT-491	Molecular Biology and Fermentation Technology Lab	0-0-6	4
CHE-482	Unit Operations Lab-I	0-0-3	2
CS-483	Data Structure Lab	0-0-3	2
C	**Sessional**		
HU 481	Technical Report Writing & Language Practice Laboratory	0-0-3	2
		0-0-15	**10**
	Semester Total	**15-5-15**	**30**

Semester: V

Code	Course Title	Contact Hrs./ Wk	Credit
A	**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	3-1-0	4
CHE-514	Unit Operations of Chemical Engg.II	3-1-0	4
CS-515	Data Base Management System and Computer Networking	3-1-0	4
	Semester Total	**15-5-0**	**20**
B	**Practical**		
BT-591	Bioinformatics Lab	0-0-3	2
CHE-582	Unit Operations Lab II	0-0-6	4
CS-583	Data Base Management System Lab	0-0-3	2
		0-0-12	**8**
	Semester Total	**15-5-12**	**28**

Biotechnology Syllabus (Old)

B. Tech. in Biotechnology

Semester: VI

Code	Course Title	Contact Hrs./ Wk	Credit
A	**Theory**	**L-T-P**	
BT-601	Plant Biotechnology	3-1-0	4
BT-602	Bio-separation Technology	3-1-0	4
BT-603	Environment, Ecology and Bio-diversity	3-0-0	3
BT-604	rDNA Technology	3-1-0	4
CHE-615	Process Instrumentation and Control	3-1-0	4
		15-4-0	**19**
B	**Practical**		
BT-691	Plant Tissue Culture Lab	0-0-3	2
BT-692	rDNA Technology Lab	0-0-6	4
CHE-683	Process Control Lab	0-0-3	2
		0-0-12	**8**
C	**Seminar**	**0-0-3**	**2**
	Semester Total	**15-4-15**	**29**

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

Semester: VII

Code	Course Title	Contact Hrs./ Wk	Credit

Biotechnology Syllabus (Old)

A	Theory	L-T-P	
BT-701	Animal Cell and Immune Technology	4-0-0	4
BT-702	Food Bio-technology	3-1-0	4
BT-703	Elective-I	3-0-0	3
HU-714	Industrial Economics and Management	4-0-0	4
B	Sessional		
BT-781	**Project Work**	**0-0-12**	**8**
BT-782	**In-Plant Training**	**-**	**3**
BT-783	**Seminar**	**0-0-3**	**2**
	Semester Total	**14-1-15**	**28**

Semester: VIII

Code	Course Title	Contact Hrs./ Wk	Credit
A	**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**
B	Sessional		
BT-886 **BT-887**	**Project Work** **Report and Viva Voce on Project Work**	**0-0-12**	**8** **6**
BT-888	**Comprehensive Viva-Voce**		**8**
	Semester Total	**12-0-12**	**34**

Biotechnology Syllabus (Old)

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 – 30

3rd Semester – 28

4th Semester – 30

5th Semester – 28

6th Semester – 29

7th Semester – 28

8th Semester – 34

Total : 237

West Bengal University of Technology
B. Tech. in Bio-Technology – Detailed Syllabi

Theory

BT-301: Cell Biology & Bio-Chemistry

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 & their cell division. General survey of plant kingdom.

Module II : 10L

Carbohydrate Metabolism: Metabolic pathways for breakdown of carbohydrates glycolytic pathway, pentose phosphate pathway, citric acid cycle, electron transport chain, photo-phosphorylation, gluconeogenesis; control of glycogen metabolism. Photosynthesis. Difference in respiratory mechanisms of aerobes and anaerobes.

Module III: 10L

Protein, Lipid and Nucleic Acid Metabolism: Catabolism of amino acids and nucleotides; biosynthesis of amino acids, lipids and nucleotides and their control; integration of metabolism, protein degradation and turnover; protein targeting; nutrients transport across cell membrane.

Module IV : 10L

Biochemistry of Small Molecules: Physiological function of vitamins, hormones, minerals. Enzyme and Co-enzymes: Their classification; signal transudation and receptor; cellular transport.

