UNIVERSITY OF KERALA
BIOTECHNOLOGY
SCHEME OF STUDIES AND EXAMINATION AND SYLLABUS FOR B. TECH DEGREE
III TO VIII SEMESTERS 2003 SCHEME

Semester III

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.301	Engineering mathematics II	3	1	0	50	3	100	4
03.302	Bio-process Calculations	2	2	0	50	3	100	4
03.303	C++ Programming (B,H)	2	2	0	50	3	100	4
03.304	Fluid Flow Operations	3	1	0	50	3	100	4
03.305	Biochemistry - 1	3	1	0	50	3	100	4
03.306	Microbiology	2	1	0	50	3	100	3
03.307	Bio-chemistry Laboratory	0	0	3	50	4	100	3
03.308	Computer Lab	0	0	3	50	3	100	3
	Total	15	8	6	400	--	800	29

Semester IV

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.401	Engineering Mathematics III	3	1	0	50	3	100	4
03.402	Humanities	3	0	0	50	3	100	3
03.403	Bioprocess Technology	3	1	0	50	3	100	4
03.404	Mechanical Operations (B,H)	3	1	0	50	3	100	4
03.405	Biochemistry - ll	3	1	0	50	3	100	4
03.406	Chemical Reaction Engineering (B)	3	1	0	50	3	100	4
03.407	Microbiology laboratory	0	0	3	50	4	100	3
03.408	Instrumental Methods of Analysis Laboratory	0	0	3	50	3	100	3
	Total	18	5	6	400	--	800	29

Semester V

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.501	Engineering mathematics lV	3	1	0	50	3	100	4
03.502	Industrial Management (T,A,B,H)	2	1	0	50	3	100	3
03.503	Bioprocess Engineering	3	1	0	50	3	100	4
03.504	Molecular Biology and genetics (B)	3	1	0	50	3	100	4
03.505	Environmental Biotechnology	3	1	0	50	3	100	4
03.506	Elective – I	3	1	0	50	3	100	4
03.507	Molecular Biology Laboratory	0	0	3	50	4	100	3
03.508	Fluid Mechanics Laboratory	0	0	3	50	3	100	3
	Total	**17**	**6**	**6**	**400**	**--**	**800**	29

Elective – I,

1. Food Biotechnology
2. Analytical Methods in Biotechnology
3. Agricultural Biotechnology

Semester VI

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.601	Chemical Engineering Thermodynamics (B,H)	3	2	0	50	3	100	5
03.602	Mass Transfer Operations – l (B,H)	2	1	0	50	3	100	3
03.603	Heat Transfer Operations (B)	2	2	0	50	3	100	4
03.604	Enzyme Science and Engineering	2	1	0	50	3	100	3
03.605	Computer Programming & Numerical Methods (B,H)	3	1	0	50	3	100	4
03.606	Elective II	3	1	0	50	3	100	4
03.607	Bioprocess Engineering Laboratory	0	0	3	50	4	100	3
03.608	Enzyme Engineering Lab	0	0	3	50	4	100	3
	Total	**15**	**8**	**6**	**400**	**--**	**800**	29

Elective II:
1. Protein Engineering (B,H)
2. Chromatographic separations
3. Drugs and Pharmaceutical Technology

Semester VII

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.701	Transport Phenomena (B,H)	3	2	0	50	3	100	5
03.702	Mass Transfer Operations II (B,H)	3	1	0	50	3	100	4
03.703	Energy Engineering (B)	3	1	0	50	3	100	4
03.704	Downstream Processing	3	1	0	50	3	100	4
03.705	Downstream Processing Laboratory	0	0	3	50	4	100	3
03.706	Elective – lII:	3	1	0	50	3	100	4
03.707	Heat and Mass Transfer Laboratory	0	0	3	50	4	100	3
03.708	Project ,Seminar & industrial Training	0	0	2	50	-	-	2
	Total	**15**	**6**	**8**	**400**	**--**	**700**	29

Elective – lII:
1. Process Plant operations and safety
2. Metabolic Engineering
3. Plant & Animal Cell Technology

Semester VIII

Course No	Name of subject	Weekly load, hours			Max sessional marks	Exam Dur Hrs	Exam max marks	Credits
		L	T	D/P				
03.801	Process Dynamics & Control (B,H)	3	1	0	50	3	100	4
03.802	Bio-informatics	3	1	0	50	3	100	4

03.803	Bio-process Plant Design	3	1	0	50	3	100	4
03.804	Process Instrumentation	2	1	0	50	3	100	3
03.805	Economics and Management of Chemical Industries (B,H)	3	1	0	50	3	100	4
03.806	Elective – lV:	3	1	0	50	3	100	4
03.807	Reaction Engineering and Process Control Lab.	0	0	3	50	4	100	3
03.808	Project/ Viva-Voce/ Industrial Visits	0	0	3	100	-	50	3
	Total	**17**	**6**	**6**	**450**	**--**	**750**	29

Elective – lV:
1. Molecular Modeling and Drug Design.
2. Immunology.
3. Bioethics.

03.301 ENGINEERING MATHEMATICS II 3-1-0 Credits: 4

MODULE 1:Ordinary Differential Equations

Differential equations of the first order and higher degree: Equations solvable for p-Equations solvable for x-Equations solvable for y-Clairut's Equation.

Linear Differential Equations: Higher order with constant coefficients-Method of variation of parameters-Homogeneous linear equations (Cauchy's and Legender's)-
Simultaneous linear equations with constant coefficients.

Orthogonal Trajectories: Cartesian form only.

MODULE 2; Fourier Series And Multiple Integrals

Fourier Series: Dirichlet's conditions-Euler's Formula-Functions with periods 2π and $2l$-Even and odd functions-Half range sine and cosine series.

Multiple Integrals: Evaluation-Change of order of integration-Transformation to polar coordinates-Area as double integral-Volume as triple integral (cartesian coordinates only).

MODULE 3: Vector Calculus

Vector differentiation: Derivative of a vector function-Velocity and acceleration-Scalar and vector fields-Gradient-It's geometrical interpretation-Directional derivative-Divergence and Curl-Their physical meaning-Relations involving ∇ -Solenoidal and irrotational fields-Scalar potentials(simple problems).

Vector Integration: Line integral, surface integral and volume integral-work done by a force-Statement and verification of Green's theorem, Stoke's theorem and Gauss' Divergence theorem-their use in evaluating the integrals.

References:

1.Engineering Mathematics, Vol 2: S.S Sastry, Prentice Hall of India (P) Ltd
2.Higher Engineering Mathematics: B.S.Grewal, Khanna Publishers
3.Engineering Mathematics: Sarveswara Rao Koneru, Universities Press
4.Advanced Engineering Mathematics: Michael D.Greenberg, Pearson Education

Note:

The question paper consists of two parts. Part A (40 marks). Ten compulsory questions of 4 marks each Part B (60 marks). Students must answer one out of two questions from each module. Each question carries 20 marks

03.302 BIO-PROCESS CALCULATIONS 2-2-0 Credits: 4

Module I:

Principles of mass and energy conservation. Thermodynamic properties of pure substances. Equations of state. Correlations for physical and transport properties. Material and energy balances for steady state processes involving single and multiphase systems. Reactive and non-reactive processes.

ModuleII:
Energy flow in biological systems. Energetics of metabolic path ways. Coupled reactions,microbial growth kinetics, Stoichiometry and energetic analysis of cell growth and product formation. Yield and maintenance coefficients. Oxygen consumption and heat evolution in aerobic cultures. Thermodynamic efficiency of growth.

Module III:
Introduction to fermentation,Design of a an industrial fermenter,Process calculations for design of typical industrial fermentation processes. Medium formulation. Batch and continuous heat sterilisation of liquid media. Requirements for process utilities (compressed air, cooling water, steam etc.). Material and energy balances for downstream processing and waste water treatment processe,Bioremediation.

Text Books:

1. D.M. Himmelblau, "Basic Principles and Calculation s in Chemical Engineering", 6th Edn., Prentice Hall India, 1997.
2. Stoichiometry , "Bhatt and Vora".
3. J.A.Rocks, "Kinetics and Energetics in Biotechnology", Elsevier, Amsterdam, 1983.
4. I.H.Segel, "Biochemical Calculations", Wiley, 1976.

Note
Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.303 C++ PROGRAMMING (B,H) 2-2-0 Credits: 4

Module I
Types and declarations: Types - boolean, character, integer, floating point, void, enumerated. Conditional statements and loops. Declarations- structure, multiple names, scopes, initialization, Function declaration, argument passing, value return. Classes - objects, private, public and protected variables. Pointers, arrays, pointer to arrays, constants, reference, pointer to void , new operator, delete operator.

Module II
Function overloading, operator overloading, friend function, derived class (inheritance), polymorphism, virtual function, templates, files and streams. Programming tools, make files, debuggers, revision control systems, exception handling.

Module III
Data structures: Linked (single and double) lists -basic operations, stack -basic operations, binary trees- basic operations. Sorting- bubble sort, shell sort, merge sort, quick sort.

Text Books:

1. B Stroustrup: *C++ Programming Language,* AW, 3rd Edition.
2. AV Aho and JD Ullman: *Data Structures and Algorithms,* AW.

References:
1. Bruce Eckel: *Thinking in C++* , Volume 1 & Volume 2, Pearson Education.
2. Robert Kruse et al: *Data Structures and Program Design in C* , PHI, 2nd Ed.
3. Balaguruswami : *Programming in C ++ ,* Shaum's Series.

Question Paper
The question paper shall consist of two parts. Part I is to cover the entire syllabus, and carries 40 marks. This shall contain 10 compulsory questions of 4 marks each. Part II is to cover 3 modules, and carries 60 marks. There shall be 3 questions from each module (10 marks each) out of which 2 are to be answered.

03.304 FLUID FLOW OPERATIONS (B) 3-1-0 Credits:4

Module 1:
Introduction - Units - Properties and nature of fluids - ideal fluid - real fluid - density - specific weight - specific volume, surface tension, compressibility, capillarity - absolute and gauge pressures.
Fluid statics - forces on fluids, hydrostatic equilibrium - measurement of pressure using manometer - U-tube manometer, differential manometer, inverted manometer, micromanometer, manometers connected in series. Continuous gravity decanter - Centrifugal decanter. Forces on submerged bodies - Buoyancy - stability of floating and submerged bodies.

Module 2:

Introduction to fluid flow - flow of incompressible fluid - classification of flow - steady and unsteady state flow, uniform and non-uniform flow - Three, two and one-directional flow - streamline, streak line, path line, stream tube, velocity potential, laminar flow.

Equations of change for isothermal systems - equation of continuity, equation of motion - Navier-Stoke's equation, Euler equation - Newtonian and non-Newtonian fluids, viscosity, momentum flux, Reynold's experiment, turbulent flow, turbulence, nature of turbulence, flow in boundary layers - boundary layer separation, wake formation- flow through pipe line system - Bernouilli equation' kinetic energy correction factors - correction in Bernouilli equation for fluid friction - Shear stress and velocity distribution in circular channel. The friction factor - Hagen-Poiseuille equation, laminar flow of non-Newtonian fluids - Velocity distribution for turbulent flow. The friction factor chart - commercial pipes and pipe fittings. Friction head loss for changes in velocity, direction and due to pipe fittings.

Module 3:

Transportation and metering of fluids - pipes and pipe standards, tubings. Pipe joints - flange - expansion joints, valves, automatic control valves - material of construction.

Water hammer - Pumps, reciprocating pumps, centrifugal pumps, centrifugal pump theory - selection of centrifugal pumps - various types, head Vs. flow rate - characteristics of centrifugal pumps, priming - cavitation, NPSH - calculations involving pump characteristics - loss of head and power in centrifugal pumps - design of pipeline systems. The displacement and current meters - variable area meter, orifice meter, venturimeter, flow nozzles, rotameter, wiers and notches - Pitot tubes - velocity meters - anemometers, turbine flow meter, current meters, hot wire anemometer, laser dopper anemometry, flow visualization.

