UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY : : CHENNAI – 600 025

R - 2008

B.TECH. PHARMACEUTICAL TECHNOLOGY

III TO VIII SEMESTERS CURRICULA & SYLLABI

SEMESTER III

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 9211	Mathematics III	3	1	0	4
CY 9261	Physical Chemistry	3	0	0	3
PA 9201	Physical Pharmacy	2	1	0	3
IB 9201	Principals of Chemical Engineering	3	0	0	3
IB 9203	Bioorganic Chemistry	3	0	0	3
IB 9204	Cell Biology	2	1	0	3
IB 9205	Microbiology	3	0	0	3
PRACTICALS					
PH 9207	Physical & Organic Chemistry Lab	0	0	4	2
IB 9208	Microbiology Lab	0	0	4	2
	TOTAL	**19**	**3**	**8**	**26**

SEMESTER IV

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 9261	Probability and Statistics	3	1	0	4
IB 9213	Instrumental Methods of Analysis	3	0	0	3
GE 9261	Environmental Science & Engineering	3	0	0	3
PH 9021	Medicinal Chemistry	3	0	0	3
PH 9251	Fundamentals of Human Anatomy & Physiology	3	0	0	3
CH 9023	Biochemical Engineering	3	0	0	3
CH 9034	Fundamentals of Heat and Mass Transfer	3	0	0	3
PRACTICALS					
CY 9214	Instrumental Methods of Analysis lab	0	0	4	2
IB 9256	Chemical Engineering Lab	0	0	4	2
	TOTAL	**21**	**1**	**8**	**26**

SEMESTER V

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
FT 9301	Biochemical Engineering – II	3	0	0	3
IB 9305	Molecular Biology	3	0	0	3
PH 9301	Pharmaceutical Analysis	3	0	0	3
PH 9302	Pharmacokinetics	3	0	0	3
GE 9023	Fundamental of Nano Science	3	0	0	3
	Electives I	3	0	0	3
PRACTICALS					
IB 9307	Molecular Biology Lab	0	0	4	2
PH 9307	Pharmaceutical Analysis Lab	0	0	4	2
PH 9304	Pharmacokinetics Lab	0	0	4	2
PH 9305	Technical Seminar	0	0	2	1
	TOTAL	**18**	**0**	**14**	**25**

SEMESTER – VI

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
IB 9351	Chemical Reaction Engineering	3	0	0	3
IB 9353	Genetic Engineering	3	0	0	3
FT 9351	Separation Process	3	0	0	3
PH 9351	Regulatory issues in Pharmaceutical Industry and Drug Validation	3	0	0	3
GE 9022	Total Quality Management	3	0	0	3
	Elective II	3	0	0	3
PRACTICALS					
GE 9371	Communication Skills and Soft Skills Lab	0	0	2	1
FT 9402	Bio Process Lab	0	0	6	3
IB 9355	Genetic Engineering Lab	0	0	4	2
	TOTAL	**18**	**0**	**12**	**24**

SEMESTER – VII

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
IB 9403	Immunology	3	0	0	3
PH 9401	Formulation of Drugs	3	0	0	3
PH 9402	Pharmacognosy	3	0	0	3
PH 9403	Pharmacology and Chemotherapy	3	0	0	3
GE 9021	Professional Ethics in Engineering	3	0	0	3
	Electives III	3	0	0	3
PRACTICALS					
PH 9404	Computer Aided Drug Design	0	0	4	2
PH 9405	Pharmacognosy Lab	0	0	4	2
PH 9406	Formulation Technology Lab	0	0	4	2
	TOTAL	**18**	**0**	**12**	**24**

SEMESTER VIII

CODE NO	COURSE TITLE	L	T	P	C
PH 9451	Project Work	0	0	12	6
	Total Credits	**0**	**0**	**12**	**6**

LIST OF ELECTIVES

ELECTIVE I

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 9262	Numerical Methods	3	1	0	4
PH 9022	Pharmaceutical Industrial Management	3	0	0	3
FT 9026	Technical Writing & Communication	3	0	0	3
PH 9023	Natural And Synthetic Drug Technology	3	0	0	3

ELECTIVE II

CODE NO	COURSE TITLE	L	T	P	C
IB 9309	Process Economics and Industrial Management	3	0	0	3
IB 9402	Protein Engineering	3	0	0	3
PH 9024	Bio Informatics	3	0	0	3
IB 9024	Metabolic Engineering	3	0	0	3
FT 9029	Operation Research	3	0	0	3
PH 9025	Principles of Drug Design	3	0	0	3

ELECTIVE III

CODE NO	COURSE TITLE	L	T	P	C
PH 9026	Immunotechnology	3	0	0	3
PH 9027	Pharmocogenomics	3	0	0	3
PH 9028	Drug Bioevaluation	3	0	0	3
IB 9401	Down Stream Processing	3	0	0	3
PH 9029	Clinical Research And Regulations	3	0	0	3
GE 9071	Creativity, Innovation & New Product Development	3	0	0	3

MA9211 MATHEMATICS III L T P C
(Common to all branches of B.E / B.Tech programmes) 3 1 0 4

AIM

To facilitate the understanding of the principles and to cultivate the art of formulating physical problems in the language of mathematics.

OBJECTIVES

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems

UNIT I FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 9+3

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

L: 45, T: 15, TOTAL : 60 PERIODS

TEXT BOOK

1. Grewal, B.S. "Higher Engineering Mathematics". 40th Edition. Khanna Publications, 2007.

REFERENCES

1. Glyn, James, "Advanced Modern Engineering Mathematics". Pearson Education,2007
2. Ramana, B.V. "Higher Engineering Mathematics" Tata McGraw Hill 2007.
3. Bali, N.P. and Manish Goyal, "A Text Book of Engineering" 7th Edition. Lakshmi Publications, 2007.

CY9261 PHYSICAL CHEMISTRY L T P C
3 0 0 3

AIM

To understand important concepts in physical chemistry.

OBJECTIVE

- To understand the different states of matter, theoretical principles governing the solid, liquid , mesomorphic and solid states and to know methods for experimental determination of characteristic properties of the states.
- To understand the principles of thermodynamics in deciding the spontaneity of reactions and energy changes involved in physical and chemical processes.
- To understand the principles of photochemistry and catalysis.

UNIT I PROPERTIES OF MATTER. GASEOUS AND LIQUID STATES 12

Gaseous state Ideal gas – Gas laws –kinetic theory – Marwell's distribution of molecular velocities – collision frequency -mean free path – real gas- van der Waal's equation of state – critical constants – law of corresponding states – liquefaction of gases (CO_2, NH_3, air, O_2 and N_2) Joule – Thomson effect - inversion temperature.

Liquid state Equilibrium vapour pressure – surface tension - viscosity-dipole moment refractive index - optical rotation - methods of determination - relationship to molecular structure

UNIT II PROPERTIES OF MATTER MESOMORPHIC AND SOLID STATES 9

Mesomorphic state or liquid crystals Themotropic and lyotropic mesomorphism classification of thermotropic liquid crystals – smectic- nematic – cholesteric - discshaped - polymer -- molecular arrangements in liquid crystals.

Solid state crystal structure - laws of crystallography -7 crystal systems-14 Bravais lattices - X-rays and crystal structure - Bragg's equation - types of crystals – molecular covalent –ionic – metallic – lattice energy - Born-Lande's equation – experimental determination using Born-Haber cycle - packing in metallic crystals - lattice-defects.

UNIT III THERMODYNAMICS I LAW AND THERMOCHEMISTRY 8

System – surroundings – properties – macroscopic –intensive – extensive processes – isothermal – adiabatic – reversible – irreversible - thermodynamic equilibrium - Zeroth law of thermodynamics – building thermometer - celsius scale - perfect gas/ absolute temperature scale.

Internal energy - work done – isothermal , reversible and irreversible expansions – **compressions** - enthalpy - heat capacity at constant volume

C_v – at constant pressure C_p - relationship between C_p and C_v - work done

In adiabatic, reversible and irreversible expansions - compressions.

Thermochemistry - enthalpy changes – physical and chemical processes-

Kirchoffs' equation - Hess' law of constant heat summation - enthalpy of

combustion - Bomb calorimeter - bond energies – applications

UNIT IV THERMODYNAMICS II AND III LAW 8

Spontaneous process- cyclic process – Carnot cycle - efficiency of a heat engine – entropy – concept - physical significance-changes accompanying processes – Free energy – Helmholtz – Gibbs - criteria for reversible and irreversible processes – Gibbs-Hermholtz equation-free energy and physical equilibria-Clapeyron and Clausius equation - free energy and chemical equilibria - vant Hoff reaction isotherm - standard free energy changes - Third law - Nernst heat theorem - determination of entropy from thermal measurements - residual entropy

UNIT V PHOTOCHEMISTRY AND CATALYSIS 8

Absorption of light - consequences – laws of photochemistry -quantum yield - photochemical processes – primary – secondary - kinetics of photochemical reactions - hydrogen and chlorine -hydrogen and bromine – photosensitization – quenching - lasers. Catalysis – catalyst – promoter – inhibitor - poisoning of catalyst –homogeneous catalysis - acid-base -metal salts - heterogeneous-adsorption – physisorption chemisorption - surface area - industrially important processes – oxidation – cracking reforming.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Puri, B.R., L.R.Sharma and M.S.Pathania "Principles of Physical Chemistry:".41st Edition. Vishal Publishing, 2006.
2. Atkins, Peter "Physical Chemistry" 9th Edition, Oxford University Press, 2009

REFERENCES

1. Bhal, B.S.,G.D. Tuli and Arun Bhal "Essentials of Physical Chemistry". S.Chand & Co., 2010
2. Glasstone, Samuel "Thermodynamics for Chemists". Narahari Press, 2008

PA9201 PHYSICAL PHARMACY L T P C
2 1 0 3

UNIT I MICROMERITIC AND POWDER RHEOLOGY 10

Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties.

UNIT II SURFACE, INTERFACIAL PHENOMENON, VISCOSITY AND RHEOLOGY 10

Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface.

Newtonian system, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

UNIT III DISPERSION SYSTEMS 10

a. Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy.

b. Suspensions and Emulsions : Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions ; types, theories, physical stability.

UNIT IV DIFFUSION & DISSOLUTION 5

Definitions, Steady state diffusion, Procedures and apparatus, Dissolution, Drug release.

UNIT V KINETICS AND DRUG STABILITY 10

General considerations and concepts, half-life determination, Influence of temperature, light, catalytic species, solvent and other factors, Accelerated stability study, expiration dating.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Sinko, Patrick J. "Martin's Physical Pharmacy and Pharmaceutical Sciences " 5th Edition, Wolters, Kluwer/ Lippincott Williams & Wilkins Publishing , 2006
2. Carter, S.J. "Cooper and Gunn's Tutorial Pharmacy, 6th Edition. CBS Publishers, 1986.