Revision : 5L

Books:

1. Lehninger, Nelson & Cox, Principles of Biochemistry, CBS Publishers
2. Modern Experimental Bio Chemistry, Boyer, Pearson Education
3. Biochemistry, Mathews, Pearson Education
4. Elliot, Biochemistry & Molecular Biology, OUP
5. Lubert Stryer, Bio chemistry, Freeman & Co, NY
6. Voet & Voet, Fundamentals of Biochemistry, John Willey & Sons
7. Hames, B.D. (Ed.), Biochemistry, Viva Books

BT-302: Process Calculations, Thermodynamics & Bio-chemical Reaction Engineering

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

Material Balance & Energy Balances: Mathematical requisites -- use of log-log and semi-log graph paper, triangular diagram, graphical differentiation and graphical integration, material balance without chemical reaction, material balance with chemical reaction, energy balance: enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.

Module II : 10L

Basic Concepts: 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.

Vapour/Liquid, Liquid/Liquid, Solid/Liquid and Solid/Vapour Equilibria: 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, K-value Correlations, VLE from Cubic Equations of State, Equilibrium and Stability, Liquid/Liquid Equilibrium, Solid/Liquid Equilibrium, Solid/Vapour Equilibrium

Module III : 10L

Application of Thermodynamics: 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 IV : 10L

Bio-chemical Reaction Engg.: Rate of chemical reaction; 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
Text Books / References :

1. Chemical Process Principles (Part one and two), Hougen, Watson & Ragatz, Asian Student Edition, Asia Publishing House
2. Basic Principles and Calculations in Chemical Engineering, Himmelblau, Prentice Hall (I) 6th Ed.
3. Coulson & Richardson's Chemical Engineering- Volume 3 (Chemical and Biochemical Reactors and process controls) ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd. 1998
4. Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.
5. Smith & Vanness, Thermodynamics for Chemical Engineers, MGH
6. Bailey & Olis, Biochemical Engg. Fudamentals, MGH, 1990

BT-303: 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 : 10L

Basic knowledge of various microorganism: Bacteria, moulds, yeast, algae: their morphology and sub cellular structure including sporulation; archaebacteria and extremophile.

Module II: 10L
Microbial taxonomy and physiology of growth: Different culture techniques, media, pure culture technique, isolation of preservation. Biochemical, serological classification; DNA/RNA based classification.

Module III: 10L
Energy metabolism: Energy transduction mechanism specific to prokaryotes-phosphoketalose; Etner Doudroff and glyoxylate pathways, anaerobic respiration.

Module IV: 10L
Nitrogen and sulfur metabolism.

Revision : 5L

Books:
1.Microbiology, Pelczar, M.J., Jr., Chan, E.C.S., Krieg, N. R., 5th ed.,1996, TMH
2.Microbiology, Hames, B.D. (Ed.), 2nd ed. , Viva Books
3.Microbiology, Tortora, Pearson Education

BT 304: Structural Chemistry of Bio-molecules

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
Chemistry of amino acids, carbohydrate, nucleic acids and lipids. Chemistry of nucleosides and nucleotides.;
Module II: 10L
Primary, secondary and tertiary structure of protein; enzymes as a class of protein, active site and protein folding.
Module III: 10L
Nucleic acid structure and composition: A, B, and Z: forms of DNA.

Module IV: 10L
Macromolecular structure determination: X-ray diffraction, crystallography, spectrophotometry, fluorescence spectrophotometry, NMR spectroscopy, circular dichroism, electron microscopy.