Flow past immersed bodies - Drag coefficient - Flow through packed bed - Ergun equation - Kozney-Carman equation - Blake Plummer equation - Design of packed beds - Motion of particles through fluids - Motion from gravitational and centrifugal fields - Terminal settling velocity - Approximate equation - Stoke's law - Intermediate law - Newton's law - Hindered settling

References:

1. McCabe and Smith, "Unit Operations in Chemical Engineering", McGraw-Hill
2. Streeter, "Fluid Mechanics"
3. Christie J. Geankoplis, "Transport Processes and Unit Operations", Prentice Hall of India.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.305 BIOCHEMISTRY- I 3-1-0 Credits: 4

Module I:

General features of cell , organelles and macromolecular assemblies ; Biochemistry of water. Review of acid/base chemistry; importance of buffers in cellular homeostasis and mechanism of pH regulation; Henderson- Hasselbalch equation; Role of carbohydrates, proteins, lipids and nucleic acids in cellular functions. Chemical properties and reactions of carbohydrates, proteins, lipids and nucleic acids

Module II:

Biomolecules structure and function; Carbohydrate – simple sugars and polysaccharides, complex polymers and glycoproteins; Fatty acids structure and chemistry, complex lipids, cholesterol, steroids; amino acids – protein building blocks, structure, nomenclature, polynucleotides – DNA, RNA and their primary and secondary, tertiary structure, chemical synthesis, replication of DNA.

Module III:

Enzymes – concepts of ligand: enzyme binding interaction, classification reactions rates, activation energy; Michaelis-Menten formalisms, inhibition and allostery; Bioenergetics – an interplay of the biomolecules, overview, basic thermodynamics , role of ATP; redox biochemistry.

Reference Books:

1. A.L. Lehninger, D.L. Nelson, M.M. Cox, " Principles of Boichemistry", 3rd Edn., Worth Publishers, 2000.
2. L. Stryer, J.M. Berg, J.L. Tymoezko, "Biochemistry", 5th Edition, W.H. Freeman and Co., 2002.
3. G. Zubay, "Biochemistry", 4th Edn., McGrawhill Publishers, 1999.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module

03.306 MICRIOBIOLOGY 2-1-0 Credits: 3

Moldule I:

Historical and development of microbiology;Microscopy; Microbial taxonomy – DNA homology and numerical taxonomy; Morphology of prokaryotes and eucaryotes (bacteria, Cyano – bacteria, algae, fungi, protozoa and viruses); Microbial nutrition – growth and cultivation of microorganism in different media, growth curve synchronous and asynchronous methods of enumeration of multiplying microorganism

Module II:

Microbial metabolism – energy sources, role of toxic material pathways, important microorganisms; important biomolecules synthesis, inorganic metabolism;factors regulating microbial metabolism;introduction to microbial genetics

Module III:

Infections and immunity;common pathogenic microbes; applied microbiology,microbiological aspects of soil, water, food, milk; sterilization,effect of antibiotics and microorganisms.

Reference Books:

1. M.J. Pelczar, E.C.S. Chase and N.R. Kreigh, "Microbiology", 4th Edition, Tata McGrawhill, India.
2. P.A. Ketchum, "Microbiology", John Wiley and Sons, New York, 1984.
3. K.P. Talaro and A. Talaro "Foundations in Microbiolog", 3rd Edition, WCB – McGrawhill, 1999.
4. Jayaram Panicker and Ananthanarayanan " Text Book of Microbiology" 5th Edition.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.307 BIOCHEMISTRY LABORATORY 0-0-3 Credits: 3

1. units, volume/weight measurements, concentration units, pH measurements, preparation of buffers, sensitivity, specificity, precision and accuracy
2. Qualitative tests for carbohydrates.
3. Quantitative determination of carbohydrates.
4. Estimation of reducing sugars by the (I) Benedicit's method (II) Nelson-Somogyi method.
5. Qualitative tests for amino acids.
6. Quantitative determination of amino acids-Ninhydrin method.
7. Protein estimation- Biuret, Folin's, spectroscopy and Bradford assay.
8. Acid hydrolysis of proteins and estimation of amino acids by ninhydrin OPA, PTH.
9. Extraction of lipids.
10. Saponification of fats.
11. Phospholipids: Ashing and estimation of phosphate.
12. Estimation of cholesterol.
13. Estimation of nucleic acids. Precipitation by sodium sulphate, test for ribose and deoxyribose.
14. Enzyme assays: Phosphatase from potato, amylase from sweet potato, trypsin digestion of proteins.

03.308 COMPUTER LAB 0-0-3 Credits: 3

Familiarisation of commonly used operating systems like DOS. Practising commonly used commands in DOS. Programming exercises in C++ which are covered in course 98.304. Introduction to computer science. Development of application programmes using arrays, strings, stacks, queues and lists.

03.401 ENGINEERING MATHEMATICS III 3- 1 – 0 Credits: 4

MODULE 1: Partial Differential Equations

Formation of P.D.E-Solution by direct integration-solution of Lagrange's linear equations-Nonlinear equations of first order-Types f(p,q)=0,f(z,p,q)=0,f(x,p)=g(y,q)-

Homogeneous P.D.E with constant coefficients-solution by the method of separation of variables.

MODULE 2: Application of partial differential Equations

Derivation of one dimensional wave equation-solution of the wave equation by the method of separation of variables –Boundary value problems involving wave equation-Derivation of one dimensional heat equation-solution by the method of separation of variables-Problems with zero and nonzero boundary conditions-Solution of Laplace equation in two dimensions (cartesian only)-Problems on finite and infinite strips.

MODULE 3: Fourier Transforms and Optimization Techniques

Fourier Transforms: Fourier integral Theorem(no proof)-Fourier sine and cosine integrals-Fourier Transforms-complex form-Sine and cosine Transforms-Inversion Formula-simple problems.

Optimization techniques: Linear Programming Problems-Formulation-Graphical solution-General L.P.P-Slack and Surplus variables-Basic feasible solution-Solution of L.P.P. using Simplex method-Big-M-method-Duality-Dual Simplex method.

References:

1. EngineeringMathematics,Vol.3:V.Sunderam, .Balasubramanian,K.A.Lakshminara-yanan, Vikas Publishing House (P) Ltd.
2. Higher Engineering Mathematics: B.S.Grewal, Khanna Publishers.
3. Advanced Engineering Mathematics: Michael D Greenberg, Pearson Education.
4. Engineering Mathematics,Vol2: S.S.Sastry, Prentice Hall Of India(P)Ltd.
5. Engineering Mathematics: Sarveswara Rao Koneru,Universiries Press.
6. Quantative Techniques: P.C.Tulsian and Vishal Pandey, Pearson Education.

Note:

The question paper consists of two parts. Part A (40 marks). Ten compulsory questions of 4 marks each. Part B (60 marks). Students must answer one out of two questions from each module. Each question carries 20 marks

03.402 Humanities 3-0-0 3 Credits

Part I – Economics (2 Periods per week)

Module I

1. Definition and scope of Economics- Definition of basic terms-Goods-wants and their classifications-wealth-Income –Money- -Near money- Credit money- Utility, features and kinds of utility – National Income and related concepts as GNP, NNP, -Disposable Income Resource Allocation, Technological choice & production possibility curve. Indifference curve analysis- the concept of supply- Supply curves-Cost curves – loss of returns.
2. Basic laws in Economics – Law of Diminishing marginal utility – Demand, Law of Demand and demand curve-The concept of supply- Supply schedule and supply curve**.**

Module II

3. Market structure – Classifications – Pricing under different markets as perfect competition, monopoly and oligopoly. Pricing under monopolistic competition.
4. Inflation – Measures to control inflation – Monetary measures and fiscal measures – Effects of inflation**.**
5. Tax – Classification of Taxes – Direct & Indirect taxes specific and AdValorem taxes – personal income tax – characteristics of a good tax system – Tax evasion.

Module III

6. International Monetary Fund – Issues & Challenges – International liquidity – Special Drawing Rights - India & IMF.
7. Welfare Economics – Old Welfare Economics -Pigou's Analysis – New Welfare Economics Pareto's welfare criterion**.**

Books for Study : Part-I

Dewtt.K.K Modern Economic theory

Books for References:-

1. Prof. G.Narendrababu " Elements of Ecomic Analysis"
2. Sundaran K.P.M " Money, Banking . Trade & Finance "

Part II – Communicative English (1 period per week)

Reading- Skimming-scanning-detailed reading-predicting content-interpreting charts and tables-identifying stylistic features in texts - evaluating texts-understanding discourse coherence-guessing meaning from the context- note making / transferring information.

Word formation with prefixes and suffixes-discourse markers and their functions-degrees of comparison-expressions relating to recommendations and comparisons-active and passive voice-antonyms-tense forms- gerunds-conditional sentences-modal verbs of probability and improbability-acronyms and abbreviations - compound nouns and adjectives-spelling-punctuation.

Sentence definition-static description-comparison and contrast-classification of information-recommendations-highlighting problems and providing solutions-formal and informal letter writing-using flow-charts/diagrams paragraph writing-editing.

Defining, describing objects-describing uses/functions-comparing-offering suggestions-analysing problems and providing solutions-expressing opinions (agreement/ disagreement) –expressing possibility/certainty – framing questions-providing answers.

Text Books: Part II

1. " English for Engineers and Technologists ", Volume I. Authors : Humanities and Social Science Department, Anna University, Published by Orient Longman Ltd., 1990.
2. Sarah Freeman, Written communication in English, Orient Longman, 1977.

References:

1. Narayanaswami, V.R, .Strengthen Your Writing, Orient Longman Ltd., Chennai 1996 (Revised Edition)
2. Pickett and Laster, Technical English, Writing, Reading and Speaking, New York Harper and Row Publications.
3. Swan, Michael, Basic English Usage, Oxford University Press, 1984.
4. Bhatnagar and Bell, Communication in English, Orient Longman, 1979.
5. Pravin.S.R.Bhatia, A.M.Sheikh, Professional Communication skills, S.Chand and Company Ltd., 2003.

University Question

Note: Part I and Part II to be answered in separate answer books.

Part – I Humanities

Part A – 30 Marks (short answers) Covering entire syllabus (3x10=30)

Part B – 40 Marks (50% choice – One out of two or two out of four from each module.)

Part - II Communicative English 30 marks (50 % choice)

03.403 BIOPROCESS TECHNOLOGY 3-1-0 Credits: 4

Module I:

Introduction to industrial bio-process: A historical overview of industrial fermentation processes and products. Role of a bio-process engineer in the biotechnology industry. Outline of the various unit operations involved in an integrated bio-process. Process flowsheeting. A brief survey of organisms, processes products and market economics relating to modern industrial bio-technology.

Raw materials for fermentation process: Isolation, preservation and improvement of industrial micro-organisms for overproduction of primary and secondary metabolites. Medium requirements for fermentation process carbon, nitrogen, minerals, vitamins and other nutrients. Examples of simple and complex media.

Production of primary metabolites: A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, itaconic acid, lactic acid, acetic acid, gluconic acid etc.), amino acids (glutamic acid, lysine, aspartic acid, phenylalanine etc.) and alcohols (ethanol 2.3, butanediol etc.)

Module II:

Production of secondary metabolites: Study of production processes for various classes of low molecular weight secondary metabolites. Antibiotics-beta-lactams (penicillins, cephalosporins etc.), aminoglycosides (streptomycin, kanamycin etc.), macrolides (erythromycin), quinines, aromatics etc. Vitamins and steroids.

Production of commercially important enzymes and recombinant proteins: Proteases, amylases, lipases, cellulases, pectinases, isomerases and other commercially important enzymes for the food and pharmaceutical industries. Production of recombinant poteins having therapeutic and diagnostic applications. Production of vaccines.

Module III:

Speciality bioproducts for agricultural, food and pharmaceutical industries: Biopesticides, biofertilizersw and plant growth factors. Natural biopreservatives (nisin), biopolymers (xanthan gum pi single cell protein.

Enzymatic bioconversion processes: Production of synthetic penicillins and cephalos racemically pure drug intermediates. Steroid bioconversion. High-fructose corn syrp. Bioconversion of vegetable
Biological waste treatment processes: Objectives of biological waste treatment processes. A brief overview of various aerobic and anaerobic processes for removal of organic waste.

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.404 MECHANICAL OPERATIONS (BH) 3-1-0

Module 1

Particle size analysis - mean diameter, shape factors, derived diameter. Seiving - cumulative method and differential method of size analyses. Subseive size analysis - microscopic counting. Pipette analysis, hydrometer analysis, Photo sedimentation - sedimentation balance, sedimentation and decantation - ICI sedimentation - Elutriation.
Size reduction - equipments used for primary and secondary stage size reductions - Jaw crusher - Gyratory crusher - Roll crusher - Hammer mill - Ball mill - Rod mill - Disk attrition mills - cutters - Fluid energy mills. Laws of size reduction, Selection of equipments.
Screening - Industrial screens - Capacity of screens, effectiveness of screens - type of screening mechanisms. Closed circuit and open circuit grinding. Wet and dry grinding.