IB9201 PRINCIPLES OF CHEMICAL ENGINEERING L T P C

3 0 0 3

(Common for IBT, Food and Pharmaceutical Technology)

AIM

To understand the principles of Process calculations.

To understand principles of fluid mechanics and its application.

OBJECTIVES

- To perform calculations pertaining to processes and operations.
- To apply fluid mechanics principles to applied problems.

UNIT I BASIC PRINCIPLES OF STOICHIOMETRY 8

Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use –Data sources, Humidity and applications.

UNIT II MATERIAL BALANCES 10

Material balance calculations for non reactive operations, once through operations, recycle operations, bypass operations. Material balance calculations for reactive processes, recycle, bypass processes – Application problems in unit operations and processes.

UNIT III ENERGY BALANCES 9

Calculation of enthalpy changes, heat capacity, Latent heats, Data sources, Thermo chemical calculations. Heat of solution, Simultaneous material and energy balances.

UNIT IV FLUID MECHANICS 9

Fluid – properties – compressible, incompressible fluids, Newtonian and Non Newtonian Fluids, Fluid statics for compressible & incompressible fluids-Static pressure-application to pressure measurement, gravity settling, Fluid Flow phenomena – through pipes and other devices – pressure drop calculations. Pressure measuring devices.

UNIT V AGITATION FLOW THROUGH PACKINGS, FLUIDZATION, FLUID TRANSPORT 9

Agitation – power requirement, Flow in packed columns, flow in fluidization columns, settling phenomena, Flow measurement, pumping of liquids and gases – equipments.

TOTAL: 45 PERIODS

TEXT BOOKS

1. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, Mc Graw Hill, 2001.
2. Bhatt, B.I. and S.M. Vora "Stoichiometry (SI Units)", 3rd Edition, Tata McGraw- Hill, 1996.

REFERENCES

1. Himmelblau, D.M. "Basic Principles and Calculations in Chemical Engineering", 6thEdition, PHI, 2006.
2. Geankoplis, C.J. "Transport Processes and Separation Process Principles",4th Edition, PHI, 2006.
3. Foust, A.S. etal., " Principles of Unit Operations", 2nd Edition, John Wiley & Sons, 1999.
4. Narayanan, K.V. and Lakshmi Kutty "Stoichiometry and Process Calculations", PHI, 2006.
5. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman / Elsevier, 2004.

IB9203 BIOORGANIC CHEMISTRY L T P C

(Common for IBT, Food and Pharmaceutical Technology) **3 0 0 3**

UNIT I INTRODUCTION TO CHEMISTRY 13

Chirality, Enantiomers, Diastereomers, Enantiotopic Faces, Absolute configuration RS normetclature, Bijvotes method of determining absolute configuration. Conformers : Ethane, butane, cyclohexane – Reactivity due to change in conformers Reactions : SN_1, SN_2, E_1, E_2, Addition of electrophile on a double bond, Hy-dride transfer mechanisms Cannizaro's reaction. Reactivity : Kinetics of Reactions, First order and kinetics of enzyme Determination of $\Delta G^{\ddagger}$, $\Delta H^{\ddagger}$, $\Delta S^{\ddagger}$. Thermodynamics: Boltzmans equation, Gibbs – Helmoltz equation. Acid – Base catalysis – Structure of water.

UNIT II INTRODUCTION TO ORGANIC SYNTHESIS 10

Useful Organic Transformations Reterosynthetic Analysis. Case Studies : Synthesis of Cholesterol, Synthesis of Chlorophyll.

UNIT III ENZYMES 5

MM kinetics – other mechanisms for enzyme action – Methods for following enzyme reactions – Analysis of Enzymatic reactions.

UNIT IV MECHANISMS 13

Case Studies : Lipase, Carboxypeptidases, Monooxygenases – Esterases
Case Study: Engineering an Enzyme – Subtilisn.
Case Study: Allostery ATpase
Mechanisms of enzymes in a Pathway : Case Study : Serratia marcasens & Prodigiosin.
Domain Movements in Enzymes MD simulations Case Study : Lipase.

UNIT V BIOLOGICAL SUPERMOLECULES 4

Supramolecular Systems – Ion Channels – photosynthesis – artificial enzymes – catalytical antibodies – ribozymes..

TOTAL : 45 PERIODS

TEXT BOOKS

1. Page, M.I., and A. Williams, "Organic and Bioorganic Mechanisms," Pearson India Edition, 1997
2. Ariya, K. and T. Kumtake, " Supramolecular Chemistry : Fundamentals and Applications ", Springer India Edition, 2006.
3. Morrison, R.T. and T.N. Boyd "Organic Chemistry", 6th Edition, Prentice Hall of India,2003.
4. Palmer, Trevor "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Affiliated East-West Press Pvt. Ltd., 2004.

REFERENCE

1. Fersht, Alan "Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding", W.H. Freeman, 1998.

IB9204 CELL BIOLOGY L T P C
2 1 0 3

AIM

To introduce students to the principles of cell biology to emphasize the role of organelles and their functions; signal transduction and crosstalk between the cells – towards biotechnological applications.

OBJECTIVES

- To provide to the students the fundamentals of cell biology and ability to solve problems in cell biology.
- To help students understand the pathway mechanisms.

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9

Eukaryotic, Prokaryotic cells, Subcellular Organelles and Functions Principles of membrane organization membrane proteins, cytoskeletal proteins eg. RBC cytoskeletal contractile proteins Actin, myosin, Actin Polymerization Act- myosin complex, mechanism of myosin-ATpase activity, contraction; microtubules, microfilaments activity in Organelle movement.

UNIT II CELL DIVISION AND CONNECTION 8

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, Extra cellular matrix, role of matrix in cell enthore : Gap junctions, Tight junctions, Desmosomes, Hemidesmosomes.

UNIT III TRANSPORT ACROSS CELL MEMBRANE 9

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na^{+} / K^{+} / Ca^{+2T} pumps uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists.

UNIT IV SIGNAL TRANSDUCTION 10

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules.

UNIT V SIGNAL AMPLIFICATION AND CROSSTALK 9

Signal amplification and crosstalk caspases and cell death, Role of Ras and Raf in oncogenesis, introduction to gene therapy.

TOTAL : 45 PERIODS

REFERENCES

1. Lodish, Harvey etal., " Molecular Cell Biology," 6th Edition. W.H.Freeman, 2008.
2. Alberts, Bruce, "Molecular Biology of Cell", 5th Edition, Garland Science, 2008.
3. Cooper,G.M. "The Cell: A Molecular Approach, 4th Edition, ASM Press, 2007.
4. Alberts, Bruce etal., "Essentail Cell Biology", 2nd Edition, Garland Science, 2004

IB9205 MICROBIOLOGY L T P C

3 0 0 3

AIM

To introduce students to the principles of Microbiology to emphasize structure and biochemical aspects of various microbes.

OBJECTIVE

- To provide to the students the fundamentals of Microbiology and solve the problems in microbial infection and their control.

UNIT I INTRODUCTION 6

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

UNIT II MICROBES- STRUCTURE AND MULTIPLICATION 12

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages.

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 12

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT IV CONTROL OF MICROORGANISMS 6

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms.

UNIT V INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY 9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors

TOTAL: 45 PERIODS

TEXT BOOKS

1. Pelczar M.J., E.C.S. Chan and N.R. Krieg. "Microbiology". 5th Edition, Tata McGraw Hill,1993
2. Prescott, L.M., J.P. Harley, and D.A. Klein. " Microbiology," 7th Edition, Mc Graw-Hill, 2008
3. Casida, L.E. "Industrial Microbiology". New Age International, 1968.
4. Reed, Gerald "Prescott & Dunn's Industrial Microbiology" 4th Edition, CBS, 1987.

REFERENCES

1. Schlegel, Hans G. " General Microbiology", Cambridge University Press, 1993.
2. Stanier, Roger Y etal., "General Microbiology" 5th Edition, Macmillan, 1986.
3. Talaro, Kathleen and Arthur Talaro. "Foundations in Microbiology" 2nd Edition, Wm.C. Brown Publishers, 1996.

PH9207 PHYSICAL & ORGANIC CHEMISTRY LAB L T P C
0 0 4 2

1. Determination of Heat of ionisation / Neutralisation of acids.
2. Determination of rate constants and activation energy of simple first and second order reactions.
3. General acid catalysed reactions – Catalytic coefficients and Dissociation Constants.
4. Determination of molecular weight of substances.
5. Experiments based on the principles of Electrochemistry. Applications of Thermodynamic principles and Surface Chemistry.
6. Systematic qualitative analysis of organic compounds by solubility, elemental analysis, group detection, physical constant and derivatization
7. Estimation of selected organic compounds such as aniline/phenol, formaldehyde/acetone, glucose, glycerol.
8. Neutral equivalence of acids and bases and estimations of the following functions groups-amide, ester, acid, amino nitro.
9. Separation and purification of binary mixtures of the type: water soluble water insoluble – water insoluble, liquid-solid and liquid-liquid.
10. Preparation of simple organic compounds involving importance unit operations.

TOTAL : 60 PERIODS

REFERENCES

1. Shoemaker, D.P., C.W. Garland and J.W. Nibler "Experiments in Physical Chemistry", 5th Edition, McGraw-Hill, 1989.
2. Furniss, B.S. etal., "Vogel's Textbook of Practical Organic Chemistry", 5th Edition, [EIBS] Addison Wesley Longman Ltd., 1989.
3. Leonard, J., B. Lygo and G. Procter "Advanced Practical Organic Chemistry", 2nd Edition, Stanley Thomes Pvt. Ltd., 1998

IB9208 **MICROBIOLOGY LAB** **L T P C**
0 0 4 2

(Common for IBT, Food and Pharmaceutical Technology)

EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques;
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining
6. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
7. Effect of Disinfectants- Phenol Coefficient
8. Antibiotic Sensitivity Assay
9. Growth Curve in Bacteria and Yeast
10. Effect of pH, Temperature, UV radiation on Growth Bacteria

EQUIPMENT NEEDED FOR 20 STUDENTS

Autocalve	1
Hot Air Oven	1
Incubators	2
Light Microscopes	4
Incubator Shaker	1
Colorimeter	2
Lamina Flow Chamber	2
Glassware, Chemicals, Media	as required

TOTAL : 60 PERIODS

TEXT BOOKS

1. Cappuccino, J.G. and N. Sherman "Microbiology : A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

MA9261 **PROBABILITY AND STATISTICS** **L T P C**
3 1 0 4

AIM

This course aims at providing the required skill to apply the statistical tools in engineering problems.