Biotechnology Syllabus (Old)

Revision : 5L

Book:

1. Crothers & Eisenberg, Physical Chemistry: Applications to Life Sciences, Benjamin Cummings, USA

M 315 : Mathematics – III
L-T-P = 3-1-0
At least 45 hrs/sem
Code: M 315
Contact: 3L + IT
Credit: 4
Allotted Hrs.: 48L

Fourier Series:

Introduction; Euler's formula; Problems related to Fourier series; Conditions for Fourier expansion; Functions having points of discontinuity; Change of Interval; Even and Odd function; Half Range series; Typical Waveforms (square, saw-toothed, triangular, half wave rectifier, full wave rectifier) *12L*

Series Solution of Ordinary Differential Equation (ODE); Special Functions:

Introduction, validity of series solution of an ordinary differential equation, general method to solve equation of the type: $P_0y''+P_1y'+P_2y=0$; Problems; Bessel's equation; Properties of Bessel's function; Recurrence formula for Bessel's function of first kind ($J_n(x)$); Equation reducible to Bessel's equation; Legendre's equation, Legendre function, Recurrence formula for Legendre function ($P_n(x)$); Orthogonality relation. *14L*

Partial Differential Equations (PDE) and its Applications:

Introduction, linear and nonlinear PDE of first order; Examples; Homogeneous Linear PDE of 2nd Order with constant coefficients and variable coefficients; Separation of variables, Formulation and solution of wave equation (1D); One Dimensional heat flow equation and solution; Two Dimensional heat flow equation and solution. *12L*

Statistics:

Mean, median; mode; Standard Deviation, Variance, Random Variable; Discrete and Continuous Probability Distributions: Distribution and Density Function, Mathematical Expectation; Standard Probability Distributions: Binomial, Poisson, and Normal; Correlation and Regression; Linear Curve Fitting—Least Square Method. *10L*

Total 48L

Text Books / References:

1. Advanced Engineering Mathematics: E. Kreyszig, Wily, 5th Edn.
2. Higher Engineering Mathematics: B. S. Grewal, 1997
3. Engineering Mathematics, Vol. 1 & 2, Shastri, PHI
4. Fundamental Concepts of Mathematical Statistics: Gupta and Kapoor, S.Chand.
5. Advanced Engineering Mathematics, GreenBerg, Pearson Education
4. Statistical Methods: N.G.Das
6. Elements of partial Differential Equation: Sneddon, MGH

Biotechnology Syllabus (Old)

BT-391: Bio-chemistry 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. Demonstration of isolation of proteins of specific molecular sizes by Ultrafiltration.
6. Demonstration of isolation and purification of enzymes by Reverse Osmosis.
7. Determination of BOD_5 and COD of a sample of waste water.
8. Preparation of cell-free extract : Bacterial cell by sonication, Rat liver by homogenization.
9. Assay of enzyme activity
   (a) Phosphatase assay (Rat liver) (b) Protease assay (Bacterial / fungal cell)
10. Study of an enzymatic reaction (conversion of glucose to alcohol by immobilized yeast cells in poly-acrylamide gel) in a packed bed-flow reactor.

BT-392: 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.
4. Gram staining and identification of microbes through a microscope.
5. Subculturing of a strain using a synthetic liquid media.
6. Study of bacterial growth of E.Coli by a Spectrophotometer.
7. Assay of an antibiotic by zone-inhibition method using antibiotic impregnated discs.
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-Proskraves and Citrate utilization test).

BT-401: Genetics

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.

Module II: 10L
Bacterial Genetics: Transformation, transduction, conjugation, phage cures (recombination)

Module III: 10L
Chromosomal Variations : Numerical – euploidy and aneuploidy : structural – deletion, duplication, inversion and translocation. Hybridization technique and selection; out breeding and heterosis.

Module IV: 10L
Application of Genetics: Genetic materials in population: equilibrium, changes of gene frequency, continuous variation, human genome, genetic disease and gene therapy.

Revision : 5L

Books:

1. Genetics, Winter,P.C., Hickey,G.I. and Fletcher, H.L., Viva Books 2002
2. Klug, Concepts of Genetics, Pearson Education
3. Genes VII, Benjamin Lewin, OUP
4. Genetics a Molecular Approach, 2nd Ed. Brown, T.A., Chapman and Hall, 1992

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BT-402: Industrial Microbiology & Enzyme 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
Microbial Processes: Microbiological processes for production of organic acids; solvents; antibiotics, enzymes, polysaccharides; lipids; pigments and aroma. Large scale production: Stationary, submerged, solid and semi-solid culture.