Module 2

Classification - Principles of free and hindered settling - Sizing and sorting. Classifiers - Hydraulic classifiers - Rake classifier - Bowl classifier - Pneumatic classifier - Hydroclones. Thickeners - Kynch theory - interpretation of batch sedimentation test. Design of continuous thickeners.
Filtration - applications - constant rate and constant pressure filtration - batch and continuous filtration - sand filter - chamber press - plate and frame filter press - leaf filter - rotary drum filter - Theory of filtration - incompressible cake - cake porosity - filter aids - methods of application - - Optimum time cycles.
Centrifugal methods of separation - centrifugal filtration - batch, semi and continuous types of centrifuges - centrifuges for liquid-liquid and liquid-solid separation - critical speed.

Module 3

Mineral beneficiation - Sorting, assay, recovery, liberation, locked particles, classification as a means of concentration - Heavy media separation - Jigging - Wilfly table - froth flotation - magnetic separation - high voltage separation.
Gas cleaning methods: Bag filters, cyclone separation, electrostatic separation, scrubbing
Storage and transportation of bulk solids - Methods of storage - different methods of transportation - type of conveyors and selection.

References:

1) McCabe and Smith, " Unit Operations in Chemical Engineering" 5th Edn. McGraw Hill
2) Badger and Banchero, "Introduction to Chemical Engineering" McGraw Hill.
3) Brown T. G et al., "Unit Operations", Asia publishing House
4) Wills B.A., "Mineral Processing Technology", 4th Ed., Pergamon Press.
5) Allen T, " Particle Size Measurement" Chapman and Hall, London, 1977.
6) Foust, "Principles of Unit Operations", McGraw Hill.
7) Gaudin A. M. "Principles Mineral Dressing ", McGraw Hill
8) Coulson and Richardson, "Chemical Engineering", Vol 2, Pergamon Press.
9) Perry and Chilton, Eds, "Chemical Engineer's Hand Book", McGraw Hill

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsary ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from eacch module.

03.405 BIOCHEMISTRY-II 3-1-0

Module I:

Overview of metabolism. Cellular energy requirement for vital functions, energy conversations, photosynthesis and ATP, the food chain, energy content of food materials, vitamins and cofactors. Analysis, design and techniques used in study of metabolism DNA to proteins.

Module II:

Mechanism involved in DNA replication and transcription, RNA processing, transnational events in protein synthesis; Glycolysis and TCA cycle- glycolysis reactions. TCA cycle and the glyoxylate cycle, mitochondrial shuttles.

Bioenergetics. Oxidation–reduction concepts, free energy and high energy molecules, thermodynamic considerations. Electron transport chain, chemiosmotic coupling, mitochondial metabolism. Photosynthesis. Comparison to oxidative phosphorylation, photophosphorylation, Calvin Cycle.

Module III:

Glyconeogenesis – urea cycle, amino acid degradative pathways, biosynthetic pathway of amino acids in microorganisms. Fatty acids metabolism – β- oxidation pathway, ketone bodies , biosynthesis of fatty acids. Control of metabolism – biosynthetic and catabolic perspectives. Control of level of glucose in blood, hormonal integration of metabolism, signal transduction cascades – an introduction, regulatory mechanisms, genetic disorders of metabolism.

Text books and reference books:

1. A.L. Lehninger, D.L. Nelson, M.M. Cox, "Principles of Biochemistry", 3rd Edn., Worth Publishers, 2000
2. L. Stryer, J.M. Berg, J.L. Tymoczko, " Biochemistry", 5th Edn., W.H. Freeman and Co., 2002
3. G. Zubay, " Biochemistry", 4th Edition, McGraw Hill Publishers, 1999.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.406 CHEMICAL REACTION ENGINEERING (B) 3-1-0

Module I

Basic concepts of chemical kinetics. Types of reactions - examples to be given. Single reactions: reversible and irreversible, simultaneous or parallel or consecutive or series. Homogeneous catalytic reactions - heterogeneous non-catalytic reactions, heterogeneous elementary reactions, rate equations, rate constant, first order, second order and third order reaction units, concentration dependency, molecularity and order, equilibrium, kinetic models, temperature dependency, Arhenius law, collision theory, transition state theory, comparisons and predictions, rate equations for simple irreversible reactions at constant volume and temperature. examples.

Non-elementary homogeneous reactions:

Active intermediates, pseudo steady state hypothesis(PSSH), searching for a mechanism, General considerations, hydrogen bromide reactions, polymerisation - steps in free radical polymerisation, developing the rate laws for the net rate of reactions, Enzymatic reactions fundamentals. definitions and mechanisms, Michaelis - Menten Equation.

Analysis of rate equations - irreversible unimolecular type first order reactions - irreversible bimolecular type second order reactions, irreversible trimolecular third order reactions, zero order reactions, reversible first order reactions, reversible second order reactions, autocatalytic reactions.

Collection and analysis of rate data.

Batch reactor data: differential method of rate analysis, integral method, method of half lives, method of initial rate, least square analysis, linearisation of rate laws, nonlinear least squares, weighted least square analysis.

Module II:

Differential reactors: Evaluation of laboratory reactions, Integral (fixed bed) reactor, stirred batch reactor, stirred contained solid reactor (SCSR), Continuous stirred tank reactor (CSTR), Laminar flow reactor, stirred through transport reactor, recirculating transport reactor.

Applications to parallel and series reactions, thermodynamic restrictions.

Ideal reactors, concept of ideality, design equations for batch, tubular and stirred tank reactors. Space time and space velocity, steady state mixed flow, plug flow and laminar flow reactors. Multiple reactor systems, Plug flow reactor in series and parallel, equal sized mixed reactors in series, mixed flow reactors of different sizes in series, determination of the best system for a given conversion. advantages and limitations of series combinations.

Module III:

Recycle reactors, recycle ratio for auto catalytic reactions, optimum recycle ratio for plug flow and mixed flow for an autocatalytic reaction.

Design of multiple reactors: Reactors in parallel, contacting patterns, for reactions in parallel, quantitative treatment of product distribution and of reactor size, best operating conditions for parallel and series reactions, kinetics of series parallel reaction.

Non isothermal reactor design - Temperature and pressure effects - single reactions : Heat of reaction from thermodynamic, heat of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, adiabatic temperature and equilibrium, general graphical design procedure, optimum temperature progression.

Heat effects: adiabatic operations and no adiabatic operations, Non-isothermal continuous flow, reactors at steady state, application to the CSTR, adiabatic tubular and batch reactor, steady state tubular reactor with heat exchange. Product distributions and temperature for multiple reactions.

Note

Question Papers consist of two Parts. Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module

03.407 MICROBIOLOGY LABORATORY 0-0-3

1. Sterilization techniques
2. Preparation of culture media (a) broth type of media (b) Agar.
3. Culturing of microorganism – (a) broth, (b) pure culture techniques- streak plate, pour plate, isolation and preservation of bacterial culture.
4. Identification of microorganisms- (a) Staining techniques, (b) hanging drop, (c) biochemical testing (d) Antibiotic sensitivity.
5. Quantitation of microorganisms – (a) counting microscopy (b) nephelometry/ Turbidimetry (c) Total N or dry weight.
6. Environmental sample analysis.
7. Food microbiology of (a) milk (b) fermented food (c) salmonella in poultry.
8. Clinical microbiology: Normal mouth flora.

03.408 INSTRUMENTAL METHODS OF ANALYSIS LABORATORY 0-0-3

Objective

To familiarise with the principle, design and application of analytical instruments and to train them in the analysis and presentation of the experimental data. For this there can be a few tutorial sessions on the principles and design of sophisticated analytical instruments and a few experiments to be done by the students and a few demonstration depending on the availability of the sophisticated analytical instruments.

These may include the following:

1. Precision and validity of an experiment- Tutorial session.
2. Analysis and presentation of data (Tables, Graphs, Histogram, pi diagram) – Tutorial &Assignment.
3. Beer-Lamberts law – Tutorial & Experimental – U V-Vis Spectrophotometer.
    a. Change in absorbance with concentration of Potassiumdichromate
    b. Absorption maxima – change in absorbance in Potassiumdichromate with wavelength
    c. Concentration of two components in a binary mixture- Absorption of light by Potassiumdichromate and potassiumpermanganate
    d. Change in absorbance of albumin and DNA solution with wavelength
    e. Determination of molar extinction coefficient of Aminoacids-Tyrosine, Tryptophan, Histidine.
    f. Kinetics of Enzyme activity- Amylase, Phenol oxidase, Carboxydase.
4. Flame photometry-Determination of Na & K.
5. pH meter
    a. Measurement of pH
    b. Titration curves for strong acids and strong bases
    c. Titration curves for Aminoacids
    d. Titration curves for weak acids
    e. Titration curves for weak bases
    f. Preparation of buffer solutions
    g. Composition of buffer solutions as a function of pH
6. Conductivity meter
    a. Measurement of conductivity
    b. Conductometric titrations

7 . Viscometer – Measurement of viscosity of fluids
8. Refractometer – Measurement of refractive index
9. Polarimeter
    a. Inversion of cane sugar
    b. Measurement of optical activity
    c. Determination of optical purity
10. Orsat analyser – Analysis of flue gases.
11. Densitometry and image analysis
12. Determination of molecular weight of macro molecules by
    a. Molecular Exclusion Chromatography
    b. SDS PAGE
13. Ion sensitive electrode- Measurement of cyanide, chloride etc.
14. Oxygraph- Measurement of Gas volume.

Principle design and applications of the following

TGA & DSC

15. PCR analyzer
16. SEM
17. FTIR Spectroscopy – IR spectra of hydrocarbons, aminoacids, carbohydrates
18. Atomic Absorption Spectrometry – Measurement of trace elements
19. Mass Spectrometry
20. NMR
21. HPLC
22. X ray diffractometer

Any 10 experiments to be done depending on the availability of instruments. Visits to research institutions and industries for demonstration of the various analytical instruments to be arranged.

03.501 ENGINEERING MATHEMATICS 1V 3-1-0

MODULE 1: Complex Analysis-Differentiation

Differentiation of functions of complex variable-Analytic functions-Cauchy-Riemann Equations(cartesian only)-Harmonic function-Orthogonal system-velocity potential

Conformal mapping-Mapping by $w=1/z, w=z^2, w=e^z, w=z+1/z, w=\sin z, w=\cos z$.

Bilenear Transformation-fixed points-Problems to find the transformation when three points and their images are given.

MODULE 2: Complex Analysis-Integration

Line integrals-simple problems-Statements of Cauchy's integral theorem,Cauchy's integral formula-Formula for higher derivatives-Evaluation of integrals using the above results.

Taylor series and Laurent's series(no proof)-simple problems.

Singularities-Residues-Cauchy's Residue theorem(no proof)-problems.

Evaluation of real definite integrals of the following types:

$\int_0^{2\pi} f(\sin\theta,\cos\theta)d\theta$, $\int_0^{\infty}[f(x)/F(x)]dx$, $\int_0^{\infty}[\sin mx/f(x)]dx$, $\int_0^{\infty}[\cos mx/f(x)]dx$

MODULE 3: Probability and statistics

Random variable-continuous and discrete distribution-mean and variance-

Binomial distribution-mean and variance-fitting a Binomial distribution-Problems.

Poisson distribution-Poisson distribution as a limiting case of the Binomial distribution-mean and variance-Problems.

Normal distribution-Properties-Problems

Curve fitting-Fitting of a straight line and a second degree parabola,by the method of least squares.

Testing of Hypothesis-Types of errors-Null hypothesis-level of significance-Confidence limits-Large sample tests-testing of proportion of attributes-confidence limits for unknown mean-test of significance for means of two large samples-Use of Student's t distribution for small sample tests-Significance test of a sample mean-Significance test of difference between sample means.

References:

1.Higher Engineering Mathematics:B.S.Grewal,Khanna Publishers

2.Engineering Mathematics,Vol.2:S.S.Sastry,Prentice Hall of India(P)Ltd.
3.Complex Variables Theory And Applications:H.S.Kasana,Prentice Hall of India(P)Ltd
4.Advanced Engineering Mathematics:Michael D Greenberg,Pearson Education
5.Probability and Statistics for engineers ;Miller & Freund ,Pearson Education

Note:

The question paper consists of two parts. Part A (40 marks). Ten compulsory questions of 4 marks each. Part B (60 marks). Students must answer one out of two questions from each module. Each question carries 20 marks.