OBJECTIVES

- The students will have a fundamental knowledge of the concepts of probability.
- Have knowledge of standard distributions which can describe real life phenomenon.
- Have the notion of sampling distributions and statistical techniques used in management problems.

UNIT I RANDOM VARIABLES 9 + 3

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – χ^2-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 9 + 3

Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9 + 3

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

L: 45, T: 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata 4th Edition, McGraw Hill, 2007.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", 7th Edition, Pearson Education, Asia, 2007.

REFERENCES

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", 7th Edition Thomson Brooks/Cole, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", 8th Edition. Pearson Education, Asia, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists," 3rd Edition, Elsevier, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw- Hill, 2004.

IB9213 INSTRUMENTAL METHODS OF ANALYSIS L T P C
3 0 0 3

AIM

To introduce students to the principles and methods of biological instruments.

OBJECTIVE

- To provide to the students the fundamentals of instrument knowledge and their applications in biology.

UNIT I OPTICAL SPECTROSCOPY 9

Design of Experiments – Error Analysis – S/N ratio – Limit of Detection – UV –VIS Spectroscopy, Applications, Instruments – single beam, double beam and Photo-diode array – applications – IR & Raman – Uses – Design – FTIR, Raman.

UNIT II CHROMATOGRAPHY 9

Distribution coefficients – solid-liquid, liquid-liquid and gas chromatography – theory of chromatography-normal phase & reverse phase chromatography – gel permeation – ion exchange & affinity chromatography – HPLC- Instrumentation & case studies.

UNIT III STRUCTURAL ELUCIDATION 9

Nuclear Magnetic Resonance – Introduction-spin states – 1H, 13C NMR – Instrumentation- use in structural elucidation. Electron Paramagnetic Resonance-concept & instrumentation – use in metal containing proteins & membrane studies. X-Ray : X-ray spectroscopy –Auger – EELS Instrumentation & applications in Biology- X-ray diffraction- Instrumentation –small molecule & macromalecular crystallography.

UNIT IV MASS SPECTROMETRY 9

Introduction – Instrumentation – CI, EI-Methods of Ionization- Methods for separation of Ions – Method for Detection. MALDI- TOF, ESI and FT-MS.

UNIT V ELECTROCHEMICAL MEASUREMENTS 9

Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous Silicon.

TOTAL : 45 PERIODS

TEXTBOOKS

1. Skoog, D.A., f.J. Holler and S.R. Crouch “Principles of Instrumental Analysis”.6th Edition, Thomson/Brooks/Cole, 2002.
2. Willard, H.H. etal., “Instrumental Methods of Analysis”.7th Edition. CBS Publishers, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis” Pharma Book Syndicate, 1987.
4. Ewing, G.W. “Instrumental Methods of Chemical Analysis” 5th Edition, Tata McGraw-Hill, 1985

GE 9261 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

AIM

To create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participates.

OBJECTIVE

- At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Masters, G.M. "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 1998.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, 2006.

REFERENCES

1. Trivedi, R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Senger, Dharmendra S. "Environmental Law", Prentice Hall of India, 2007.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.

PH9021 MEDICINAL CHEMISTRY L T P C
3 0 0 3

UNIT I CONCEPT OF AROMATICITY AND AROMATIC 9

Characteristics of organic compounds. Huckel rule, Structures of benzenoid and nonbenzenoid compounds. Idea of homoaromaticity and antiaromaticity. Orienting influence of different substituents present in benzene and naphthalene rings – Charge distribution method and stability of the intermediate method, general mechanism of an aromatic electrophilic substitution reaction. Friedel–Crafts and related reaction: Principle involved, alkylation and acylation, industrial applications, Fries rearrangement, Hoesch reaction, formylation reactions – Gatterman, Gatterman-Koch, Vilsmeyer, Reimer – Tiemann, Duff, chloromethylation reaction, Kolbe reaction.

UNIT II HALOBENZENES 9

Halogenation reaction, Aromatic nucleophilic substitution reactions, Mechanisms including benzyne mechanism. Nitroaromatics: Mechanisms of aromatic nitration reaction, Uses of nitrocompounds, Reduction products of nitrocompounds. Aromatic amines: Methods of introduction of amino group in an aromatic nucleus, Basicity of rections of diazototization reaction and reactions of aryl diazonium salts such as – Sandmeyer, Gatterman, Ullmann, azocoupling, deamination, etc. and Benzidine rearrangement. Aromatic sulphonic acids: Sulphonation rection, Chlorosulphonation, Reactions of Uses of SO_3H group as the blocking group, Kinetic and thermodynamic controls of the reaction.

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UNIT III PHYSIOCHEMICAL PRINCIPLES AND STRUCTURE ACTIVITY CONCEPTS WITH EXAMPLES 9

Modern method of drug design and discovery ,Cardiovascular drugs, Antidiabetics, anticancer, antiviral, drug metabolism, diuretics, diagnostic agent (radio opaque and other) other than biochemistry based.

UNIT IV HETEROCYCLIC AROMATIC COMPOUNDS 9

Nomenclature, Aromaticity of pyridine, pyrrole, thiophene and furan, Dipole moment, Reactive sites and stabilities of these heterocycles. Synthesis: General principles of heterocyclic synthesis, methods of preparation of pyridines, pyrroles, hiophenes and furans, quinolines and isoquinolines. Reactions of pyridine, pyrrole, furan and thiophene, pyridine-N-oxide.

UNIT V STRUCTURE ELUCIDATION 9

Structure elucidation of organic molecules by chemical and instrumental methods

TOTAL: 45 PERIODS

TEXT BOOKS

1. Nogardy, Thomas, Donald F. Weaver, “Medicinal Chemistry: A Molecular and Biochemical Approach”. Oxford University Press, 2005
2. Nath, R.L. “A Textbook of Medicinal Biochemistry”. New Age International, 1996

REFERENCES

1. Thomas, Gareth, “Fundamentals of Medicinal Chemistry”. John Wiley & Sons Ltd. 2003.
2. Block J.H., “Wilson and Gisvold’s Text Book of Organic, Medicinal and Pharmaceutical Chemistry”. 11th Edition, Lippincotts William Wilkins, 2004.
3. March, Jerry. “Advanced Organic Chemistry: Reactions, Mechanisms and Structure”, 4th Edition, John Wiley, 2007.

PH9251 FUNDAMENTALS OF HUMAN ANATOMY & PHYSIOLOGY L T P C
3 0 0 3

UNIT I FOUNDATIONS OF PHYSIOLOGY 7

Organization of the Human Body , Chemical Foundations – Atoms, Ions, Molecules, Bonds, Solutions, Classes of organic molecules; Physical Foundations – Morphology of the cell (plasma membrane, nucleus, cell organelles) Tissue Organization, Cellular Transport – Intracellular movement, Intercellular movement, Movement of molecules across the plasma membrane

UNIT II HOMEOSTASIS AND INTERCELLULAR COMMUNICATION 9

Nervous and Muscular Systems; The Brain & Nervous System ; Structure of the Neuron ; Types of Neurons ; The Central Nervous System – Brain, Spinal cord, Limbic system; The Peripheral Nervous System – Afferent division, Efferent division (somatic nervous system, autonomic nervous system [sympathetic & parasympathetic divisions]) ; Receptors The Blood-Brain Barrier Membrane Potentials – Graded potentials & Action potentials (resting, initiation, transmission and integration of neural signals);

UNIT III SYNAPSES NEUROTRANSMITTERS & NEUROMODULATORS 7

The Muscular System, Types of Muscle Tissue – Skeletal (types of skeletal muscle fibres), Smooth (types of smooth muscle fibres), Cardiac muscle Muscle Contraction – Skeletal muscle fibre & Smooth muscle fibre Regulation.

UNIT IV CARDIOVASCULAR AND RESPIRATORY SYSTEMS 9

The Cardiovascular System ,Structure of the Heart , The Cardiac Cycle
Regulation;The Circulation of Blood – Pulmonary, Systemic & Portal circulation; The Vascular System – Arteries, Arterioles, Capillaries,
Venules, Veins; The Respiratory System Structure – The lungs & Airways; The Dynamics of Respiration, Gas Exchange, Gas Transport in Blood Regulation

UNIT V THE RENALSYSTEM AND REGULATION OF ACID-BASE BALANCE 13

The Renal System Structure – The renal system & Kidney ; Structure of the Nephron & Network of Blood Capillaries ;Types of Nephrons , Formation of Urine, Concentration of Urine; Regulation of Acid-Base Balance; The Chemical Acid-Base Buffer Systems of Body Fluids; Role of the Respiratory System,Role of the Kidneys
THE GASTROINTESTINAL SYSTEM AND ENDOCRINE CONTROL OF GROWTH & METABOLISM
The Gastrointestinal System; Structure & Function of the Gastrointestinal Tract (secretion, motility, digestion and absorption) , Structure & Function of the Liver, Spleen & Pancreas (exocrine) ;Endocrine Control of Growth & Metabolism; Endocrine Glands – Pituitary, Thyroid, Parathyroids, Adrenals, Islets of Langerhans, Pineal, Thymus, Testes, Ovaries (endocrine control of ovaries in the female life cycle – puberty, pregnancy, childbirth, menopause) – Structure, Hormones & Functions

TOTAL : 45 PERIODS

TEXT BOOKS

1. Guyton, A.C. and Hall,J.E. “Textbook of Medical Physiology”, 11th Edition, Saunders, 2006.
2. Ganong, W.F. “Review of Medical Physiology”, 22nd Edition (A Lange Medical book series) McGraw – Hill (International Ed.) 2005.
3. Khurana, Indu “A Textbook of Medical Physiology” Elsevier, 2006.
4. Johnson, L.R. “Essential Medical Physiology”, 3rd Edition, Academic Press / Elsevier), 2003.

REFERENCES
1. Waugh, Anne and Allison Grant "Ross and Wilson Anatomy and Physiology in Health and Illness", 10th Edition, Churchill – Livingstone / Elsevier), 2006.
2. Carola, R., J.P. Harley and C.R. Noback. "Human Anatomy & Physiology", 2nd Edition, McGraw – Hill, 1992.
3. Vander, A.J., J.H. Sherman and D.S. Luciano "Human Physiology: The Mechanisms of Body Function", 5th Edition, McGraw – Hill, 1990.

CH9023 BIOCHEMICAL ENGINEERING L T P C
(Common for Food and Pharmaceutical Technology) **3 0 0 3**

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 9

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, pH and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION 6

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

UNIT IV OVERVIEW OF FERMENTATION PROCESSES 9

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT V RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 12

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

TOTAL: 45 PERIODS

TEXT BOOKS
1. Bailey, J.E. and Ollis, D.F. "Biochemical Engineering Fundamentals", 2nd Edition, McGraw-Hill, 1986.
2. Blanch, H.W. and D.S. Clark "Biochemical Engineering", Marcal Dekker, Inc., 1997.
3. Lee, James M. "Biochemical Engineering", Prentice – Hall, 1992.