Module II : 10L

Commercial strain development: Induced mutation, over producing decontrolled mutants, genetically engineered strain.

Module III : 10L

Stability of enzyme: Enzyme stabilization by selection and genetic engineering, protein engineering. Application of enzymes in industry, analytical purpose and medical therapy.

Module IV: 10L
Reaction environment: Reaction environment rebuilding, chemical modification, intramolecular cross linking and immobilization.

Revision : 5L

Books:
1. Industrial Microbiology, Prescot and Dunn,
2. Biochemical Engineering and Biotechnology Handbok, Atkinson, B and Marituna, F., The Nature Press, Macmillan Publ. Ltd.
3. Biochemical Engineering Fundamentals, Bailey & Olis. MGH.

BT-403: Molecular Biology

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
The biochemical basis of inheritance, DNA as the genetic material. The central dogma.
DNA structure and replication in prokaryotes and eukaryotes.

Module II: 10L
Nucleotide sequence composition: unique, middle and highly repetitive DNA; Redundant DNA; Genetic code.

Module III: 10L
Transcription and translation machinery in prokaryotic and eukaryotic system.

Module IV: 10L
Regulation of gene expression in encolioperation concept; hormonal control of gene expression in eukaryotes. Tools of recombinant DNA: restriction endonucleases and other enzymes; vectors; plasmid, bacteriophage and other viral vectors, cosmids, Ti plasmid, yeast artificial chromosome.

Revision : 5L

Books:
1. Molecular Biology, Turner, P.C., McLennan, A.D. Bates & White, M.R.H., 2nd Ed. Viva Books.
2. Elliot, Biochemistry & Molecular Biology, OUP
3. Watson, Molecular Biology of Gene, Pearson Education
4. Cell and Molecular Biology, Rastogi, S.C., New Age International.

CHE 414: Unit Operations of Chemical Engineering-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 equipment. Unsteady state heat transfer, Radiation.

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

Books:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Heat Transfer: D.Q. Kern, MGH
5. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, MGH
6. Foust, A.S., Wenzel, L.A, et.al. Principles of Unit Operations, 2nd edition, JWS
7. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

CS 415: 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

Text book :

1. Aho Alfred V. , Hopperoft John E. , Ullman Jeffrey D. , "Data Structures and algorithms, Pearson Education
2. Berman, Data Structure Via C++, OUP

References :

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

BT491: Molecular Biology and Fermentation Technology Lab

L-T-P = 0-0-6

Protein analysis by SDS-PAGE.
Spectroscopic analysis of DNA/RNA.
Transformation of drug resistance.
Plasmid mediated transformation of any generic marker.
Induced mutation by: (a) Chemical mutagen. (b) Ultraviolet light.
Function of bioreactor.
Sterilization of air and calibration of DO electrode.
Calibration of pH electrode and pH regulation.
Manipulation of DO with air flow and stirrer speed regulation.
Preparation of inoculum and production of ethanol by *S. cerevisiae.*
Analysis of ethanol produced by enzymatic method.
Microbial growth of *S. cerevisiae* and production of ethanol.

CHE 482: Unit Operation 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: 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

HU 481: Report Writing & Technical 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.

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

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

BT: 501 Immunology

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
The origin of immunology : Inherent immunity; humoral and cell mediated immunity. Primary and secondary lymphoid organ : antigen, B cell, T cell and macrophages.

Module II: 10L
Major Histocompatibility complex (MHC) : antigen processing and presentation; synthesis of antibody and secretion,

Module III: 10L
Molecular basis of Immunology: Molecular basis of antibody diversity, polyclonal and monoclonal antibody, complement, antigen-antibody reaction.

Module IV: 10L
Immune response and tolerance: Regulation of immune response, immune tolerance; hyper sensitivity, autoimmunity; graft versus host reaction. Immuno-deficiency and immuno-proliferate diseases.

Revision : 5L

Book:

1. Immunology: Lydyard, P.M., Whelan,A., Fanger, M.W. , 1st Ed., Viva Books
2. Essential Immunology, Roitt, I.M., 9th Ed. (1997), Blackwell Scientific, Oxford, UK
3. Immunology, Kuby, J. 3rd Ed. (1997), Freeman, W.H. ,Oxford

BT-502 Bio-reactor 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.