03.502 INDUSTRIAL MANAGEMENT (T,A,B,H) 2-1-0

Module I

Evolution of Scientific Management and Industrial Engineering. Functions of Management - Brief description of each function. System concept.

Types of Organisation structures such as line, staff, functional, project and matrix organisations.

Types of companies and their formation.

Personal Management - Objectives and functions - Recruitment, Selection, Training and Induction concepts and Techniques.

Accounting and financial Management - Principles of double entry-Preparation of Financial statements

Budget and budgetary control-Profit-Volume analysis.

Module II

Facilities Planning - Factors to be considered in site selection, layout planning, plant layout, Systematic layout planning, computerized layout planning techniques.

Introduction to Material Handling Principles.

Work study-Methods study and Time Measurement, Steps in methods improvement-Use of chart and diagrams.

Performance rating and Methods - Types of Allowances, computation of basic time and Standard time - Examples.

Wages and Incentives-System of Wage Incentive Plans, Job evaluation and Merit rating.

Module III

Industrial relations- Fatigue and methods of eliminating fatigue.

Industrial disputes-Settlement Machinery-collective bargaining-Trade unions-Workers participation in Industries in Indian context.

Labour welfare and social security-Industrial safety-Methods and Techniques.

Production Planning and Control-Functions and Objectives-job, batch, mass and continuous production-Economic lot size, Routing, Scheduling, Dispatching and Follow up. Materials Management – Importance, Inventory, Types of systems, selective inventory control techniques.

Quality Engineering-Quality control-Quality Vs. Cost concept, Control chart for variables and attributes-Introduction to ISO-9000 series(2000 version), ISO 14000 (2000 version) and Total Quality Management, Quality Information systems, Bench marking and Documentation.

Introduction to Marketing and its Environment - Marketing concept, Marketing mix.

References:

1. M. A. Sahaf : *Management Accounting Principles & Practices,* Vikas Publications Pvt. Ltd.
2. Grant and Levenworth : *Statistical Quality Control* , TMH
3. Krafewski: *Operations Management,* Pearson Education 6th Edn.
4. Introduction to Work Study – ILO
5. Besterfield : *Total Quality Management,* Pearson Education.
6. Richard L Francis & John A White: *Facility Layout & Location,* Prentice Hall
7. Kotler: *Marketing Management,* Pearson Education.
8. Roger G Schroedu: *Operations Management,* Mc Graw Hill.
9. Monappa : *Industrial Relations,* TMH
10. Stephen P Robbins, David A Decenyo: *Fundamentals of Management,* Pearson Education.

Question Paper

The question paper shall consist of two parts. Part I is to cover the entire syllabus, and carries 40 marks. This shall contain 10 compulsory questions of 4 marks each. Part II is to cover 3 modules, and carries 60 marks. There shall be 3 questions from each module (10 marks each) out of which 2 are to be answered.

03.503 BIOPROCESS ENGINEERING 3-1-0

Module I:

Design and analysis of bioreactors: Modelling of non-ideal behaviour in bioreactors. Tanks-in-series and dispersion models. Applications to design of continuous sterilisers. Design and operation of novel bio-reactors. Air-lift loop reactors. Fluidised-bed bioreactors. Stability analysis of bioreactors.

Bioreactor scale-up: Regime analysis of bioreactor processes. Correlations for oxygen transfer. Scale-up criteria for bioreactors based on oxygen transfer and power consumption.

Module II:

Monitoring of bioprocesses: On-line data analysis for measurement of important physico-chemcal and biochemical parameters. Methods of on-line and off-line bio-mass estimation. Microbial calorimetry. Flow injection analysis for measurement of substrates, products and other metabolites. State and parameter estimation techniques for biochemical processes. Computer based data acquisition, monitoring and control-LABVIEW software.

Module III:

Modern biotechnological processes: Recombinant cell culture processes. Guidelines for chosing host vector systems, plasmid stability in recombinant cell culture, limits to over expression. Modelling of recombinant bacterial cultures. Bioreactor strategies for maximising product formation. Bioprocess design consideration s for plant and animal cell cultures.

Modelling and simulation of bioprocesses: Study of structured models for analysis of various bioprocesses. Model simulation using MATLAB-SIMULINK and ISIM software packages.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.504 MOLECULAR BIOLOGY AND GENETICS 3-1-0

Module I:

PROKARYOTES:

1. Structure of DNA, different forms of DNA and RNA, secondary structure in single stranded nucleic acids.
2. Replication
3. Transcription
4. Translation, codon usage, inhibitors of transcription and translation
5. Mutation
6. Gene regulation, operon concept gal, lac, trp.

Module II:

1. Organization of genome, interaction with histones.
2. Transcription: Exon, intron concepts, transcription initiation factors and characteristics motifs in these factors, promoters and enhancers.
3. RNA splicing
4. Retroviruses, retroposons and oncogenes.

Module III:

1. Classical genetics Mendelian Laws, monohybrid and dihybrid inheritance
2. Chromosome structure and organization in prokaryotes and eukaryotes
3. Multiple alletes and blood group antigens
4. Sex chromosomes and sex linked inherited disorders
5. Linkage, crossing over and genetic mapping of chromosomes
6. Identification of the genetic material classical experiments, Hershey Chase, Avery McLeod etc.
7. Genetic transfer: Conjugation, transduction and transforation.

References:

1. Benjamin Lewin, “Genes V”, Oxford University Press, Oxford, New York, 1994.
2. Freifelder D., “Molecular Biology”, Jones and Bartlett Publishers Inc., 1987
3. Goodenough U., “Genetics”, Hold Saunders International, 1985.
4. Gardner E.J., Simmons M.J., Slustad D.P., “Principles ofGenetics”, 1991

03.505 ENVIRONMENTAL BIOTECHNOLOGY 3-1-0

Module I:

Fundamentals of micro-organisms: Microbial flora of soil, growth, ecological adaptations, interactions among soil micro-organisms, bio-geochemical role of soil microorganisms.

Degradation of xenobiotic compounds: Simple aromatics, chlorinated polyaromatic petroleum products, pesticides and surfactants.

Module II:

Industrial Waste Water Management: Waste water characteristics, biological waste water treatment, unit operations, design and modelling of activated sludge process, mathematical modelling of anaerobic-digested dynamics.

Module III:

Treatment of Industrial Wastes: Dairy, pulp, dye, leather and pharmaceuticals, solid waste management.

Molecular biology: Latest elements, developments pertaining to environmental biotechnology.

Reference:

1. Stanir R.Y., Ingraham J.L., Wheelis M.L., Painter R.R., "General Microbiology", McMillan Publications, 1989.
2. Foster C.F., John Ware D.A., "Environmental Biotechnology", Ellis Horwood Ltd., 1987.
3. Karnely D., Chakrabarthy K.,Omen G.S., "Biotechnology and Biodegradation", Advances in Applied Biotechnology Series, Vol. 4, Gulf Publications Co., London, 1989.

Note

Question papers consists of two parts. Part A (40 marks) Compulsory ten short questions (10 x 4). Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.506 Elective I: 1. FOOD BIOTECHNOLOGY 3-1-0

Module I:

1. **Introduction to food processing;** Biotechnology in relation to the food industry, nutritive value of food, types of microorganisms associated with food, its sources, types and behavior in foods, recent trends in food biotechnology.

2. **Food Preservation;** Bioprocessing of meat, fisheries vegetables, diary product, enzymes and chemicals used in food processing, biochemical engineering for flavour and food production.

Module II:

3. **Fermented food products;** Dairy product, meat, Fishery, non beverage plant product beverages and related products of baking.

Module III:

4. **Food spoilage;** Food borne illness, quality control, case studies on biotechnology in the evolution of food quality, HFCS (High Fructose Corn Syrup) and mycoproteins

5. **Food Microbiology;** Utilization of microorganisms in food industries , genetic manipulations, food borne illness

Reference:

1. Lidsay, willis Biotechnology, Challenges for the flavour and food industries, Elsevier Applied Science, 1988.
2. Roger A., Gordan B., and John T., Food Biotechnology, 1989.
3. George j. B., Basic Food Microbiology, CBS Publishers & Distributors, 1987.
4. James M. J., Modern Food Microbiology, CBS Publishers & Publishers, 1987.
5. Freiser " Food Microbiology"

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.506 Elective I: 2. ANALYTICAL METHODS IN BIOTECHNOLOGY 3-1-0

Module I:

1. **Microscopy:** Microscopic identification of various microorganisms; phase contrast and

confocal microscopy; SEM-TEM microscopy.

2. **Methods of biochemical analysis:** Glucose, sugars, carbohydrates, lipids, proteins and nucleotides; enzymatic assays of various metabolites.

Module II:

3. **Electrophoretic Techniques:** Electrophoresis of proteins and nucleic acids; ID & 2D Gels; pulsed field electrophoresis; capillary electrophoresis; western southern and northern blotting; dot and slot, gel documentation.

4. **Nucleotide and DNA Analysis :** DNA purification, PCR-based analysis; DNA fingerprinting; DNA sequencing.

Module III:

5. **Immuno-Techniques:** Antiserum production, immunofluroscence, immuno histocompatibility ELISA; localization of cells in tissues immunoblotting; monoclonal antibodies. **Analysis of Bioprocesses:** Analysis of biomass; measurement of dry weight and biomass composition; analysis of substrate uptake and product formation rates; measurement of BOD and COD in waste-waters; Gas analysis for O2 and CO2; flow injection analysis, computerized data acquisition of bioprocesses.

References

Readings in Scientific American, W. H. Freeman, 1985-1993

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.506 Elective I: 3. AGRICULTURAL BIOTECHNOLOGY 3-1-0

(Syllabus will be finalized later)

03.507 MOLECULAR BIOLOGY LAB 0-0-3

1. Isolation and visulisation of plasmids on agarose gels.
2. Restriction mapping and ligation.
3. Transformation, screening for recombinants, chemical and transposon mutagenesis.
4. Selection of hyper producers of secondary metabolites.
5. Characterisation of medium components.
6. Characterisation of secondary metabolites by polyacrylamide gel electrophoresis silver staining of protein on gels and HPLC.
7. Purificaton of proteins by chromatographic methods.

References:

1. Freifelder D., “Molecular Biology”, Jones and Bartlett Publishers Inc., 1987

03.508 FLUID MECHANICS LABORATORY 0-0-3

Study of plumbing tools, pipe fittings, taps and valves. Calibration of flow meter for gas and liquid flows. Measurement of flow using notches and weirs. Measurement of flow using orifices and mouth pieces under constant and varying heads. Reynold's experiment. Determination of velocity profile using Pitot tube. Flow through packed beds : estimations of pressure drop. Flow through fluidised beds. Fall of solid bodies and liquid drops through liquids: determination of drag coefficient and verification of Stoke's Law. Characteristics of pumps. Measurement of pressure. Measurement of viscosity, shear stress - shear rate relationships for non-Newtonian fluids. Losses in pipes and fittings : Determination of equivalent length.

03.601 CHEMICAL ENGINEERING THERMODYNAMICS (B,H) 3-2-0

Module 1

Introduction and fundamental concepts of thermodynamic terms. First law of thermodynamics- Work equivalent of heat -classification of energy, thermodynamic state function and path function- Enthalpy and specific heat-

Application of first law to steady state flow processes and reversible process. Entropy and second law of thermodynamics- Limitations of first law, statement of second law, heat reservoirs, heat engines and heat pumps, thermodynamic and ideal gas temperature scale, concept of entropy, entropy and unavailable energy. Concepts of free energy.

Module 2.

The ideal gas, ideal gas law, isobaric, isothermal, adiabatic and polytropic process. P-V-T relations of fluid, equation of state for gases, the principles of corresponding states, compressibility factors, gas mixtures, behaviour of liquids, coefficient of expansion and isothermal compressibility, thermodynamic charts. Thermodynamic properties of fluids- Reference properties, energy properties, derived properties, path properties, Maxwell relations, heat capacity relations, effect of pressure and volume on heat capacities. Thermodynamics of flow process- Flow through pipes, nozzles and compressors. Power and refrigeration cycles-steam power plant cycle, I.C. Engines, air refrigeration cycles, the vapour compression cycles, absorption refrigeration, Choice of refrigerant, liquefaction process.