REFERENCES

1. Palmer, Trevor "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Affiliated East-West Press Pvt. Ltd., 2004.
2. Stanbury, P.F., A. Whitaker and S.J. Hall "Principles of Fermentation Technology", 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
3. Wiseman, Alan "Handbook of Enzyme Biotechnology", 3rd Edition, Ellis Harwood Publications, 1999.
4. Hartmeier, Winfried "Immobilized Biocatalysts : An Introduction", Springer – Verlag,1986.

CH9034 FUNDAMENTALS OF HEAT AND MASS TRANSFER L T P C
3 0 0 3

(Common for Food and Pharmaceutical Technology)

AIM

To understand the principles and applications of heat and mass transfer operations.

OBJECTIVES

- To understand and apply the principles in heat transfer phenomena.
- To understand and apply the principles in mass transfer phenomena.
- To design heat and mass transfer equipments.

UNIT I HEAT TRANSFER 11

Phenomena of heat transfer by conduction-concept of heat conduction resistances – application of heat conduction in series – heat transfer coefficient –heat convection phenomena- application for different situations –combined conduction and convection-overall heat transfer coefficient –application to design of heat exchangers- Principles of radiation heat transfer – Laws in radiation- View factor concepts – application.

UNIT II DIFFUSION & MASS TRANSFER COEFFICIENTS 8

Diffusion in Mass Transfer –gas, liq, solid diffusion and mass transfer-Diffusion in biological solutions-measurement of diffusion Coefficients – concept of mass transfer Coefficients-application for different situations.

UNIT III ABSORPTION 9

Interphase mass transfer and overall mass transfer Coefficients – Absorption equipments-Hydraulics of Packed Absorbers-Process Design of Packed Absorbers-Concept of height of transfer units and number of transfer units in design.

UNIT IV DISTILLATION 9

Vapour Liquid equilibrium and distillation-simple Distillation, Steam distillation, Flash distillation-Staged distillation Column-Design by Mc Cabe-Thiele method-Enthalpy-Concentration diagrams and use in Distillation Column design.

UNIT V LIQUID EXTRACTION & LEACHING 8

Principles of liq-extraction-Equilibrium –staged extraction calculation – continuous extraction equipments. Principles of Leaching –equilibrium-staged leaching – Leaching equipments. Principles of adsorption -Design of packed adsorber.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Treybal, R.E. "Mass-Transfer Operations" 3rd Edition, McGraw-Hill, 1981.
2. Dutta, Binay, K. "Principles of Mass Transfer and Separation Process", PHI, 2007.
3. Nag, P.M. "Heat and Mass Transfer", 2nd Edition, Tata McGraw-Hill, 2007.
4. Geankoplis, C.J. "Transport Processes and Separation Process Principles (Includes unit Operations) 4th Edition, PHI, 2003.

REFERENCES

1. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004.
2. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, Mc Graw Hill, 2003.

CY9214 INSTRUMENTAL METHODS OF ANALYSIS LAB **L T P C**
0 0 4 2

1. Precision and validity in an experiment using absorption spectroscopy .
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the molar absorbtivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.
6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO_4^{--} by nephelometry.
8. Estimation of Al^{3+} by flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

TOTAL : 60 PERIODS

IB9256 CHEMICAL ENGINEERING LAB **L T P C**
0 0 4 2

1. Flow measurement
2. Pressure drop in pipes and packed columns
3. Fluidization
4. Filtration
5. Heat exchanger
6. Simple and steam distillation
7. Distillation in packed column
8. Liquid-liquid equilibria in extraction
9. Adsorption equilibrium

TOTAL : 60 PERIODS

FT9301 BIOCHEMICAL ENGINEERING II L T P C
3 0 0 3

AIM

To expose the students to the principles, methods and techniques of cultivation at industrial scale.

OBJECTIVE

- To understand the methods of sterilization
- To understand the metabolic phenomenon
- To predict the kinetics of growth, product formation etc.

UNIT I STERILIZATION KINETICS 5

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous.

UNIT II METABOLIC STOICHIOMETRY AND ENERGETICS 12

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT III KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION- UNSTRUCTURED KINETIC MODELS 8

Modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, growth of filamentous organisms, product formation kinetics - Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

UNIT IV KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION- STRUCTURED KINETIC MODELS 8

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model.

UNIT V BIOREACTOR SCALE – UP 12

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – Mass transfer Coefficient- methods for the determination of mass transfer coefficients; mass transfer correlations. Power requirements of Bioreactors. Scale-up considerations on heat transfer oxygen transfer, power consumption and impeller tip speed.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Lee, James M. “Biochemical Engineering”, PHI,1992.
2. Shuler, M.L. and Kargi, F. “Bioprocess Engineering : Basic Concepts”, 2nd Edition, PHI, 2002.
3. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals” 2nd Edition, McGraw – Hill, 1988.
4. Blanch, H.W. and Clark, D.S. “Biochemical Engineering”, Marcel Decker Inc., 1997.

REFERENCES

1. Moser, Anton. “Bioprocess Technology : Kinetics and Reactors”, Springer – Verlag, 1988.
2. Stanbury, P.F. etal. “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann / Elsevier, 1995.

IB 9305 MOLECULAR BIOLOGY L T P C
3 0 0 3

UNIT I CLASSICAL GENETICS 5

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

UNIT II STRUCTURE OF NUCLEIC ACIDS AND DNA REPLICATION 15

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

UNIT III TRANSCRIPTION 8

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

UNIT IV TRANSLATION 10

Elucidation of genetic code, mechanism, codon usage, suppressor mutation

UNIT V REGULATION OF GENE EXPRESSION 7

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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Friefelder, David, "Molecular Biology", 2nd Edition, Narosa Publishing House,1999.
2. Lewin Benjamin, "Genes IX" Jones and Bartlett, 2008.
3. Weaver, R.F. "Molecular Biology", 3rd Edition, McGraw Hill, 2005.

REFERENCES

1. Waston, J.D. "Molecular Biology of the Gene", 5th Edition, Pearson Education, 2004.
2. Walker, J.M. and R. Rapley "Molecular Biology and Biotechnology" 4th Edition, Panima, 2002.
3. Karp, Gerald. "Cell and Molecular Biology :Concepts and Experiments."2nd Edition, John Wiley & Sons, 1999.

PH9301 PHARMACEUTICAL ANALYSIS L T P C
3 0 0 3

AIM OF THE COURSE

To provide the student with a basic understanding of the format of the pharmacopoeial monograph and the major physical and instrumental methods used in the monographs to specify standards, the scope, advantages and disadvantages together with a brief account of the regulatory framework such as The Drugs and Cosmetics Act 1940 and an introduction to the ICH Guidelines.

UNIT I INTRODUCTION, PHYSICAL METHODS, GRAVIMETRY 9

Introduction to Pharmaceutical Analysis, Definition, Significance, Differences in analysis of synthetic, herbal and genetically modified drugs, Qualitative and quantitative analysis, connection between quality, safety and efficacy, Drugs and Cosmetics Act 1940, Pharmacopoeia, Typical monograph, IP, ICH Guidelines.

Physical methods: Melting point, Boiling point, refractive index, optical rotation, density, specific gravity, Gravimetry, Thermogravimetry - uses, limitations, advantages, and method of determination for each method

UNIT II ACID-BASE TITRATIONS 9

Introduction, definitions of titration, analyte, acid base theory- Arrhenius, Bronsted-Lowry, Lewis acid, Acid-base strength, conditions for use of titrimetry, precision, accuracy, ion product of water, Henderson-Hasselbalch equation, uses, limitation, pH, buffer, effective range, acid-base indicators, theory of, effective range and choice of, titration curves for acid-base titration, mixed solvents, non-aqueous titration, pharmacopoeial applications

UNIT III OTHER TITRATIONS 9

Precipitation titration, Solubility Product, Argentimetric titrations, Mohr's method, Vollhard's method, examples in pharmacopoeia, complexometric tritration, indicators for, redox titrations, oxidation, reduction - definitions, half reactions and half equations, common oxidising and reducing agents used in volumetric analysis, redox equivalent weights, reduction potential, significance of reduction potential, standard reduction potentials, titrations with potassium permanganate, iodimetry, iodometry, iodine displacement reactions, phenol estimation, iodine absorbing substance in penicillins

UNIT IV ULTRAVIOLET SPECTROSCOPY 9

Electromagnetic spectrum, UV range, UV spectroscopy, principle of, factors governing absorption of radiation, electronic transitions and wavelength of absorption, Instrumentation source of light, sample, solvents used, UV spectrometer, terms used to describe structure- spectra relationships, Applications, structure effects, UV spectra of some representative drug molecules, benzenoid chromophore quantitative analysis, Beer Lambert Law, example of quantitative assay

UNIT V CHROMATOGRAPHY 9

Thin Layer Chromatography TLC, Rf, definition, How to run a TLC, Adsorbents, solvents, elutropic series, uses, limit test for impurities using TLC, known impurity, unknown impurity,

HPLC High Performance Liquid Chromatography, technique, advantages, basic HPLC, Columns, Detectors, Qualitative analysis and Quantitative Analysis, Packing materials, Normal and reversed phase, Solvents, HPLC terms, retention factor, selectivity factor, resolution, distribution of analytes between phases, theoretical plate.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". 8th Edition, Oxford University Press, 1977.
2. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol.I & II, CBS, 2006.
3. Parimoo, P. "Pharmaceutical Analysis". CBS, 1998.

REFERENCES

1. Gennaro, Alfonso R. "Remington : The Science and Practice of Pharmacy" Vol. I & II, 20th Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
2. Connors, Kenneth A. "A Textbook of Pharmaceutical Analysis". 3rd Edition,Johnwiley & Sons, 1982.
3. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis".Marcek Dekker, 2002.
4. Stahl, Egon "Thin – Layer Chromatography : A Laboratory Handbook". 2nd Edition, Springer, 2005.
5. Ermer, Joachim "Method Validation in Pharmaceutical Analysis ; A Guide to Best Practice", Wiley – VCH, 2005.
6. Evans, Gary "A Handbook of Bioanalysis and Drug Metabolism", CRC Press, 2004.