Module I: 10L
Basic Principles: Recapitulation of the principles of Kinetics for chemical and Bio-chemical Reactions. Fundamentals of homogeneous reactions for batch, plug flow, semi-batch, stirred tank/ mixed reactors., adiabatic and programmed 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, Reactor stability.

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

1. Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.
2. Bailey & Olis, Biochemical Engg. Fudamentals, MGH, 1990
3. Atkinson, B., Biological Reactors, Pion Ltd., London,1974

BT: 503 Bio-informatics

L-T-P = 3-1-0

Module I: 10L **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 Genomic data and Data Organization: Sequence Data Banks – Introduction to sequence date banks – protein sequence data bank. NBFR-PIR, SWISSPROT, Signal peptide data bank, Nucleic acid sequence data bank – GenBank, EMBL nucleotide sequence data bank, AIDS virus sequence data bank. RRNA data bank, structural data banks – protein Data Bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank – Metabolic pathway data : Microbial and Cellular Data Banks.

Module II: 10L
Introduction to MSDN (Microbial Strain Data Network): Numerical Coding Systems of Microbes, Hibridoma Data Bank Structure, Virus Information System Cell line information system; other important Data banks in the area of Biotechnology/life sciences/biodiversity.

Sequence analysis: Analysis Tools for Sequence Data Banks; Pair wise alignment -NEEDLEMAN and Wunsch algorithm, Smith Waterman, BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles.

Module III: 10L
Secondary Structure predictions; prediction algorithms; Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Tertiary Structure predictions; prediction algorithsms; Chao-Fasman algorithm, Hidden-Markov model, Neural Neworking.

Module IV: 10L
Applications in Biotechnology: Protein classifications, Fold libraries, Protein structure prediction: Fold recognition (threading), Protein structure predictions : Comparative modeling (Homology), Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling & Dynamics, Drug Designing.

Revision : 5L

Books:

1. Lesk, Introduction to Bio Informatics, OUP
2. Developing Bioinformatics Computer Skills, Cynthia Gibas and Per Jambeck, 2001 SPD
3. Introduction to Bioinformatics, Atwood, Pearson Education
4. Beginning Perl for Bio-informatics, Tisdall, SPD
5. Biocomputing: Informatics and Genome Project, Smith, D.W., 1994, Academic Press, NY
6. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Baxevanis, A.D., Quellette, B.F.F., John Wiely & Sons.

CHE:514 Unit Operations of Chemical Engineering– 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

Book:

1. Unit Operations of Chemical Engineering: McCabe, Smith & Harriot, TMH, 5th edition
2. Transport Processes & Unit operations: Geankopolis, PHI, 3rd edition
3. Chemical Engineering, Vol-I & II: Coulson & Richardson, Butterworth Heinemann
4. Treybal, R.E., Mass-Transfer Operations, MGH
5. Perry, Chilton & Green, Chemical Engineers' Handbook, MGH

CS 515: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
Books: Text

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Pearson Education.
3. Ramakrishnan: Database Management System , McGraw-Hill
4. Gray Jim and Reuter Address, "Transaction Processing : Concepts and Techniques", Moragan Kauffman Publishers.
5. Jain: Advanced Database Management System CyberTech
6. Date C. J., "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
7. Ullman J. D., "Principles of Database Systems", Galgottia Publication.
8. Feuerstein ; Oracle PL/SQL Programming – 3/edition, Shroff Publishers / O'reilly
9. Tennenbaum, A. S., "Computer Networks"., Pearson Education/PHI
10. Stallings, W., "Data Communication & Computer Network", Pearson Education/PHI

Reference:

1. James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi
2. "Fundamentals of Database Systems", Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
3. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

BT 591: Bio-informatics Lab

L-T-P = 0-0-3

1. DNA sequence analysis using BLAST; sequence pattern, motifs and profiles.
2. Prediction of secondary structure of proteins
3. Prediction of tertiary structure of (fold recognition, homology search)
4. Molecular modeling and dynamics: using small oligonucleofides and small protein with known crystal structure (available from data bank)
5. Drug designing – using available data

Applications of bio informatics – open ended / small project.