Module 3

Properties of solutions - Relationship between the thermodynamic properties - systems of variable compositions - basic equations. Excess properties of mixtures - temperature and pressure dependence of Gibb's free energy - partial molar properties - Chemical potential - Gibbs-Duhem equation - fugacities and fugacity coefficients - activity and activity coefficients.

Phase equilibrium: Nature and criteria for equilibrium between different phases, Gibbs phase rule, fugacity as criterion of equilibrium, vapour-liquid equilibrium, completely miscible liquids, phase diagram for miscible systems. Consistency, the coexistence equations, Wohl's equations, Van Lar equations.

Chemical reaction equilibrium: Free energy and chemical reactions, reaction coordinate, criterion for chemical reaction equilibrium, equilibrium constant, standard Gibbs free energy change, evaluation of equilibrium constant and its dependence on temperature, effect of pressure on equilibrium constant. Homogeneous and heterogeneous reactions.

Text Book:

Smith J. M and H. C. Van Ness, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill,

Reference Books:

1. Barnett F. Dodge, " Chemical Engineering Thermodynamics,
2. Abbott and Van Ness, "Schaums Outline of Theory and Problems of Thermodynamics"
3. Weber H. C and Meissner H. P, "Thermodynamics for Chemical Engineers"

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.602 MASS TRANSFER OPERATIONS I (BH) 2-1-0

MODULE 1

Diffusional mass transfer, molecular diffusion in fluids, definition of mass transfer coefficients theories of diffusion in turbulent flow, mass, heat and momentum transfer analogies. Interface mass transfer, diffusion in solids. Equipment for gas-liquid operations, tray towers, ventury scrubbers, wetted wall towers, spray towers and spray chambers, baffle towers and packed columns.

Gas absorption : Absorption conditions of equilibrium between liquid and gas, the mechanism of absorption and desorption between phases, interphase mass transfer, liquid and gas side resistance. Design of absorbers - Liquid phase hold up - Pressure drop - Loading, flooding in packed towers. Absorption of one component, overall coefficients, dilute solution. Non-isothermal operations. Multicomponent absorption : Absorption with chemical reaction.

MODULE 2

Humidification : General theory, definition of absolute humidity humid volume, humid-heat total enthalpy, adiabatic saturation temperature, wet-bulb temperature and psychrometric chart Enthalpy calculations involved in the following operations : Adiabatic humidification and dehumidification processes, cooling towers and related equipments, Evaluation of heat and mass transfer coefficients, cooling towers, types of cooling equipments.

MODULE 3

Drying : Equilibrium between a wet solid and drying air. Batch drying equipment, rate of drying curve, time of drying continous drying equipments, calculation of rate drying.

Crystallisation : Factors governing nucleation and crystal growth rates, growth and properties of crystals, saturation, nucleation crystallisation rate and growth kinetics. Effect of impurities on crystal formation, effect of temperature on solubility, fractional crystallisation, caking of crystals, crystallisers batch crystallisers, tank crystallisers, evaporators. Use of vaccum continuous crystallisers, controlled growth of crystals, classification of equipments and typical crystallisers. Controlled growth of crystals. Principles of design of crystallisers. MSMPR crystallisers.

TEXT BOOK

1. Treybal R.E. "Mass Transfer Operations" 3rd Edn. MGK (1980)

REFERENCES

1. Coulson J.M. and Richardson J.F. 'Chemical Engineering' Vol.I, Eb.3.
2. McCabe W.L. and Smith J.C. 'Unit Operations of Chemical Engineering' Ed. 3, (MGK - 1976)
3. Caulson J.M. and Richardson J.F., 'Chemical Engineering' Vol 2., Unit Operations, Edn. 3., Permom Press (1978)
4. Philip C. Wankat, Equilibrium Stage Separations, Prentice Hall, 1989.

Note: Question Papers consist of two Parts. Part A (40 marks) Compulsory ten short questions (10 x 4). Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.603 HEAT TRANSFER OPERATIONS 2-2-0

Module 1:

Conduction: Introduction to conduction, conservation of energy for a control volume - conduction rate equation - general heat diffusion equation - Poisson's equation - Laplace equation - boundary and initial conditions - thermal conductivity of solids, liquids and gases. One dimensional steady state conduction - Temperature distribution and heat flux in plane wall, in radial systems (cylinders and spheres). Conduction with thermal energy generation in plane wall and in radial systems. Temperature distribution in composite walls - analogy between heat and electrical flow, contact resistance.

Convection boundary layer - Velocity and thermal boundary layer, film concept, individual and overall heat transfer coefficient, LMTD and its correction factor. Natural and forced convection: dimensional analysis - Rayleigh method, Buckingham π theorem, empirical correlations for natural and forced convection in various geometries and flow conditions. Critical and optimum thickness of insulation. Boundary layer analogies: Analogy between heat and momentum transfer, Prandtl analogy, Reynold's analogy, Colburn analogy, Von Karman analogy - Merits and limitations of various analogies, heat and mass transfer analogy, evaporative cooling - physical significance of dimensionless parameters

Radiation: Process and properties, fundamental concepts, radiation intensity - definitions, relation to emission, irradiation, . Black body radiation - Laws of radiation - The Plank distribution law, Wien's displacement law, Stefan-Boltzman law, Kirchhoff's law - Band emission, surface emission - terms like absorptivity, reflectivity, transmittivity - Grey surface, environmental radiation.

Radiation exchange between surfaces: The view factor - view factor integral, view factor relations. Black body radiation exchange - Radiation exchange between two infinite parallel grey surfaces in an enclosure. Radiation shields, temperature errors in pyrometry, gases emission and absorption.

Module –II:

Heat exchanger types, the overall heat transfer coefficient, Heat exchanger analysis, use of logmean temperature deference - parallel flow heat exchanger counter flow exchanger, multipass and cross flow heat exchangers, the effectiveness - NTU method - differential effectiveness, NTU relations, methodology of a heat exchanger calculation, Use of Wilson's plot, compact heat exchangers - heat transfer and flow characteristic for specific configurations. Heat transfer from extended surfaces - Different types of fins - General conduction analysis, fins of uniform cross sectional area, fin performance . heat transfer equipments. Double pipe heat exchangers - design calculations and temperatures - Shell and tube heat exchangers - Design of shell and tube heat exchangers without pressure drop considerations.

Module – III:

Boiling and Condensation : - Dimensionless parameters in boiling and condensation. Pool boiling - Boiling curve - modes of pool boiling, pool boiling correlations - Nucleate pool Boiling - correlations - Yamagata et al correlation, Rohsenow correlation. Correlation for critical heat flux for nucleate pool boiling - Zuber correlation. Correlation for minimum heat6 flux - zuber correlation. Correlations for film pool boiling. Parametric effects on pool boiling . Forced convection boiling - Brief over view of external forced convection boiling of internal forced convection boiling. Different types of boilers and their Classification - detailed study of equipments.

Condensation: Physical mechanisms, Laminar film condensation on a vertical plate - detailed analysis by Nusselt - to determine the heat transfer coefficient. Turbulent film condensation. Laminar film condensation on radial systems - condensation on spheres, horizontal tubes and for a vertical tier of horizontal tubes. Drop wise condensation - correlations. Effect of non condensables on condensation.

Evaporation : Various Equipments and their classification, liquid characteristics . Single effect and multiple effect evaporators, Performance of evaporators, capacity and economy of evaporators, factors affecting the performance of evaporators. Overall heat transfer coefficient. Enthalpy balances for single and multiple effect calculators. Effect of liquid head and boiling point elevation. Vapour recompression - Mechanical and thermal recompression. Different feeding arrangement in multiple effect evaporators - merits and demerits.

Reference books:

1. Increpera and Dewit, "Fundamentals of Heat and Mass Transfer", McGraw-Hill
2. M.NJ. Ozizik, 'Heat transfer - a new approach", McGraw-Hill
3. Hollman, "Heat Transfer"
4. McCabe and Smith, "Unit Operations in Chemical Engineering", McGraw-Hill
5. Badger and Banchero, "Unit Operations in Chemical Engineering", McGraw-Hill
6. Karlekar and Desmond, "Heat Transfer", Prentice Hall.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.604 ENZYME SCIENCE AND ENGINEERING 2-1-0

Module I:

APPLICATION OF ENZYMES : Classification of Enzymes; Commercial application of enzymes in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic applications

PURICATION AND CHARACTERISATION OF ENZYME FROM NATURAL SOURCES: Production and Purification of Crude Enzyme extracts from plant, animal and microbial sources-some case studies; methods of characterization of enzyme; development of enzymatic assays.

Module II:

MECHANISMS AND KINETICS OF ENZYME ACTION: Mechanism of Enzyme Action; Concept of active site and energetic of enzyme substrate complex formation; Specifically of enzyme action; Kinetics of single substrate reactions; turnover number; estimation of Michaelis – Menten parameters, multi - substrate reactions- mechanism and kinetics; Types of inhibition – kinetic models; Substrate and Product Inhibition; Allosteric regulation of enzyme; Deactivation kinetics

ENZYME IMMOBILISATION: Physical and Chemical techniques for enzyme immobilisation – adsorption, matrix entrapment, encapsulation, cross linking, covalent binding etc..-examples; advantages and disadvantages of different immobilization techniques, overview of application of immobilized enzyme systems

Module III:

MASS TRANFER EFFECTS IN IMMOBILISED ENZYME SYSTEM: Analysis of Film and Pore Diffusion Effects on Kinetics of immobilized Enzyme Reactions; Formulation of dimensionless group and calculation of Effectiveness Factors

DESIGN OF ENZYME REACTORS FOR BIMCONVERSION PROCES: Design of Immobilized Enzyme Reactors – Packed – bed, Fluidized- bed and Membrane reactors; Bioconversion calculation in free enzyme CSTRs and immobilized enzyme rectors

ENZYME BIOSENSORS: Application of enzyme in analysis; Design of enzyme electrodes and their application as biosensors in industry, health care and environment

03.605 COMPUTER PROGRAMMING AND NUMERICAL METHODS (BH) 3-1-0

Module I

Polynomial interpolation and extrapolation. - Rational function interpolation and extrapolation- Fortran programs to implement the above methods.

Numerical integration: Trapezoidal rule, Simpson's rule Romberg integration, extended trapezoidal rule, and simsons rule. Gaussian quadrature and orthogonal polynomials. Fortran programs for the above methods.

Module II

Solution of linear algebraic equations using iterative methods: Gauss Jordan elimination, Gauss elimination with back substitution, LU decomposition. Cholesky decomposition, QR decomposition, Vendermonde matrices and Toeplitz matrices.

Roots of non-linear sets of equations: Bracketing and bisection, secant method, method of false position, Riders method, Newton- Raphson method using derivative, Newton- Raphson method for non-linear system of equations. Fortran programs to implement the above methods.

Module III

Solution of ordinary differential equations: Initial value problems – Eigen value – Eigen vector decomposition- Runge-Kutta method with adaptive step-size control, modified midpoint method, multi-step and multi-value predictor-corrector method, Euler method, use of Taylor series. Fortran programs for the above methods.

Introduction to partial differential equations: Laplace equation, boundary value problems, Finite difference method of solution of Laplace equation, Fortran programs for the above methods.