PH9302 PHARMACOKINETICS L T P C
3 0 0 3

UNIT I INTRODUCTION TO PHARMACOKINETICS 10

Definitions; biopharmaceutics, pharmacokinetics, the ADME process bioavailability, relevance to clinical practice;
GIT absorption of drugs – mechanisms, factors affecting drug absorption
Distribution, metabolism and elimination of drugs
Bioavailability and bioequivalence – definitions, federal requirements, methods of determination of bioavailability, protocol design for bioequivalence assessment

UNIT II COMPARTMENT AND NON-COMPARTMENTAL MODELS 3

COMPARTMENT MODELS: Preliminary aspects, concept of a compartment models, assumptions and limitations of models and modeling, open *v* closed systems types of models: catenary *v* mammillary ,kinetics: linear *v* non-linear

UNIT III ONE COMPARTMENT OPEN MODEL 10

Compartmental models – one compartment open model with first order kinetics – pharmacokinetics of single dose administration by IV "bolus" administration, IV infusions.

UNIT IV TWO COMPARTMENT MODEL 7

Two compartment open model with first order elimination kinetics, kinetics of single dose administration as applied to IV, oral administration. Pharmacokinetics of sustained release formulations.

UNIT V ABSORPTION KINETICS NON – LINEAR KINETICS AND NON COMPARTMENTAL MODELS 15

Curve fitting, Wagner nelson, Loo Riegelman, Urinary excretion - Michaelis Menton Kinetics-In Vivo estimation of K_m and V_m, Dosage Regimen - Non Compartmental Models

TOTAL : 45 PERIODS

TEXT BOOKS

1. Brahmanker, D.M. and S.B. Jaiswal "Biopharmaceutics and Pharmacokinetics : A Treatise". Vallabh Prakashan, 1995.
2. Venkateswarlu, V. "Biopharmaceutics and Pharmacokinetics". Pharmabook Syndicate, 2004.

REFERENCES

1. Notari, R.E. "Biopharmaceutical and Clinical Pharmacokinetics : An Introduction".4th Edition, Marcel Dekkar, 1987.
2. Welling, P.G. "Pharmacokinetics : Regulatory, Industrial and Academic Perspective". 2nd Edition, Marcel Dekker, 1995.
3. Gibaldi, Milo "Pharmacokinetics" 2nd Edition, Marcek Dekker, 1982.
4. Burton, M.E. "Applied Pharmacokinetics & Pharmocodynamics : Principles of Therapeutics" 4th Edition, Lippincott Williams Wilkins, 2006.
5. Shargel, Leon "Applied Biopharmaceutics & Pharmacokinetics". 5th Edition, McGraw – Hill, 2005.
6. Burton, M.E. "Applied Pharmacokinetics & Pharmacodynamics" : Principles Therapeutic Drug Monitoring". 4th Edition, Lippincott Williams & Wilking, 2006.

GE9023 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

AIM

To make the students understand the importance , relevance and potentialities of this emerging field of study.

OBJECTIVES

- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the importance role of physics, chemistry, biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

UNIT I INTRODUCTION 10

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 10

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

UNIT IV PREPARATION ENVIRONMENTS 10

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 10

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

TOTAL : 45 PERIODS

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), “The Hand Book of Nano Technology,Nanometer Structure”, Theory, Modeling and Simulations”, Prentice-Hall of India (P) Ltd, New Delhi, 2007.

IB9307 **MOLECULAR BIOLOGY LAB** **L T P C**
0 0 4 2

1. Isolation of bacterial DNA
2. Isolation of plant cell and animal cell genomic DNA
3. Agarose gel electrophoresis
4. Restriction enzyme digestion
5. Competent cells preparation
6. Transformation and screening for recombinants
7. Agarose gel electrophoresis
8. Restriction enzyme digestion
9. Competent cells preparation
10. Blue and white selection for recombinants
11. Plating of □□□phage
12. λ□ phage lysis of liquid cultures

TOTAL : 60 PERIODS

Equipments Required
Laminar flow hood
Shaker
Agarose gel electrophoresis kit
Refrigerated centrifuge

REFERENCE
1. Ausubal, F.M. "Short Protocols in Molecular Biology", 4th Edition, John Wiley, 1999.

PH9307 **PHARMACEUTICAL ANALYSIS LAB** **L T P C**
0 0 4 2

1. Standardization of analytical weights and calibration of volumetric apparatus.

2. **Acid Base Titrations** ; Preparation and standardization of acids and bases, some exercise related with determination of acids and bases separately in mixture form, some official assay procedure e.g. boric acid should also be covered.

3. **Oxidation reduction titrations ;** Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate, etc., some exercises related to determination of oxidizing and reducing agents in the sample shall be covered. Exercises involving potassium iodate, potassium bromate, iodine solution, titanous chloride, sodium 2,6,-di chlorophenol indophenol, ceric ammonium sulphate be designed.

4. **Precipitation Titrations ;** Preparation and standardization of titrants like silver nitrate and ammonium thiocyanate, titrations according to Mohrs Volhards and Fajans methods.

5. **Gravimetric Analysis :** Preparation of Gooch crucible for filtration and use of sintered glass crucible, determination of water of hydration, some exercises related to gravimetric analysis should be covered.

6. **Non-aqueous Titrations ;** Preparation and standardization of perchloric acid and sodium/ potassium/lithium methoxides solutions, Estimations of some pharmacopoeial products.

7. **Complexometric titrations ;** Preparations and standardization of EDTA solution, some exercises related to pharmacopoeial assays by complexometric titrations.

TOTAL : 60 PERIODS

REFERENCES

1. Atherden, L.M. "Bentley and Driver's Textbook of Pharmaceutical Chemistry". 8th Edition, Oxford University Press, 1977.
2. Siddiqui, Anees A. "Pharmaceutical Analysis". Vol.I & II, CBS, 2006.
3. Parimoo, P. "Pharmaceutical Analysis". CBS, 1998.
4. Higuchi, Tekeru and Brochmann, Einar "Pharmaceutical Analysis". CBS Publishers, 1997.
5. Gennaro, Alfonso R. "Remington : The Science and Practice of Pharmacy" Vol. I & II, 20th Edition, Lippincott Williams & Wilkins / B.I. Publication, 2000.
6. Connors, Kenneth A. "A Textbook of Pharmaceutical Analysis". 3rd Edition, Johnwiley & Sons, 1982.
7. Ohannesian, Lena and Streeter, A.J. "Handbook of Pharmaceutical Analysis". Marcek Dekker, 2002.
8. Stahl, Egon "Thin – Layer Chromatography : A Laboratory Handbook". 2nd Edition, Springer, 2005

PH9304 PHARMACOKINETICS LAB L T P C
0 0 4 2

1. Bioavailability studies - protein binding
3. One compartment models – IV Bolus
4. One compartment models – IV Infusion
5. 2 compartment models
6. Kinetics – oral administration
7. Kinetics – oral administration – Nelson Wagner
8. Kinetics based on urinary excretion data
9. Non Linear Kinetics
10. Computer Applications – Single Dose simulations

Equipments Required

Wet Granulator
Tablet dissolution test apparatus
Ultrasonics
Liquid filling
Tablet disintegration test apparatus
Friability test apparatus
Tablet hardness tester

TOTAL : 60 PERIODS

REFERENCES

1. Brahmanker, D.M. and S.B. Jaiswal "Biopharmaceutics and Pharmacokinetics : A Treatise". Vallabh Prakashan, 1995.
2. Venkateswarlu, V. "Biopharmaceutics and Pharmacokinetics". Pharmabook Syndicate, 2004.
3. Notari, R.E. "Biopharmaceutical and Clinical Pharmacokinetics : An Introduction". 4th Edition, Marcel Dekkar, 1987.
4. Welling, P.G. "Pharmacokinetics : Regulatory, Industrial and Academic Perspective". 2nd Edition, Marcel Dekker, 1995.

5. Gibaldi, Milo "Pharmacokinetics" 2nd Edition, Marcek Dekker, 1982.
6. Burton, M.E. "Applied Pharmacokinetics & Pharmocodynamics : Principles of Therapeutics" 4th Edition, Lippincott Williams Wilkins, 2006.
7. Shargel, Leon "Applied Biopharmaceutics & Pharmacokinetics". 5th Edition, McGraw – Hill, 2005.
8. Burton, M.E. "Applied Pharmacokinetics & Pharmacodynamics" : Principles Therapeutic Drug Monitoring". 4th Edition, Lippincott Williams & Wilking, 2006.

IB9351 CHEMICAL REACTION ENGINEERING L T P C
3 0 0 3

AIM

To understand kinetics of reaction and rate equations
To understand design principles of reactors.

OBJECTIVES

- To estimate kinetic parameter
- To apply design equations.

UNIT I KINETICS OF HOMOGENEOUS REACTIONS 10

Principles of Homogeneous reactions – and rate equations-estimation of rate constants using constant volume and constant pressure Batch reactor-data for typical reactions – Arrherius equation-Non elementary reaction kinetics-Multiple reactions-yield Concepts.

UNIT II IDEAL REACTORS 8

Performance equations for single batch reactor, ideal CSTR, ideal PFR-Application to design.

UNIT III MULTIPLE REACTORS & NON ISOTHERMAL REACTORS 8

Multiple reactor systems – selection of suitable reactor systems for multiple reactions-recycle reactor-Principles in non isothermal reaction and reactors.

UNIT IV NON IDEAL FLOW & REACTORS 10

Non Ideal reactors- Non Ideal Flow-Tracer experiments and application-TIS model, Axial Dispersion model-for tubular reactors. Exchange volume and By Pass and dead volume models for CSTR.

UNIT V MULTIPHASE REACTIONS & REACTORS 9

Gas-Liquid Reactions-kinetics-G-L reactor design Principles-Principle of Catalysis-types of Catalytic reactors-Concept of effectiveness factor in Catalytic reactions-G-L-S-reactors – slurry reactor.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Levenspiel, Octave "Chemical Reaction Engineering", 3rd Edition, John – Wiley & Sons, 1999.
2. Fogler, H.S. "Elements of Chemical Reaction Engineering", 2nd Edition, Prentice Hall, 1999.
3. Richardson, J.E. and D.G. Peacock "Coulson & Richardson's ChemicalEngineering", Vol.3 (Chemical & Biochemical Reactors & Process control) 3rd Edition, Butterworth – Heinemann / Elsevier, 2006.

REFERENCES

1. Missen, R.W. et al., "Chemical Reaction Engineering and Kinetics", John – Wiley,1999.
2. Davis, Mark E and Robert J. Davis "Fundamentals of Chemical Reaction Engineering" McGraw – Hill, 2005.
3. Harriot, Peter "Chemical Reactor Design" Marcel Dekker, 2003.
4. Sila, Harry "Chemical Process Engineering : Design and Economics" Marcel Dekker, 2003.
5. Nauman, E. Bruce "Chemical Reactor Design, Optimization, and Scaleup", McGraw – Hill, 2002.

IB9353 GENETIC ENGINEERING L T P C
3 0 0 3

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 4

Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

UNIT II CREATION OF RECOMBINANT MOLECULES 10

Restriction mapping, design of linkers and adaptors. Characteristics of plasmid and phage vectors, prokaryotic and eukaryotic expression vectors. Insect, Yeast and Mammalian vectors.