CHE 582: Unit Operation Lab – II

L-T-P = 0-0-6

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.

CS 583: 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.

Books:

1. Oracle 9i Complete Reference – Oracle Press.

West Bengal University of Technology
B. Tech. in Bio-Technology – Detailed Syllabi

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 45 hrs/sem

Module I: 10L

Plant tissue culture – theory and methods:
Introduction of plant tissue culture and cell suspension culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement, continuous culture, techniques for immobilization of plant cells, continuous product recovery system using immobilized plant cell system.

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

Module III: 10L
Plant tissue culture – genetic engineering (a):
Structure and organisation of plant genome, regulation of plant genome expression, transcriptional, translational and post transcriptional regulation of plant genome.

- Transposons, chloroplast and mitochondrial genome.

Module IV: 10L
Plant tissue culture – genetic engineering (b):
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 new genetic traits, conferring resistance to herbicide, pesticide, plant pathogens.
Plant engineering towards development of enriched food products,
plant growth regulators

References:

1) Slater, Plant Biotechnology, OUP

2) H.E Street(ed): Tissue culture and Plant science,
Academic press,London, 1974

3) M.K.Sateesh, Biotechnology-5
Animal cell biotechnology
Immune biotechnology
Plant biotechnology
New Age Int Publishers,2003

4) Concepts in Biotechnology
D. Balasubramaniam, Bryce, Dharmalingam, Green, Jayaraman
Univ. Press, 1996

BT – 602: Bio-separation 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.

Module IV: 10L
Industrial Applications
Industrial aspects of separation of bio-molecules, Material balances, mathematical analysis and modelling: Case studies.

References: I

1. Schuler & Kargi, Bio-process Engg. PHI
2. Keith Wilson and John Walker, Practical Biochemistry—Principles and Techniques, Cambridge, 5th Ed.2000
3. Coulson & Richardson's Chemical Engineering – Volume 3 (Chemical and Biochemical Reactors and process controls) ed. Richardson, J.F., Peacock, D.G., First Indian ed. Asian Books Pvt. Ltd. 1998.
4. Bailey & oils, Biochemical Engg. Fundamentals, McGraw-Hill, 1990
5. Geankoplis, C.J. Transport Processes and Unit Operations Prentice Hall of (I) 3rd ed. 1997.
6. Mukhopadhyay, S.N. Process Biotechnology Fundamentals, Viva Books Pvt. Ltd. 2001.
7. Muni & Cheryan, Handbook of Ultrafiltration

References: II

1.Perry, Chilton & Green, Chemical Engineers' Handbook, McGraw-Hill

2. Ho, W.S.W. and K. K. Sirkar, Membrane Handbook, Van Nostrand Reinhold, N.Y. (1992)

BT - 603: Pollution Control, Environmental Biotechnology & Bio-diversity
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
Ecology & Biodiversity
Introductory concepts, The biological world and Ecology: Ecological balance and consequences of change, Biological word and eco-systems; Biochemical Diversity in ecosystem development; Diversity indices; Cellular diversity and the classification of living system – Prokaryotic & Eukaryotic organisms, General physical properties and Tolerance to environmental conditions; Microbial Biodiversity – strategies – bio-prospecting and recovery.

Module II
Air Pollution Control Methods and Equipment
Primary and secondary air pollutants, 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.

Module III: 10L
Wastewater Treatment by Biotechnological Processes
Water pollution; sources and classification of pollutants, B.O.D, C.O.D, D.O, T.D.S, Oil and grease, Metals etc. Standards, sampling and method of analysis, Bacteriological measurements. Overview of treatment principles and theory of aeration, Municipal Sewer and Industrial Wastewater Treatment –Principles, operation and design aspects of: Activated Sludge process, Extended Aeration, Nitrification-denitrification, Trickling Filter, Mechanically aerated lagoons, Concepts of Waste stabilization ponds, Aquatic plant systems, Ranking of waste water treatment processes, common effluent treatment plant.