References:

1. Rajaraman V., "Computer Oriented Numerical methods", Prentice Hall of India.
2. Saran, Swance and Singh, "Computer programming and numerical methods."
3. Krishnaraju and Muthu, "Numerical Methods for Engineering problems", Macmillan,1980
4. Salvachri and baron, "Numerical Methods in Engineering."
5. "Numerical Recipes in fortran", Cambridge university press.
6. S.K.Gupta, "Numerical Methods for Engineers", Wiley Eastern, 1984

Note: Question Papers consist of two Parts. Part A (40 marks) Compulsory ten short questions (10 x 4). Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.606 Elective II: 1. PROTEIN ENGINEERING (B,H 3-1-0

Module I:

STRUCTURE OF PROTEINS: Primary structure and its determination, secondary structure prediction and determination of supersecondary structure, protein folding pathways, tertiary structure and domain in proteins, quaternary structure, methods to determine tertiary and quaternary structures, post translational modification

Module II:

STRUCTURE FUNCTION RELATIONSHIP OF PROTEINS: DNA binding proteins, prokaryotic and eukaryotic transcription factors, DNA polymerases, Membrane proteins and receptors, bacteriorhodopsin, photosynthetic centers, epidermal growth factor, insulin and PDGF receptors and their interaction with effectors, protein phosphorylation, immunoglobulins Nucleotide binding proteins, enzyme serine proteases, ribonuclease, Iysozyme

Module III:

PROTEIN ENGINEERING AND PROTEIN DESIGN: Protein database analysis, methods to alter primary structure of protein, examples of engineered proteins, protein design, principles and examples

REFERRENCE:

1. Moody PCE, and AJ Wilkinson, *Protein Engineering*, IRL press, Oxford, 1990
2. Creighton TE, Proteins, Freeman WH, Second De, 1993.
3. Branden C, Tooze R, *Introduction of protein structure*, Garland, 1993

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module

03.606 Elective II: 2. CHROMATOGRAPHIC SEPARATIONS 3-1-0

Module I:

1. **Introduction:** Classification of techniques, distribution coefficients, retention chromatography, sorption mechanisms, retention parameters, factors affecting retention, qualitative and quantitative aspects of chromatography, peak shape sorption isotherms, column efficiency, band broadening processes, selectivity and resolution.
2. **Classical Chromatography:** Stationary phases, applications of ion exchange size exclusion, TLC-HPTLC.

Module II:

3. **High performance liquid chromatography :** Introduction – design of a typical HPLC machine-types of columns – applications.

Module III:

4. **Gas chromatography:** Introduction – instrumentation – columns-qualitative and quantitative aspects of gas chromatography – quantitative analysis of GC.
5. **Chiral Chromatography:** Principles – types of chromatography – scopes and limitations – applications – capillary electrophoresis

Reference:

1. Sewell P.A. Clarke B, Chromatographic separations. John Wiley & Sons, 1991
2. Lindsay B., High performance Liquid Chromatography, John Wiley & Sons,
3. Lecture Notes on short course on Enantiomeric separations, April 28-29,1995.

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.606 Elective: II 3. DRUGS AND PHARMACEUTICAL TECHNOLOGY 3-1-0

Module I

1. **Introduction:** Development of Drug and Pharmaceutical Industry – Therapeutic agents, their use and economics; Regulatory aspects.

2. **Drug Metabolism and Pharmacokinetics:** Drug metabolism-physico chemical principles, radio activity-pharma kinetic action of drugs on human bodies.

Module II

3. **Important Unit Processes and their Applications:** Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Special requirement for bulk drug manufacture.

Module III

4. **Manufacturing Principles:** Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses, coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquids-injections-ointment-topical applications, Preservation, analytical methods and test for various drug and pharmaceuticals, packing-packing techniques, quality management, GMP.

5. **Pharmaceutical Product and their Control:** Therapeutic categories such as vitamins, laxatives, analgesics, non-steroidal contraceptives, Antibiotics, biologicals, hormones.

Reference

Leon Lachman tet al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
Remington's Pharmaceutical Science, Mark Publishing and Co.

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.607 BIOPROCESS ENGINEERING LABORATORY 0-0-3

On-line data analysis for measurement of important physico-chemcal and biochemical parameters. Methods of on-line and off-line bio-mass estimation. Microbial calorimetry. Flow injection analysis for measurement of substrates, products and other metabolites. State and parameter estimation techniques for biochemical processes. Computer based data acquisition, monitoring and control-LABVIEW software.

Model simulation using MATLAB-SIMULINK and ISIM software packages.

Microbial CultureStudies: Culturing of different types of microorganisms (bacteria, yeast, fungi) used in the production of commercially important products. Formulation of simple and complex culture media. Estimation of biomass (dry weight). Substrate and product analysis. Study of growth, substrate utilization and product formation kinetics in shake-flask cultures.

Text Books:

J.M. Lee, "Biochemical Engineering", Prentice Hall, New York, 1992.

03.608 ENZYME ENGINEERING LABORATORY 0-0-3

Extraction of commercially important enzymes from natural sources. Development of enzymes from natural sources. Development of enzme assays. Quantification of enzyme activityand specific activity.

Enzyme kinetics: Estimation of Michaelis Menten parameters. Effect of pH and temperature onenzme activity, kinetics of inhibition.

Immobilised enzyme reactions: Techniques of enzyme immobilization matrix entrapment, ionic and cross linking. Column packing. Analysis of mass transfer effects on kinetics of immobilized enzyme reactions. Bioconversion studies with immobilized-enzyme packed-bed reactors.

Text Books:

R. Eisenthal and M.J. Dansen, "Enzyme Assays –A PracticalApproach", IRL Press, Oxford University Press, Oxford, 1993

03.701 TRASPORT PHENOMENA (BH) 3-2-0

MODULE 1

Mechanism of momentum transport : Newton's law of viscosity, Newtonian fluids, pressure and temperature dependence on viscosity. Theory of viscosity of gases at low density. Theory of viscosity of liquids.

Velocity distribution in laminar flow - Shell momentum balance, boundary conditions, flow of falling film, flow through circular tubes and annulus, adjacent flow of immiscible fluids, creeping flow around spheres.

Equations of change for isothermal systems - Equations of continuity, equations of mechanical energy, equation of change in curvilinear co-ordinates, use of equations of change to set up steady state flow problems.

Dimensional analysis of equations of change.

MODULE 2

Mechanism of energy transport : Fourier's Law of heat conductions, temperature and pressure dependence of thermal conductivity of gases and liquids. Thermal conductivity of solids.

Temperature distribution in solids and in laminar flow - Shell energy balances, boundary conditions, heat conduction with an electrical heat source, heat conduction with viscous heat source, heat conduction with nuclear heat source, heat conduction through composite walls, conduction in cooling fins, forced convection and free convection.

Equations of change of nonisothermal systems - Equations of energy, energy equations in curvilinear coordinates, equations of motion in nonisothermal systems to set up steady state heat transfer problems.

MODULE 3

Mechanism of mass transport : Fick's Law of diffusion, temperature and pressure dependence of mass diffusivity. Theory of ordinary diffusion in gases at low density. Theory of ordinary diffusion in liquids.

Concentration distribution in solids and in laminar flow-shell mass balance, boundary conditions, diffusion through a stagnant gas film, Diffusion with heterogeneous chemical reaction. Diffusion into a falling liquid film.

Equation of change for binary systems, equations of continuity, for a binary mixture in curvilinear coordinates. Use of equations of change to set up diffusion problems.

TEXT BOOKS :

1. Biron R. Bird, Warren E. Stewart, and Edwin Lightfoot , "Transport Phenomena"

REFERENCE :

1. Bennet C.O. and Meyer J.E., "Momentum and mass Transfer"
2. Sission and Pitts "Introduction to Transprot Phenomena"
3 Christie J. Geankoplis, "Transport Processes and Unit Operations", Prentice hall of India, 1997
4. J.C.Slattery, " Momentum, Energy and Mass Transfer in continuum , Kruger Publishing company

Note: Question Papers consist of two Parts. Part A (40 marks) Compulsory ten short questions (10 x 4). Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.702 MASS TRANSFER OPERATION II (BH) 3-1-0

MODULE 1

Basic concepts of Distillation: Vapour - Liquid equilibrium pressure - temperature - concentration - phase diagram - isothermal and isobaric equilibrium - Relative Volatility - Raoult's law - ideal solutions deviations from ideality - Minimum and maximum boiling azeotropes - Insoluble liquids - Enthalpy - concentration diagrams - Treatment of multicomponent systems.

Different distillation Methods : Flash Vapourisation of binary mixture - Simple distillation of binary mixtures continuous rectification methods - brief discussion on general characteristics of tray and packed tower - Azeotropic and extractive distillation, low pressure distillation and molecular distillation.
Multistage Tray tower Design : Material and enthalpy balance of a fractionator - Mecabe - Thiele Method - Introduction of feed and its influence on operating lines - q-lines and location of tray -effect of reflux ratio - total reflux and minimum reflux. Use of Open or steam - Ponchon - Savarit Method - Enriching section with total condenser and reflux below the bubble point - partial condenser - Stripping section. Complete fractionation Feed below bubble point - Feed tray location - Effects of reflux ration - total reflux - minimum reflux - Optimum reflux. Reboiler arrangements - use of open steam - Use of multiple feeds - efect of heat loss of fractionation - Fractionation of azeotropic and partially miscible binary mixtures - Tray efficiencies. Continuous Contact Equipment: Concepts of transfer units - HTU and NTU - and height of the enriching section and stripping section - Graphical methods.

MODULE 2

Description of liquid extraction - terminologies - application of ternary liquid equilibrium - representation in equilateral triangular co-ordinate of different type systems - Effect of temperature - Representation of ternary equilibrium data in rectangular co-ordinates on total and solvent free bases, equilibria of multicomponent systems - Criteria for selection of solvent.
Design of stage wise extractors : Mixers -settlers - Sieve tray tower single - stage extraction - graphical method of determining composition, flow rates. Multistage crosscurrent extraction with practically miscible and immiscible solvents, graphical method of determining number of stages. Continuous countercurrent multistage extraction - graphical method of determining number of stages - composition and minimum solvent on total and solvent free basis - Counter current extraction with insoluble solvents - continuous counter current extraction with reflux - Graphical solution in total and solvent free basis - total reflux minimum reflux ratio. Constructional & hydrodynamic aspects of stagewise extractors - Design of differential continuous contact extractors. Common characteristics of differential extractors. Types of extractors and their brief description - Design of differential contact tower extractors - Two resistance theory - Overall transfer Coefficient and corresponding HTU and NTU for insoluble liquids and dilute solutions - Hydro dynamics of differential contact extractors selection of extractors.
Solid Liquid Extraction: Description of leaching operations and technologies - Applications of leaching - Preparation of solid - Methods of Operation and classification of equipment - Solid - Liquid Equilibrium in leaching - methods of representation on total and inert free basis - Counter current leaching - material balance and graphical solution.

MODULE 3

Description of at adsorption processes and their application - Types of adsorption - nature of adsorbents - adsorption equilibria - adsorption hysterisis - Isotherms for adsorption of single components and mixtures - Effect of temperature and pressure - Freundlich equation. Stagewise adsorption : Contact filtration of liquids - single and multistage crosscurrent adsorption - Multistage Countercurrent adsorption - Agitated vessels for solid - liquid adsorption - Multi stage fluidised bed adsorber for recovery of Vapour - Continuous Contact Adsorption : Steady state moving bed adsorber - Countercurrent adsorption of one component - Adsorption of two components - Unsteady state fixed bed adsorber - adsorption wave - break through curves and rates of adsorption.
Ion Exchange : Principles of ion exchange techniques and application - Ion exchange Equilibira - Rate of ion exchange. Modern separation Techniques - Membrane separation process - solid and liquid memberance separation process solid and liquid membranes - concept dialysis and electrodialysiss - Continuous dialyser - concept of diffusion and permeation - Concept of osmosis and reverse osmosis - Industrial application and design aspects.

TEXT BOOK :

1. Treybal R.E. - Mass Transfer Operations.

REFERENCE BOOKS :

1. Coulson J.M. and Richardson, F.F. "Chemical Engineering, Vol.I fluid Fluid, heat transfer, and Mass transfer Ed.3, Pergamon Press.
2. Coulson J.M. and Richardson, J.F. "Chemical Engineering, Vol.2 Unit Operations, Ed.3, Pergamon Press (1978).
3. Mc Cabe, W.L. and Smith J.C., "Unit Operations of Chemical Engineering" MGK.
4. Sherwood, T.K.P, R.L. and Walke, C.R., Mass Transfer.
5. King C.J. Separation Processes.
6. Coulson J.M. and Richardson J.F. and Chemical Engineering Volume I
7. Coulson J.M. and Richardson J.R. and Chemical Engineering Volume V solutions to the problem in Chemical Engineering Vol. II.

Note: Question Papers consist of two Parts. Part A (40 marks) Compulsory ten short questions (10 x 4). Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.703 ENERGY ENGINEERING 3-1-0

MODULE 1

Classification and sources of energy; problems relating demand and supply of various energy sources. Coal : origin and formation, composition and classification, resources and production, exploration and mining; analysis and testing storage and handling; coal carbonisation, briquetting, coal hydrogenation. Wood and wood products. Petroleum; origin, occurrence; Chemical composition. World reserve, production, refining operations, storage and conveying, testing and analysis different products from petroleum like naphtha, aviation gasoline, kerosene, diesel oil, gas oil, lubricating oil, asphalts etc., petroleum coke, oil shale and oil sand. Combusting methods; and systems, pulverised coal furnaces; cyclone furnaces, oil fired systems, gas fired systems, waste heat boilers.