UNIT III CONSTRUCTION OF LIBRARIES 15

Construction of cDNA and genomic libraries. Screening of libraries with DNA probes and with antisera.

UNIT IV POLYMERASE CHAIN REACTION 10

Inverse PCR, Nested PCR, Taqman assay, Molecular beacons, RACE PCR, RAPD, site directed mutagenesis, methods of nucleic acid sequencing- Sangers method, (Kunkel's Method).

UNIT V APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY 6

Cloning in plants, Ti plasmid, and transgenic and knockout animals.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Primrose, S. Twyman, R. "Principles of Gene Manipulation and Genomics" 7th Edition, Blackwell Publishing, 2006.
2. Brown, T.A. "Gene Cloning & DNA Analysis : An Introduction", 5th Edition, Blackwell Publishing, 2006.
3. Watson, James., Molecular Biology of the Gene" 5ht Edition, Pearson Education, 2004.

REFERENCES

1. Winnacker, Ernst – L. "From Genes to Clones : Introduction to Gene Technology", Panima, 2003.
2. Karp, Gerald. "Cell and Molecular Biology : Concepts and Experiments", 4th Edition, John – Wiley & Sons, 2005.
3. Mc Pherson, M.J. and S.G. Moller "PCR" Bios Scientific Publication, 2000.
4. Hughes, S. and Moody, "PCR" Scion Publishing Ltd., 2007.
5. Glick, B.R. and J.J. Pasternak "Molecular Biotechnology : Principles and Applications of Recombinant DNA", 3rd Edition, ASM, 2003.

FT9351 SEPARATION PROCESS L T P C
3 0 0 3

AIM

To understand the principles involved in separation methods.

OBJECTIVES

- To understand Principles of separation methods used in the process industry.
- To appreciate different equipments developed for separation.

UNIT I SIZE REDUCTION 9

Characterisation of solid particles – Mixing of solids – equipments – storage of solids – size reduction of solids – Crushing, grinding Cutting-Power requirements-equipments-size enlargement.

UNIT II FLUID – SOLID SEPARATION 9

Separation of solids & suspension from gas medium-screening- settling- Principles and equipments-classification-clarification.

UNIT III FILTRATION 9

Filtration – Principles –Equipments-Centrifugal filtration-Principles- equipments – Centrifugal separation of immiscible liquids.

UNIT IV MEMBRANE SEPARATION 9

Cross flow filtration- Membranes –Ultrafiltration-Microfiltration-Concentration Polarisation-operation and equipments.

UNIT V DRYING & CRYSTALLISATION 9

Principles of Drying – Drying equipments Principles of Crystallisation- crystallization equipments.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Geankoplis, C.J. “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.
2. McCabe W.L., Smith J.C. “Unit Operations in Chemical Engineering”, 7th Edition, McGraw – Hill Int., 2001,

REFERENCE

1. Richardson, J.E. et al., “Coulson & Richardson’s Chemical Engineering” Vol.2 (Praticle Technology & Separation Processes”) 5th Edition, Butterworth – Heinemann / Elsevier, 2003.

PH9351 REGULATORY ISSUES IN PHARMACEUTICAL INDUSTRY AND DRUG VALIDATION **L T P C**
3 0 0 3

UNIT I REGULATORY ASPECTS **10**

Drugs & Cosmetics Act - Schedules particularly M, NPPA, Aspects of GMP, Magic Remedies Act, Prevention of Food Adulteration Act Pharmacopoeias, Drug control, FDA , ICH

UNIT II GOOD MANUFACTURING PRACTICE FOR PHARMACEUTICALS 5

Introduction, WHO guidelines, practice of GMP- Procedure (SOP'S), Building, Equipment, Personnel, Components, Documentation, Containers, Labeling, Laboratory Control, Distribution Records, Recovery & Reprocessing

UNIT III INTELLECTUAL PROPERTY RIGHTS AND ETHICAL ISSUES IN PATENTING LIFE FORMS **9**

What are patents, know-how, copyright, trademark, service mark, design, Conditions for patentibility; Indian Patent Act; Opposition and Infringements of patents; Case study on patenting indigenous products (e.g. Neem, turmeric), DNA, Microbes, Transgenic Plants and Animals Industrial property, TRIPS, WTO, treaties, Budapest Convention. Application process for a patent and the post application process.

UNIT IV ETHICAL ISSUES IN HEALTH AND DISEASE, TRANSGENIC TECHNOLOGY **12**

Animal experimentation: concerns of welfare, Justification of use of animals in research; use of alternatives; Human experimentation-Nuremberg code and Helsinki declaration; Assisted Reproductive Technologies, Pre-implantation genetic diagnosis, Surrogacy, Use of Embryos; Therapeutic and Reproductive Cloning-Ethical, Legal and Social Issues; genetic testing and Genetic Screening, Types of Testing, Clinical Utility and Validity of Tests, Testing processes, Social stigma, discrimination, misuse of data; HGP & ELSI, case study; Somatic and Germline gene therapy; Organ transplantation and Xenotransplantation; Eugenics and Euthanasia.

UNIT V ETHICAL ISSUES IN TRANSGENIC TECHNOLOGY; **9**

Genetically modified foods; genetically modified organisms; effect on biodiversity; guidelines for testing, transplantation and release-Cartagena Protocol on Biosafety Considerations; Transgenic animals for food and drugs; Terminator technology, GURTS and farmer's rights; Environmental Issues; DBT, NIH and Paul Berg guidelines on the use and release of transgenics. Biosafety and biodiversity: Classification of microorganisms based on safety, Biosafety levels, Risk groups, Risk Assessment and Management, Spill Protocols, Biosafety Containment guidelines; Biodiversity – Need and Methods for Protection; Convention for preservation of biodiversity and farmer's rights; patenting of biodiversity: ethical issues

TOTAL : 45 PERIODS

TEXT BOOKS

1. Malik, Vijay "Drugs and Cosmetics Act – 1940", 11th Edition, Eastern Book Co., 1998.
2. "Quality Assurance of Pharmaceuticals : A Compendium of Guidelines and Related Materials", Vol.I and Vol.II. Good Manufacturing Practices and Inspection", WHO / Pharma Book Syndicate, 2002.

REFERENCES

1. Abraham, John and Smith, Helen Lawton, "Regulation of the Pharmaceutical Industry", Palgrave / Macmillan, 2003.
2. Weinberg, Sandy "Good Laboratory Practice Regulations", 3rd Rev. Edition, Marcel Dekker Inc., 2003.
3. Gad. Shayne C. "Drug Safety Evaluation", John Wiley Intersciences, 2002.
4. Thomas, J.A. and Fuchs, R.L. "Biotechnology and Safety Assessment", 3rd Edition, Academic Press, 2002.

GE9022 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To under the various principles, practices of TQM to achieve quality
- To learn the various statistical approaches for quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL: 45 PERIODS

TEXT BOOK

1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia,Third Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.

GE9371 COMMUNICATION SKILLS AND SOFT SKILLS LAB L T P C
0 0 2 1

AIM

To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

OBJECTIVES

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

1. PC based session

A. Career Lab (15 periods) Viewing and discussing audio-visual materials

Resume / Report Preparation / Letter Writing: (3)
Letter writing – Job application with Resume - Project report - Email etiquette.

Presentation skills: (3)
Elements of effective presentation – Structure of presentation - Presentation tools – Body language.

3. Soft Skills: (3)
Time management – Stress management – Assertiveness – Negotiation strategies, Psychometrics - Analytical and logical reasoning.

Group Discussion: (3)
Group discussion as part of selection process, Structure of group discussion – Strategies in group discussion – Mock group discussions.

Interview Skills: (3)
Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

II. Class Room Session 45 periods

Resume / Report Preparation / Letter writing: Students prepare their own resume and report. (9)
Presentation Skills: Students make presentations on given topics. (12)
Group Discussion: Students participate in group discussions. (12)
Interview Skills: Students participate in Mock Interviews (12)

Note: Classroom sessions are practice sessions.

REFERENCES

1. Prakash, P. “Verbal and Non-Verbal Reasoning”. 2nd Edition. Macmillan India Ltd., 2004.
2. Seely, John. “The Oxford Guide to Writing and Speaking”. Oxford University Press, 2004.
3. Anderson, Paul V. “Technical Communication”. 6th Edition Thomson Wadsworth,2007.
4. Thorpe, Showick. “Objective English”. 2nd Edition, Pearson Education, 2007.
5. Evans, David.” Decision Maker”. Cambridge University Press, 1997.

Lab Requirement:

Teacher console and systems for students.
English Language Lab Software
Tape recorders

FT9402 **BIOPROCESS LAB** **L T P C**
0 0 6 3

AIM

To enable the students to understand the concepts and operation of equipment in handling of enzymes and cultivation of microbes on industrial scale .

OBJECTIVE

- To sterilize the bioreactor
- To operate the bioreactor
- To design experiments to evaluate the performance of the bioreactor
- To develop enzyme immobilized processes.

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – gel entrapment,cross linking
5. Preparation of bioreactor, utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, estimation of K_La – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of K_La – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

TOTAL : 90 PERIODS

REFERENCES

1. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals” 2nd Edition, McGraw – Hill, 1988.
2. Lee, James M. “Biochemical Engineering”, PHI, U.S.A.Stanbury, P.F. etal. “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann / Elsevier, 1995.
3. El-Mansi, E.M.T. etal., “Fermentation Microbiology and Biotechnology”, 2nd Edition, CRC / Taylor & Francis, 2007.
4. Peppler, H.J. and D. Perlman “ Microbial Technology” (vol. I Microbial Processes and Vol. I Fermentation Technology)” 2nd Edition, Academic Press / Elsevier, 2004.

Equipment Required:

Shaker
Laminar flow hood
Spectrophotometer
Laboratory scale reactor
Table top centrifuge

IB9355 GENETIC ENGINEERING LAB L T P C
0 0 4 2

1. Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Ligation of DNA into expression vectors
4. Transformation
5. Optimisation of inducer concentration for recombinant protein expression
6. Optimisation of time of inducer for recombinant protein expression
7. SDS-PAGE
8. Western blotting
9. Hybridisation with anti-sera
10. PCR.

TOTAL : 60 PERIODS

Equipments Required:

1. Laminar flow hood
2. Shaker
3. Agarose gel electrophoresis kit
4. Refrigerated centrifuge
5. Western blotting apparatus

REFERENCE

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols : From Molecular Cloning ; A Laboratory Manual" Cold Spring Herbor Laboratory Press, 2006.

IB9403 IMMUNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 6

Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.

UNIT II CELLULAR RESPONSES 12

Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses.