Module IV: 10L
Environmental Biotechnology: Specialized aspects
Oil pollution – treatment with micro-organisms, Bioremediation—recovery of metals from waste water and sludge, xenobiotics, degradative capabilities of microorganisms with reference to toxicology, pesticides, herbicides, polyaromatic hydrocarbons, .Anaerobic and aerobic composting, Vermiculture, Wetland Management, Membrane based waste water treatment processes – case studies.

Books :

1. Odum, E.P., Fundamentals of Ecology
2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 3rd ed., Tata McGrawhill
3. Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999
4. Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH

BT – 604: rDNA 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
Expression of genes in prokaryotic and eukaryotic systems
Gene structure in prokaryotic and eukaryotic cells.
Gene expression – concept of operon and related elements in the unit, regulatory and structural gene, post translational processing of mRNA, extra chromosomal DNA and its functions.

Module II: 10L
Tools of rDNA technology
Restriction endonuclease and other enzymes, Vectors: bacteriophages, cosmids, Tri plasmids, yeast artificial chromosome and others, DNA labelling radioactive and non-radioactive methods, DNA sequencing, Southern and Northern blotting in situ, DNA fingerprinting

Module III: 10L
Gene transfer technology
cDNA and genomic DNA library, gene isolation and cloning, Polymerase chain reaction and site directed mutagenesis,-Expression of cloned gene in recombinant cells,-Stability of recombinant cells – production of biochemicals – discussion with examples.

Module IV: 10L
Application of rDNA technology
Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

References:

1). D.M. Glover, Genetic Engineering, Cloning DNA, Chapman and Hall, New York, 1980
2) S. Mahesh and A.B. Vedamurthy, Biotechnology-4 (rDNA Technology, Environmental biotechnology, Animal cell culture), New Age International Publisher

Biotechnology Syllabus (Old)

CHE - 615: Instrumentation and Process 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**

Module: 10 L

Introduction

Principles of measurement. Error Analysis, Static and dynamic characteristics of instruments.

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.

Module II: 10 L

Miscellaneous measurement

Measurement of density and specific gravity, humidity, viscosity and composition. Analytical principles involving emission spectrometry, I R, spectroscopy, gas chromatography, Polarography, x-ray and P^H.

Process Instrumentation: Recording, indicating and signaling instruments , Transmission of instrument readings, Instrumentation diagram

Module III: 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, closed loop response.

Principle of automatic control with reference to proportional, integral and derivative modes.

Module IV: 10 L

Stability Concepts: Routh – Hertwitz method, root locus method and Bode diagrams

Controller tuning i) Zigler Nicols method ii) Process reaction curve

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

Text Books / References:

1. Instrumentation, measurement and Analysis – B. C. Nakra & K. K. Chaudhury (TMH)
2. Process system analysis & Control – D. R. Coughanowr MGH.
3. Chemical Process Control – G. Stephanopoulus PHI.

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 lab

1) Isolation of genomic RNA

2) Isolation of plasmid
3) Agarose gel electrophoresis
4) Restriction Digestion DNA/plasmid
5) Isolation of RNA
6) Southern Blotting

CHE – 683
PROCESS INSTRUMENTATION AND 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.

BT – 701: Animal cell and Immune technology
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
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
Technology – Present and future
Hybridoma technology, Organ culture technology, Transfection of animal cells, Future tissue engineering

Module IV: 10L
Immune system
Defence and immunity, Immune response, Dysfunctions of immune system and their modulation, Approaches for correcting immune dysfunction, Vaccinology, Monoclonal antibody technology

References:

1. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (Eds.), Concepts in Biotechnology, University Press, 1996
2. Hood L.E., Weissman I., Wood W.B. and Wilson J.H. Immunology, Benjamin Cummings, 1989
3. Biotol Series – Butterworth and Heineman, Oxford, 1992

Biotechnology Syllabus (Old)

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: 10L
Preservation technology
Spoilage of food, Microbiology of water, meat, milk, vegetables, Technology - canning, dehydration, ultrafiltration, sterilization, irradiation etc.