MODULE 2

Nuclear energy : basic aspects of nuclear radiation, fission and fusion, process reactor systems; BW/PW/HW reactor; gas cooled reactors, fast breeder reactor; thermal design; problems of nuclear power generations and remedial measures.

Solar energy : Facts and scope; solar radiation; radiation measuring instruments; basic flat collector; solar heat pump and heat engine cooling and refrigeration; solar pond; conversion of solar energy into electrical energy; solar thermal power generation; hydroelectric energy; problems of hydro-electric energy and remedial measures. Thermal power plants, generation cycles, energy from ocean tidal wave, ocean thermal source; geothermal energy; wet steam and water, hot dry rocks, electricity from exothermal; sources; wind energy; tunnel mills and conversion cycles.

MODULE 3

Biogas plant and its design :KVIC plants, process kinetics, digester design, sludge treatment, energy from wastes. Development in energy routes.

Conversion of heat to power : thermoelectric converters; thermo-electric refrigerators magneto-hydrodynamics; fuel cells; conversion of chemical energy into electricity, fuel cell performance; co-generation, efficiency improvement; energy conversion in petrochemical industries, polymer industries, natural organic industries, fertilizer industries etc.

Energy conservation – Process modifications – Preventing energy loss - Waste utilisation – Energy audit.

TEXT BOOKS ;

1. S.B Pandya, "Conventional Energy Technology - Fuels and chemical Energy - TMH (1987)
2. S.P. Sharma and Chander Mohan, Fuels and Combustion, "TMH, 1984
3. Kash Kori, C., Energy resources, demand and conservation with special reference to India, TMH, 1975.

REFERENCE BOOKS:

1. Gulp Jr., "Principles of Energy Conservation, "MGK (1979) 2. Chemtech I - Manual of Chemical Technology, "Vol.I. S. Chand and Co., New Delhi (1985)
3. Pryde P.R., "Non Conventional energy resources" JW (1983)
4. Connolly, T.J., "Foundation of nuclear engineering" JW (1978)
5. Gray T.J. and Gashos G.K., Tidel Power," Plenum Press (1972)
6. Sarkar S. "Fuels and Combustion, "Orient Longmans (1974)
7. Duffie T.R. and Beckman, W.A., 'Solar Energy Thermal Processes " JW (1974).

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.704 DOWNSTREAM PROCESSING 3-1-0

Module I:

Role of down stream processing in biotechnological processes . Problems and requirements of bioproduct purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value product and low volume, high value product), physico- chemical basis of bioseparation processes

Primary seperation and recovery processes: Cell disruption methods for intracellular products, removal of insolubles, biomass(and particulate debris) separation techniques, flocculation and sedimentation, centrifugation and filtration methods.

Module II:

Enrichment operations: Membrane – based separations (micro and ultrafiltration theory, design and configuration of membrane separation equipment, applications, precipitation methods(with salts, organic solvents, and polymers, extractive separation , aqueous two-phase extraction, supercritical extraction) insitu product removal, integrated bioprocessing

Module III:

Product resolution / fractionation: Adsorptive chromatographic separations processes, electrophoretic separations (all electrophoresis techniques including capillary electrophoresis) hybrid separation technologies (membrane chromatography, electrochromatography etc)

Product polishing: gel Permeation Chromatography, dialysis, Crystallisation

REFERENCE :

1. Wankat PC , *Rate Controlled separations* , Elsevier, 1990
2. Belter PA and Cussler *E, Bioseparations*, Wiley 1985
3. *Product Recovery in Bioprocess Technology*, BIOTOL Series, VCH, 1990
4. Asenjo JM, *Separation processes in Biotechnology*, 1993, Marcel Dekker Inc

03.705 DOWNSTREAM PROCESSING LAB 0-0-3

Cell disruption techniques, solid – liquid separation methods- filtration, sedimentation, centrifugation, product enrichment operations, precipitation, ultrafiltration, two phase aqueous extraction, high resolution purification, preparative liquid chromatographic techniques, product crystallization and drying

References:

Scopes Ak, Protein Purification, IRL Press, 1993.

03.706 Elective III: 1. PROCESS PLANT OPERATIONS AND SAFETY 3-1-0
(Syllabus will be put later)

03.706 Elective III: 2. METABOLIC ENGINEERING 3-1-0

1. **Introduction:** Induction-Jacob Monod Model, catabolite regulation, glucose effect, camp deficiency, feed back regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feed back regulation, cumulative feed back regulation, amino acid regulation of RNA synthesis, energy charge, permeability control passive diffusion, facilitated diffusion, active transport group transportation.
2. **Synthesis of Primary Metabolites:** Alteration of feed back regulation, limiting accumulation of end products, feed back, resistant mutants, alteration of permeability.
3. **Biosynthesis of Secondary Metabolites:** Precursor effects, prophophase, idiophase relationships, enzyme induction, feed back regulation, catabolite regulation by passng control of secondary metabolism, producers of secondary metabolites.
4. **Bioconversions:** Advantages of Bioconversions, specificity, yields, factors important to bioconversions, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.
5. **Regulation of Enzyme Production:** Strain selection, improving fermentation, recognizing growth cycle peak, induction, feed back repression, catabolite repression, mutants resistant to repression, gene dosage.

Reference

1. Wang D. I. C., Cooney C. L., Demain A. L., Dunnil P., Humphrey A. E., Lilly M. D., Fermentation and Enzyme Technology, John Wiles and Sons., 1980.
2. Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
3. Zubay G., Biochemistry, Macmillan Publishers, 1989.

Note

Question Papers consist of two Parts.

Part A (40 marks) Compulsory ten short questions (10 x 4)

Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.706 Elective III: 3. PLANT AND ANIMAL CELL TECHNOLOGY 3-1-0

Module I:

DNA Replication, translation, transcription, fundamentals of recombinant DNA technology, gene regulation.
Agrobacterium meditated gene transfer and cloning. Types of plant vectors and their use in gene manipulation
Plant viruses: Classification and diagnosis. Remedy. Viruses as a tol to deliver foreign DNA.

Module II:

Developmental aspects of rhizobium: Legume symbiosis, symbiotic nitrogen fixation. Regulation of nif and nod gene
Molecular aspects of disease susceptibility and resistance: Transposable elements, factors influencing disease resistance and susceptibility RFLP
Transgenics: Herbicide tolerance. Insect resistance. Viral resistance. Stress tolerance. Development of disease resistance plants by introducing bacillus thringiensis genes

Module III:

What is animal biotechnology and its scope. Animals in biotechnology. State of the art.
Animal cell culture: Principles of sterile techniques and cell propagation. Chemically defined and serum free media for membrane cell culture, scaling up of animal cell cultures. Preservation and characterization of animal cells, organ culture, cytotoxity and viability assays. Cell cultures as sources of valuable products.
Genetic recombination techniques: Mammalian genome, genetic recombination in mammalian cells and embryos. Protein production by genetically engineered mammalian cell lines. Optimisation of animal cells growth I bio-reactors emission.

References:

1. Mantal S.H., Mathews J.A., Mickee R.A., "Principles of Plant Biotechnology. An introduction to genetic engineering in plants", Blackwell Scientific Publications, 1985.
2. Marx J.L., "Revolution in Biotechnology", Cambridge UniversityPress, 1989.
3. Dodds J.H., "Plant Genetic Engineering", Cambridge University Press, 1985.

03.707 HEAT AND MASS TRANSFER LABORATORY 0-0-3

1. Conduction : Determination of thermal conductivity - Transient heat conduction - determination of critical insulation thickness.
2. Convection : Heat transfer in laminar and turbulent flow in circular and noncircular ducts - Double pipe heat exchanger - Verification of design equations for shell and tube neat exchangers - heat transfer in agitated vessels - heat transfer in extended surfaces - heat transfer in pool boiling - condensation heat transfer - heat transfer through submerged coils in agitated vessels - cross flow heat transfer.
3. Radiation : Determination of emissivity and absorptivity of black and grey bodies - measurement of radiation heat losses from furnace walls.
4. Evaporation : Study of evaporation equipment - determination of steam economy in multiple effect evaporators.
5. Heat transfer in packed beds.
6. Heat transfer in fluidised beds.
7. Diffusion coefficient measurement _ Wetted wall column, measurement of mass transfer coefficient.
8. Distillation : Determination of VLE, steam requirement and vaporisation efficiency, efficiency in steam distillation, verification of Raleigh's equation for simple distillation, HETP.
9. Absorption : Verification of design equation for height of packing in packed tower absorption of ethanol in water, absorption of carbon dioxide in sodium carbonate solution.
10. Surface evaporation - Free convection mass transfer.
11. Liquid extraction : Determination of ternary liquid - liquid equilibrium.
12. Leaching : simple leaching; cross current leaching and counter current leaching.
13. Absorption : Determination of absorption isotherm.
14. Drying : Determination of drying rate curve and mass transfer coefficient for atmospheric batch drying.

REFERENCES :

1. Shankar Srinivas, "Mass Transfer Operations - A Lab Manual for Chemical Engineering CEED, III Madras
2. R.E. Trebal, "Mass Transfer Operations " MGH
3. Shankar Srinivas, "Heat Transfer Operations - A Lab Manual, Chemical Engineering Education Development Centre, IIT Madras

03.708 **PROJECT, SEMINAR AND INDUSTRIAL TRAINING 0-0-2**

Students should prepare a preliminary report of the project work to be done in the VIII semester. They have also to present a seminar and submit a report.

Industrial training: They should undergo an industrial trading for 15 to 30 days in any factory or organisation and submit a report of the same.

03.801 PROCESS DYNAMICS AND CONTROL (B,H) 3-1-0

MODULE I

Design aspects of a process control system: Classification of the variables in a chemical process. Design elements of a control system. Control aspects of a complete chemical plant.

Hardware for a process control system: Hardware elements of control system. Use of digital computers in process control.

Development of a Mathematical Model: State variables and state equations for chemical process. Additional elements of mathematical models. Additional examples of mathematical modeling. Modeling difficulties.

Modeling considerations for control purposes: The input-output model, degrees of freedom, degrees of freedom and process controllers. Formulating the scope of modeling for process control.

Linearization of nonlinear systems: Computer simulation of process dynamics, linearization of systems with one variable, deviation variables, linearization of systems with many variables

Laplace Transforms: Definition of the Laplace transform. Laplace transforms of some basic functions, Laplace transform of derivatives and integrals, initial value theorem and final value theorem.

Solution of linear differential equations using Laplace transforms: A characteristic example and the solution procedure. Inversion of Laplace transforms. Heaveside exapansion. Examples on the solution of linear differential equations using Laplace transforms. Transfer functions and input-output models.

Transfer functions of a process with a single output, Transfer function matrix of a process with multiple outputs. Poles and zeros of a transfer function. Qualitative analysis of the response of a system.

Dynamic behaviour of first order systems: What is a first order system ? Processes modelled as first order systems. Dynamic response of a pure capacitive process. Dynamic response of a first order lag system. First order systems with variable time constant and gain.

Dynamic behaviour of higher order systems: Capacites in series. Dynamic systems with dead-time. Dynamic systems with inverse response.

MODULE II

Introdution to feedback control: Concept of feedback control. Types of feedback controllers. Measuring devices (sensors), transmission lines and final control elements. Dynamic behaviour of feedback controlled processes.

Block diagrams and closed loop response: Effect of proportional control on the response of a feedback controlled process. Effect of integral and composite control actions on the response. Stability analysis of feedback systems Notion of stability, the characteristic equation, Routh Hurwitz criterion for stability, Root locus analysis.

Design of feedback controllers: Outline of the design problems, simple performance criteria, time-integral performance criteria, selection of the type of feedback controller, controller tuning, frequency response analysis of linear processes. Response of a first order system to a sinusoidal input, frequency response characteristics of a general linear system,

MODULE III

Bode diagrams, Nyquist plots. Design of feedback control systems using frequency response techniques. Bode stability criterion, gain and phase margins, Ziegler Nichols tuning, Nyquist stability criterion.