UNIT III INFECTION AND IMMUNITY 16

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; complement; immunosuppression, tolerance; allergy and hypersensitivity; AIDS and Immunodeficiencies; resistance and immunisation; Vaccines.

UNIT IV TRANSPLANTATION AND TUMOR IMMUNOLOGY 8

Transplantation: genetics of transplantation; laws of transplantation; tumor immunology.

UNIT V AUTOIMMUNITY 3

Autoimmunity, Autoimmune disorders and diagnosis.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Male, David et al., "Immunology", 7th Edition, Mosby Publication, 2007.
2. Kindt, T.J. etal., "Immunology", 6th Edition, W.H. Freeman, 2007.
3. Janeway, C.A. etal., "Immunology : The Immune Systems in Health and Diseases", 6th Edition, Garland Science, 2005.

REFERENCES

1. Coico, R. etal., "Immunology : A Short Course", 5th Edition, Wiley – Liss, 2003.
2. Parham, Peter "The Immune System", 2nd Edition, Garland Science, 2005.
3. Abbas, A.K. etal., "The Cellular and Molecular Immunology", 6th Edition, Sanders / Elsevier, 2007.
4. Weir, D.M. and Stewart, John "Immunology", 8th Edition, Churchill Pvt. Ltd., 2000.
5. Lydyard, P.M. "Instant Notes in Immunology", Viva Books Pvt. Ltd., 2000.

PH9401 FORMULATION OF DRUGS L T P C
3 0 0 3

UNIT I LIQUID DOSAGE FORMS, SEMI – SOLID DOSAGE FORMS 9

Introduction, types of additives used, vehicles, stabilizers, preservatives, emulsifying agents, solubilizers, colors, flavours , manufacturing, packaging and evaluation of solutions, suspensions and emulsions

Definitions, types, mechanisms of drug penetration through skin, factors influencing penetration, semisolid bases and their selection. General formulation/manufacture of semisolids, clear gels, evaluation and packaging.

UNIT II ORAL DOSAGE FORMS 12

Advantage and disadvantages of capsule dosage form, size of capsules, material for production of hard gelatin capsules, Formulation of hard gelatin capsules, method of capsule filling, soft gelatin capsule, shell and capsule content, stability testing & storage of capsule dosage forms.

Introduction to types of tablets; excipients, granulation techniques, Machinery for large scale granulation, compression machinery, In process controls, processing problems , Evaluation parameters and equipments.

Coating of tablets: objective, types of coating, film forming materials, formulation of coating solution, equipment for coating, coating process, evaluation of coated tablets , coating defects, specialized coating process.

Microencapsulation

UNIT III PARENTERAL PRODUCTS 9

Routes of administration, vehicles- aqueous, nonaqueous; pyrogenicity, Pyrogen testing, isotonicity, containers and closures -types, characteristics

Manufacture and evaluation of parenteral products - design of manufacturing facility, sources of contamination and method of prevention, aseptic techniques, evaluation

UNIT IV PHARMACEUTICAL AEROSOLS 6

definitions, propellants, general formulation, manufacture, packaging and evaluation

UNIT V CONTROLLED DRUG DELIVERY 9

concept, routes of delivery – design of oral, parental products, transdermal delivery, implants

TOTAL : 45 PERIODS

TEXT BOOKS

1. Lachman, Leon etal., "The Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publishing House, 1986.
2. Ansel, H.C. "Pharmaceutical Dosage Forms and Drug Delivery Systems", 7th Edition, Lippincott Williams & Wilkins, 2000.
3. Lieberman, H.A. etal., "Pharmaceutical Dosage Forms : Tablets" (Vol. I, II & III) 2nd Edition, Marcel Dekkar, 1989.

REFERENCES

1. Li, Xiaoling and Bhaskara R. Jasti "Design of Controlled Release Drug Delivery Systems", Mc Graw – Hill, 2006.
2. Wise, Donald L. "Handbook of Pharmaceutical Controlled Release Technology", Marcel Dekker, 2000.
3. Lieberman, H.A. etal., "Pharmaceutical Dosage Forms: Disperse Systems" (Vol.I, II & III) 2nd Rev. Edition, Marcel Dekker, 1996.
4. Avis, K.E. etal., "Pharmaceutical Dosage Forms : Parental Medications", (Vol.I, II & III) 2nd Rev. Edition, Marcek Dekker, 1992.
5. Jain, N.K. "Advances in Controlled and Novel Drug Delivery", CBS Publishers, 2001.
6. Jain, N.K. "Controlled and Novel Drug Delivery" CBS Publishers, 1997.

PH9402 PHARMOCOGNOSY L T P C
3 0 0 3

UNIT I **9**

Definition, history, scope and development of pharmacognosy.

UNIT II **9**

Sources and Classification of drugs : Biological, marine, geographical and plant tissue cultures as sources of drugs. Alphabetical, morphological, taxonomical, pharmacological and chemical. Cultivation, collection, processing and storage of crude drugs. Factors influencing cultivation of medicinal plants, types of soil and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants.

UNIT III **9**

Quality control of crude drugs : Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.

UNIT IV **9**

An Introduction to chemical constituents of drugs : their isolation, classification and properties & systematic pharmacognostic study of following :

a) Carbohydrates and derived products :Agar, Guar gum, Gum acacia, Honey, Isabgol, Pectin, Starch, Sterculia and Tragacanth.

b) Lipids : Bees wax, Castor oil, Coca butter, Cod-liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice bran oil, shark liver oil and wool fat.

c) Resins and resin combinations :Colophony, Podophyllum, Jalap, Cannabis, Capsicum, Myrrh, Asafoetida, Balsam of Peru, Balsam of Tolu, Benzoin, Turmeric.

d) Tannins and tannins containing drugs : Gambir, black catechu, gall and myrobalan.

e) Volatile oils : General methods of obtaining volatile oils from plants. Study of volatile oils of Mentha, Coriander, Cinnamon, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Cumin, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Musk, Palmarosa, Gaultheria, Sandal wood.

UNIT V **9**

Study of the biological sources, cultivation, collection, commercial varieties, chemical constituents, substitutes, adulterants, uses, diagonistic macroscopic and microscopic features and specific chemical tests of following groups containing glycosides. Saponins: glycyrrhiza, ginenseng, dioscorea, sarsaparilla and senega. Cardioactive sterols : digitalis, squill, strophanthus and thevitia. Anthraquinone cathartics: Aloe, Senna, rhubard and cascara. Psoralea, Ammi, gentian, saffron, chirata, quassia.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Evans, W.C. "Trease and Evans Pharmacognosy", 15th Edition, Saunders / Elsevier, 2005.
2. Kokate, C.K. etal., "Pharmacognosy", 39th Edition, Nirali Prakashan, 2007.
3. Wallis, T.E. "Textbook of Pharmacognosy", 5th Edition, CBS Publishers, 1985.

REFERENCES

1. Gennaro, A.R. "Remington : The Science and Practice of Pharmacy", Vol. I & II. 20th Edition, B.I. Publications Pvt. Ltd. / Lippincott Willisams & Wilkins, 2004.
2. Mohammed Ali, "Textbook of Pharmacognosy", 2nd Edition, CBS Publishers, 1994.
3. Kalia, A.N. "Textbook of Industrial Pharmacognosy", CBS Publishers, 2005.

PH9403 PHARMACOLOGY AND CHEMOTHERAPHY L T P C
3 0 0 3

UNIT I GENERAL PHARMACOLOGY **9**

Introduction to pharmacology, sources of drugs, dosage forms and routes of administration. Mechanism of action, combined effect of drugs, factors modifying drug action, tolerance and dependence, Pharmacogenetics drug receptors, dose response relationship. Absorption, Distribution, Metabolism and excretion of drugs. Principles of Basic and Clinical Pharmacokinetics. Adverse Drug Reactions and treatment of Poisoning, ADME drug interactions

UNIT II PHARMACOLOGY OF PERIPHERAL NERVOUS SYSTEM **9**

Neurohumoral transmission (autonomic and somatic), Parasympathomimetics, Parasympatholytics, Sympathomimetics, adrenergic receptor and neuron blocking agents, ganglionic stimulants and blocking agents. Neuromuscular blocking agents. Local anesthetic agents.

UNIT III AUTOCOIDS **9**

Histamine, 5-HT and their antagonists.Prostanglandins, thromboxane and leukotrienes. Pentagastrin, cholecystokinin, Angiotensin, Bradykinin and substance P.

UNIT IV CHEMOTHERAPY **12**

General principles of chemotherapy. Sulphonamides, co-trimoxazole, Quinolones,nitrofurans. Antibiotics:- Penicilines, cephalosporins, Betalactams, Tetracyclines, Aminoglycosides, Chloramphenicol, Erythromycin and Miscellaneous Antibiotics. Chemotherapy of tuberculosis, leprosy, fungal Diseases, viral diseases, urinary tract infections and sexually Transmitted Diseases [STD]. Chemotherapy of malignancy and Immunosuppressive Agents.

Chemotherapy of the parasitic diseases:- Helmenthiasis, malaria, amoebiasis and other Protozoal infections.

UNIT V IMPORTANT CLASS OF DRUGS OF CNS,CARDIAC AND GI SYSTEMS 6

Analgesics, Antiemetics, Antiulcer, Laxatives, Antihypertensives, Antihyperlipidemic and Antidiabetic drugs

TOTAL : 45 PERIODS

TEXT BOOKS

1. Sharma, V.N. "Essential of Pharmacology", 2nd Edition, CBS Publishers, 2003.
2. Tripathi, K.D. "Essential of Medical Pharmacology", 6th Edition, Jaypee Bros. Med. Pub., 2008.
3. Bennett, P.N. and Brown. M.J. "Clinical Pharmacology", 9th Edition, Churchill Livingstone, 1998.

REFERENCES

1. Elmer, G.W. etal., "Biotherapeutic Agents and Infections Diseases", Humana Press, 1999.
2. Hickman, J.A. and Caroline Dive "Apoplosis and Cancer Chemotherapy", Humana Press, 1999.
3. Zhang, Jie "PARP as a Therapeutic Target", CRC Press, 2002.
4. Hardman, Jeol G. "Goodman & Gilman's The Pharmacological Basis of Therapeutics", 10th Edition, McGraw – Hill, 2001.
5. Mycek, M.J. etal., "Lippincott's Illustrated Reviews Pharmacology", 2nd Edition, Lippincott Williams & Wilkins, 2000.
6. Rang, H.P. etal., "Pharmacology", 5th Edition, Churchill Liningstone / Elsevier, 2003.
7. Dipalma, Joseph R. "Basic Pharmacology in Medicine", 3rd Edition, McGraw – Hill Publishing, 1990.
8. Satoskar, R.S. Bhandarker, S.D. and Rege, N.N. "Pharmacology and Pharmocotherapeutics", 9th Edition, Popular Prakasham, 2005.