Module II: 10L
Food Production technology
Single cell protein (yeast, mushroom, Fermentative production of food, Pickling and alcoholic beverages, Genetically manipulated crop.

Module III: 10L
Technology for improved process
Enzyme in bakery and cereal products, Enzymes in fat/oil industries, Protease in cheese making and beverage production, Utilization of food waste for production of valuables.

Module IV: 10L
Food quality and control
Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination.

References:

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

Biotechnology Syllabus (Old)

HU 714: Industrial Economics and Management **L-T-P =3-0-0**

At least 45 hrs/sem

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

Revision: 5L

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.
4. 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

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

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 (Xanthum 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.

Ref. : 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.

References:
1) G. Francis, Modelling and Simulation
2)A. Haerder and J. A. Roels " Application of simple structured l Bioengineering, and P55 in Advances In Biochemical engineering Vol21, A. Fiechts (ed) Spring –Verlag , Berlin, 1982.
3)J.E. Bailey and D.F. Ollis, Biochemical Engg Fundamentals, 1986, McGraw Hill Book Company

BT – 703E

Biosensors and Diagnostics

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 = 3-1-0 **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.

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

BT – 801

Ethics and IPR in Biotechnology

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

Module I:
Juriprudential definition and concept of property , rights, duties and their correlation; History and evaluation of IPR – like patent design and copyright.

Module II:
Distinction among the various forms of IPR, Requirement of a patentable invention like novelty, inventive step and prior art and state of art.

Module III:
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 specificaytion and procedure for patents

a) Obtaining patents
b) Geographical indication
c) WTO,

Detailed information on patenting biologic products: Biodiversity, Budapest treaty.

Module IV:
Applications of Genetic engineering-Safety, social, moral and ethical considerations, Ethics in genetic testing and screening, medical safety, Legal implications and public concerns in Human gene therapy, genetic modifications and food uses.

References:
1) J.E. Smith – Biotechnology, 3rd edition,, 1996 Cambridge Univ. Press.
2) Santaniello, Evenson, Ziberman, Carlson – Agriculture and Intellectual Property Rights, Univ. Press, 1998
3) Thackerey,A (ed) – Private Science : Biotechnology and the Rise of the Molecular sciences, Univ of Pennsylvania Press, Phil, 1998

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

References:

1. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University Press, 1996
2. Epenetos A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London

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

References:
1) H.D. Kumar, Molecular Biology,2nd edition
Vikas Publishing House pvt ltd
2) B.Alberts,D.Bray, J.Lewis et al
Molecular Biology of the Cell
Garland Pub. N.Y 1983
3) Concepts in Biotechnology
D. Balasubramaniam, Bryce, Dharmalingam, Green, Jayaraman
Univ. Press, 1996

BT 803 B:
Human genomics
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
- 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

References:

1) H.D. Kumar, Molecular Biology,2nd edition
Vikas Publishing House pvt lt
2) Singer.M, and Berg.P
– Genes and genomes, Blackwell Scientific Publication, Oxford ,1991
3) Beebe.T, and Burke.T,
Gene Structure and Transcription,
2nd edition,1992, Oxford Univ Press

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.

(Ref (1) J.E. Smith – Biotechnology 3rd ed)

BT 803 E
Bio-fertilizers and Bio-pesticides

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)

References:

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

ID 814 D Biometallurgy

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 pipe lines; microbial degradation of water-based metal working fluids.

References:

1. 1. H.D. Kumar and S. Kumar, Modern Concepts of Microbiology, Vikas
Publishing House, 2nd Edition, 2001
2. M.E. Curtin, Microbial mining and metal recovery biotechnology (1), pp 229-235, 1983
3. Woods D, Rawling D.E., Bacterial bleaching and biomining in marx J.L. (ed), Revolution in biotechnology, Cambridge University Press

ID 814A Information Technology/ Artificial Intelligence

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 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**

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:

Biotechnology Syllabus (Old)

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

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.