A general introduction to advanced control systems, familiarity of terms like dead-time compensation, inverse response, cascade control, selective control systems, split-range control, feedforward control , ratio control, adaptive control, inferential control, state space models and MIMO systems

Control with digital computers: Introduction to computer technology, computer control theory, how digital control theory developed

Z-transform: Introduction, theorems of z-transforms, inverse z-transforms.

convolution sum, pulse transfer function and z-transfer function, properties of z-transfer functions and difference equations.

Introduction – Direct Digital Control systems – Supervisory Control – Distributed Control System

Text Books:

Stephanopoulose G. Chemical Process Control, An introduction to theory and practice., Prentice Hall of India, New Delhi, 1993.

Additional references:

1) Coughanowr , "Process Systems Analysis and Control", McGraw Hill
2) W. L. Luyben , "Process Modeling Simulation and Control For Chemical Engineers" II Edn. McGraw Hill, Singapore, 1990.
3. E. Segorg, & J.F.Edgar and Mellichamp,"Process Dynamics &Control"

Note: Question Papers consist of two Parts. Part A (40 marks) Compulsory ten short questions (10 x 4). Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.802 BIOINFORMATICS 3-1-0

Module I:

Role of bioinformatics – elementary commands, network topologies and protocols.

Module II:

Application of databank – FASTA, BLAST, PDB, microbial and cellular databank, hybridoma databank, virus information system, genbank, cDNA bank, mapping database, details of organization – access, search, retrieval, datamining.

Module III:

Sequencing alignment – parametric sequence alignment, common multiple alignment, homology search; evolutionary trees and phylogeny.

References:

1. S. Misener and S.A. Krawetz, "Bioinformatics – Methosds and Protocols", Humana Press, 2000
2. H. Rashidi and L.K. Buehler, "Boinformatics Basics", CRC Press, 2000.

03. 803 BIO-PROCESS PLANT DESIGN 3-1-0

Review of mass and energy balance concepts. Development of the flow sheet and its description. Piping and instrumentation diagrams. Detailed design of the following equipments: Double pipe heat exchanger, shell and tube heat exchanger, evaporators, distillation columns, absorbers, driers, storage tanks, reaction vessels- Development of computer programs in C++ for the above.

Design of cylindrical and spherical vessels for internal and external pressures, heads and closures, nozzles, supports, non-standard flanges, pipeline design. Design of tall vertical vessels. Development of C++ programs for all the above procedures. Selection and design of fluid moving machinery. Design aspects aimed at maintaining asceptic conditions. Bioprocess validation.

03.804 PROCESS INSTRUMENTATION 2-1-0

MODULE 1:

Basic principles of measurements - Classification methods of measurements - Direct and indirect measurements, various elements in a measuring instrument - Sensing element, transducing element manipulating element and functioning element etc. Principles of working with a suitable example, static and dynamic characteristics of measuring instrument, accuracy, reproducibility, sensitivity, static error, dead zone, dynamic error, fidelity lag, speed of response etc.

Sensing elements - various types of sensing elements, sensors for temperature, pressure and fluid flow, transducers, different types of transducers, their principles and working, transmission methods, indicating and recording means.

Temperature measurements, temperature scales, basic principles and working of thermometers, mercury in glass thermometers, resistance thermometers, thermocouples, optical pyrometers, radiant pyrometers, ranges of different types of temperature measuring instruments, sources of errors and precautions to be taken in temperature measurements.

MODULE 2

Pressure measurement - Principles of working of manometers, various types of manometers - McLeod gauge, Knudsen gauge, Bourdon gauge, bellows, diaphragm, electrical pressure transducers piezo electric manometers,

thermal conductivity gauges- ionisation gauge high pressure measuring instrument, liquid level measurements - Sensitive measurements, conductivity meters, measurements of PH.

MODULE 3

Flow measurements - Liquid and gas flow measurements, ways of measuring liquids and gas flow, direct volume measurements, quantity meters, gas meters, magnetic flow meters, heat input flow meters, elbow flow meters, impact meters, variable area meters, rotameters, cylinder and piston type - Liquid flow velocity, turbine meters, open channel flow measurements, wires notches, head meters, pitot tube, orifice meters ventury meters, theory and working flow measurements, electrical transducers, turbine type flow meters strain gauge flow meters mass flow meters measuring flow of dry materials. Thermal analysis - Differential thermal analysis, thermo gravimetric, conductometric analysis Chromatography and application, developments of P&I, diagram for flow systems, level, PH control temp control, Heat exchangers, Distillation column, reaction system etc.

TEXT BOOKS :

1. Industrial instrumentation - D.P. Eckman, Wiley Eastern
2. Industrial instrumentation fundamentals - FRIBANCE, T.M.H. Edition
3. Mechanical and industrial measurements - R.K. Jain (Khanna)

REFERENCE :

1. Principles of industrial instrumentation - Patranabis T.M.H.
2. Measurement systems - Beckwith and Buck.

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.805 ECONOMICS AND MANAGEMENT OF CHEMICAL INDUSTRIES (B,H) 3-1-0

MODULE 1.

Equivalence and cost comparisons : Time value of money and equivalence - Equations that are used in economic analysed - Compound interest as an operator - Unacost - Hoskolds formula - Cost comparisons - Comparison with equal durations - Common denominator of service lives, unacost and capitalised cost Depreciations and taxes : Nature of depreciations - Methods for determining depreciation - Straight line method - sinking fund method - Declining balance method - Double declining balance method - Sum of digits methods - Units of production method - Taxes and depreciation method - Comparison of depreciation methods - Cost comparison after taxes - Present worth after taxes three continuous interest and discounting - Logic for continuous interest - Continuous interest as an operator - Uniform flow - Flow changing at an exponential rate - flow declining in a straight line to zero - Discounting with improving performance - Unaflow - Capital recovery factor - Capitalised cost-taxes.

MODULE 2

Technical advancement and inflation : Displacement Vs replacement - One year more of existence - More than one year of existence - Uniform gradient series delay value of an existent inflation - Cost comparison under inflation unaburden high inflation rates - Inflation and technological advancements.

Capital requirements and cost of production for process plants - Equipment for process plants, cost index, Nelson refinery construction index - Material cost indices - Process equipment cost index - Material cost indices - Process equipment cost index - Labour cost index - equipment costs - Williams six-tenths factor.

Capital investments - Fixed capital investment and working capital - Estimation of capital investment - direct cost and indirect costs - Types of capital cost estimates - Order of magnitude estimates, study estimates, preliminary estimate definitive estimate and detailed estimate.

Cost factors in capital investment - Cost and installation of purchased equipment - insulation costs - Instrumentation and controls - Piping - Electric installation - Building - Yard improvements - Service facilities - Land design engineering and supervision - construction expenses contractors fee - Contingencies - Start up expenses - Methods for estimating capital investment.

MODULE 3

Estimation of total product cost Manufacturing costs general expenses - Direct production costs - Fixed costs plant over head cost - administration expenses - Distribution and marketing expenses.

Financial statements : Balance sheet and profit and loss accounts - Ratios used for comparing the balance sheet and profit and loss account.

Break even and minimum cost analysis - Types of costs - Cost analysis. Types of costs valuable and fixed costs - Economic production charts - Differential analysis of economic production charts - critique in the use of break-even and minimum cost analysis.

Profitability - investment evaluation - mathematical methods for profitability evaluation - pay out time - pay out time with interest return on original investment - return on average investment - investment - discounted cash flow - venture worth.

TEXT BOOKS :

1. Peters and Timmerhaus, "Plant Design and Economics for Chemical Engineers"
2. G.S. Davies, "Process Engineering Economics" CEED III Madras.
3. F.C. Jelen, "Cost and Optimisation Engineering".

REFERENCES :

1. Aries and Newton, "Chemical Engineering Cost Estimation "
2. Schweyer, "Process Engineering Economics"
3. Happel, "Chemical Process Economics"
4. Vilbrandt and Dryden, "Chemical Engineering Plant Design"

Note

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Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.806 ELECTIVE IV: 1. MOLECULAR MODELING AND DRUG DESIGN 3-1-0

Module I:

Imperial Force fields molecular mechanism;

Bond Stretching – Angle Bending – Torsional terms – Out plane bonding motions – Electrostatic interactions – Van Der Waals interactions – Effective pair Potentials – Hydrogen Bonding – Simulation of liquid water

Computer simulation methods;

Calculation of thermodynamic properties – Phase space – Practical aspects pf computer simulation – Boundaries monitoring Equilibrium – Long range Process – Analyzing result of simulation and estimating errors

Module II:

Molecular dynamics simulation methods;

Molecular Dynamics using simple modules – Molecular Dynamics with continuous potentials – Running Molecular Dynamics simulation – Constant dynamics – Time dependent properties – Molecular Dynamics at constant temperature and pressur

Monte Carlo simulation methods;

Module III:

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

Molecular modeling to discover and design new molecules;

Molecular modeling in drug discovery – deriving and using 3D Pharma cores – Molecular docking – Structure Based methods to identify lead components- Denovo ligand design

REFERENCE:

1 A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996

2 J.M. Haile, Molecular Dynamics Simulation Elementary methods, , John Wiley and Sons ,1997

03.806 ELECTIVE IV 2. IMMUNOLOGY 3-1-0

Module I

1. **The Immune System:** Introduction, Lymphocytes, their origin and differentiation, antigens, their structure and classification, compliments and their biological functions, types of immune response, anatomy of immune response.

2. **Humoral Immunity:** B-lymphocytes and their activation, structure and function of immunoglobulin, immunoglobulin classes and subclasses, genetic control of antibody production, mono clonal antibodies and diagnosis, idiotypes and idiotypic antibodies, major histocompatibility complex.

Module II

3. **Clellular Immunity:** Thymus derived lymphocytes(T-cells) their classification antigen presenting cells(APC), macrophages, langerhans cells, their origin and functions, mechanism of phagocytosis, identification of cell, types of immune system, immunosupression, immune tolerance.

4. **Immunity to Infection:** Hypersensitivity reactions, mechanism of T cell activation, cytokines and their role in immune response macrophage activation and granuloma formation.

Module III

5. **Transplantation:** Graft rejection, evidence and mechanism of graft rejection, prevention of graft rejection, immunosuppressive drugs, HLA and disease, mechanism of immunity to tumour antigens.
6. **Autoimmunity:** Auto antibodies in humans, pathogenic mechanisms, experimental models of autoimmune disease, treatment of autoimmune disorders.

Text

1. Roti I, Essential Immunology, Blackwell Scientific Publications, Oxford 1999.
2. Benjamin E. and Leskowitz S., Immunology A Short Course, Wiley Liss, NY, 1991.

Note

Question Papers consist of two Parts.
Part A (40 marks) Compulsory ten short questions (10 x 4)
Part B (60 marks) Three modules. Students must answer one out of two from each module.

03.806 ELECTIVE IV: 3. BIOETHICS 3-1-0

Module I

The legal and socioeconomic impact of biotechnology, public education of the process of biotechnology involved in generating new forms of life for informed decision making, biosafety regulation and national and international guidelines, r-DNA guidelines, experimental protocol approvals, levels of containment,

Module II

Environmental aspect of biotech applications, use of genetically modified organism and their release in environment Special procedures for r-DNA based product production, Intellectual property rights, TRIPS, International conventions patents and methods of application of patents.

Module III

Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor, identification of directions for yield effect in agriculture, aquaculture etc.., Bioremediation.

Reference

1. Sasson A., Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A., Biotechnologies in developing countries present and future, UNESCO Publishers, 1993
3. Singh K., Intellectual Property Rights on Biotechnology, BCIL, New Delhi.

Note

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03.807 REACTION ENGINEERING AND PROCESS CONTROL LABORATORY 0-0-3 Credits: 3

Determination of kinetics of chemicals reactions - Batch reactor - Tubular flow reactors - Stirred tank reactors - cascade of deal reactors. Residence time distribution (RTD) - Stirred tank - Tubular reactor - Cascade of ideal reactors - Fixed bed and fluidised bed reactors. Measurement of surface area and porosity of solid catalysts.

Dynamics of thermocouples - Liquid level systems - Optimum controller settings for laboratory scale temperature control system, pressure control system, and level control system, Tuning of controllers for distillation control system.

Computerised control of liquid level system, flow control system, pressure control system, temperature control system and distillation control system.

03.808 PROJECT/VIVA/INDUSTRIAL VISITS 0-0-3

students should submit a project report of the actual work done during their course. Also, a report of the industrial visits done during V to VII semesters.

Credits : Project and viva: (Internal) 80 marks; Industrial visits (internal) 20 marks.