GE9021 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

AIM

To sensitize the engineering students on blending both technical and ethical responsibilities.

OBJECTIVES

- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, (2000).

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

PH9404 COMPUTER AIDED DRUG DESIGN L T P C
0 0 4 2

Stereochemistry and Drug Design

Structurally Rigid Groups – Conformation – Configuration.

Structure, Activity Relationship

Changing size and shape – degree of unsaturation Additon and removal of ring system – New substitutions – methyl – halogen. Basic groups – changing existing substituents for a lead compound.

Quantitation Structure – Activity Relationship
Partitional parameters – partition coefficients – hepo substituent constants – electronic parmeters – Hammet constant steric parameters – Hansch analysis

Docking
Docking ligands to macromolecules – Docking algorithms - Dock – AUTODOCK

Molecular Simulations
Molecular dynamic simulations – GROMACS – GROMOS – AMBER

TOTAL : 60 PERIODS

TEXT BOOKS
1. Cohen, N.C. "Guide Book on Molecular Modeling on Drug Design", Academic Press / Elsevier, 2006.
2. Eliel, E.L. "Stereo Chemistry of Organic Compounds", John Wiley, 1994.
3. Leach, Andrew R. "Molecular Modeling and Applications", 2nd Edition, Pearson / Dorling Kindersley (India) Pvt. Ltd., 2010.

REFERENCES
1. Frenkel, Dean and Berend Smith "Understanding Molecular Simulation: From Algorithms to Applications", 2nd Edition Academic Press, 2002.
2. Lee, Mike S. "Integrated Strategies for Drug Discovery using Mass Spectrometry" John Wiley – Interscience, 2005.

PH9405 **PHARMACOGNOSY LAB** **L T P C**
0 0 4 2

1. Macroscopic Identification-1: Adhatoda, Datura, Cinnamon, Clove, Coriander Macroscopic Identification-2 Arjuna, Liquorice, Ashwagandha, Turmeric, Cardamom
2. Microscopic Identification-1: Adhatoda, Datura, Tulsi or suitable specimens
3. Microscopic Identification-2: Arjuna, Liquorice, Ashwagandha or suitable specimens
4. Chemical Screening: Adhatoda, Datura, Liquorice, Aloes, Acacia, Gelatin
5. Fibre analysis: Cotton, Silk, Wool, Jute
6. Herbarium- 10 specimens
7. Preparations: Potato from starch
8. Curcumin from turmeric or caffeine from tea leaves or nicotine from tobacco leaves or suitable preparation
9. Andrographolide form Andrographis or suitable preparation depending upon material and apparatus availability

TOTAL : 60 PERIODS

Equipments Required
Microscope

REFERENCES
1. Kokate, C.K. "Practical Pharmacognosy", 4th Edition, Vallabh Prakashan, 1994.
2. Sharma, Varun Dutt "Pharmacognosy : Practical Note book", CBS Publishers,2007.

PH9406 FORMULATION TECHNOLOGY LAB L T P C
0 0 4 2

1. Preparation and evaluation of suspensions
2. Preparation and evaluation of emulsions
3. Preparation and evaluation of creams
4. Preparation and evaluation of ointments
5. Preparation of granules
6. Physical parameters - angle of repose
7. Tablets - manufacture
8. Tablets - evaluation
9. Preparation and evaluation of injections
10. Preparation and evaluation of a sustained drug delivery dosage form

TOTAL : 60 PERIODS

Equipments Required
Mortar and Pestle
Sieve

REFERENCES

1. Lachman, Leon etal., "The Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publishing House, 1986.
2. Ansel, H.C. "Pharmaceutical Dosage Forms and Drug Delivery Systems", 7th Edition, Lippincott Williams & Wilkins, 2000.
3. Lieberman, H.A. etal., "Pharmaceutical Dosage Forms : Tablets" (Vol. I, II & III) 2nd Edition, Marcel Dekkar, 1989.
4. Lieberman, H.A. etal., "Pharmaceutical Dosage Forms: Disperse Systems" (Vol.I, II & III) 2nd Rev. Edition, Marcel Dekker, 1996.
5. Avis, K.E. etal., "Pharmaceutical Dosage Forms: Pareutal Medications", (Vol.I, II & III) 2nd Rev. Edition, Marcek Dekker, 1992.

MA9262 NUMERICAL METHODS L T P C
3 1 0 4

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 10 +3
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 8 + 3
Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 9 + 3
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9 + 3

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

L : 45 , T : 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, 2004.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', 3rd Edition Prentice Hall of India Private Ltd., 2007.

REFERENCES

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, 2006.
3. Brian Bradie, "A Friendly Introduction to Numerical analysis", Pearson Education Asia, 2007.

PH9022 PHARMACEUTICAL INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

UNIT I ACCOUNTANCY, FINANCE AND FOREIGN TRADE 7

Principles of Accountancy ledger posting and book entries preparation of trial balance columns of a cash book Bank reconcilation statement rectification of errors profits and loss account balance sheet purchase keeping and pricing of stocks treatment of cheques bills of exchange promissory notes and hundies documentary bills. (Preliminary idea) Principles of economics with special reference to the laws of demand and supply demand schedule demand curves general principles of insurance and inland and foreign trade procedure of exporting and importing goods.

UNIT II PHARMACEUTICAL MARKETING AND SALESMANSHIP 9

Introduction functions- buying selling transportation storage finance feedback information. Channels of distribution- wholesale retail depart mental store multipile shop and mail order business.

Principles of Sales promotion advertising ethics of sales merchandising literature detailing.

UNIT III MARKETING INFORMATION & RESEARCH 7

Marketing information system (MIS) components characteristics.Research-meaning process methods of data collection techniques types of survey.

UNIT IV PRINCIPLES OF MANAGEMENT:BASIC INFORMATION SERVICES 11

Concept of Management functions Administrative Management (planning organisation) Principles of Management (Co-ordination controlling communication decision-making leadership innovation Creativity Delegation of Authority / Responsibility Record keeping.) A brief exposure of the basic principles of materials Management ABC analysis

UNIT V INDUSTRIAL PSYCHOLOGY AND INDUSTRIAL SOCIOLOGY 11

Recruitment selection training efficiency evaluation compensation to the pharmacist service conditions Termination etc.) Motivation-Maslow's, theory Herzberg's theory approaches and styles of leadership

Meaning types role of industry in national development, cottage & large scale industry.Problems of industrialization w.r.t pharmaceutical industry. History of labour movement in India problems of trade unions in India (collective bargaining industrial disputes causes and remedies) labour welfare.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kesiraju, Krishna Phani “Pharma Sector : Trends and Cases”, Vol. I, II & III, ICFAI University, 2004.
2. Aishiya, Manish “TRIPS and Pharmaceutical Industry : Impact on Developing Countries”, ICFAI University, 2007.
3. Kaushesh, Anshul “Pharmaceutical Marketing : Emerging Trends”, ICFAI University, 2002.

REFERENCES

1. Kotler, P., and Kevin Lane Keller. “Marketing Management”, 12th Edition, Prentice Hall, 2006.
2. Sreenivasan, N.S. and V. Narayana “Managing Quality : Concepts and Tasks”,New Age International, 2005.
3. Pandey, I.M. “Financial Management”, 9th Edition, vikas Publications, 2004.
4. Wood, J.P. “Containment in the Pharmaceutical Industry”, Marcel Dekker, 2001.
5. Pala, Surya and A. Srikant “TRIZ : A New Framework for Innovations ; Concepts and Cases”, ICFAI University, 2005.
6. Suresh, K. “New Product Development : Concepts and Cases”, ICFAI University, 2006.
7. Narasimha Rao, A.V. “Pharma Patents : An Introduction”, ICFAI University, 2007.
8. Chakraborty, Shibashish “New Patent Regime ; Lessons for Indian Pharma”, ICFAI University, 2006.
9. Madapati, Ravi S. “Entrepreneurial Finance ; Concepts and Cases”, ICFAI University, 2004.

FT9026 TECHNICAL WRITING AND COMMUNICATION L T P C

3 0 0 3

UNIT I RESEARCH & WRITING 9

The project/term paper, selecting a topic, using a library, compiling a working bibilography, taking notes, plagiarism, outlining, writing drafts, guides to writing.

UNIT II MECHANICS OF WRITING 9

Spelling, punctuation, numbers, titles and quotations.

UNIT III FORMAT OF A TERM/PROJECT REPORT 9

Typing, paper, margins, spacing, heading and title of paper, page numbers, tables and illustrations, corrections and insertions, binding.

UNIT IV PREPARATION OF CITATIONS 9

General guidelines, placement, arrangement, citing books, citing articles in periodicals, documenting sources, what is a document, parenthetical documentation, information required in parenthetical documentation, readability, sample references.

UNIT V ABBREVIATIONS AND REFERENCES 9

Introduction, time, common scholarly abbreviations and references words, publishers names, symbols and abbreviations used in proof-reading and correction, literary and scientific indexing.

TOTAL : 45 PERIODS

TEXT BOOK

1. Gibaldi W.S. "Achtert Handbook for Writers of Research Papers ", Wiley Eastern, 1987.

REFERENCE

1. "Chicago Manual of Style 14th Edition", Chicaco, University of Chicaco Press, 1996.

PH9023 NATURAL AND SYNTHETIC DRUG TECHNOLOGY L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF DRUGS FROM NATURAL SOURCE 15

Introduction, history,Chemistry of selected natural products. Special emphasis on the synthesis of steroids, terpenes, alkaloids, pheromones, prostaglandins, macrolides and polyether antibiotics. Selected topics from the current literature.

UNIT II THE HERBAL DRUG INDUSTRY 10

Overview, potential, products. Plants in complementary and traditional systems of medicine

UNIT III API'S MANUFACTURE TECHNOLOGY 15

Overview of the drug industry evolution, economics, prospects, process development, scale up considerations Chemistry and synthesis of select examples of drugs belonging to important classess like cardiovascular, hormones, anti cancers, gastrointestinal etc

UNIT IV REGULATORY ASPECTS 2

Regulatory aspects:Guidelines for manufacture of herbal preparations standardization of natural drugs

UNIT V DRUGS FORM OTHER SOURCES 3

Drugs form other sources:Drugs from animal, marine sources - introduction, history, development

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bisset, N.G. and Wichtl, M. "Herbal Drugs and Phytopharmaceuticals", 2nd Edition, Meelpharmscientific Publishers / CRC, 2001.
2. Hanson, J.R. "Natural Products : The Secondary Metabolites", Royal Society of Chemistry, 2003.
3. Somesworo Rao, C. "The Chemistry of Process Development in Fine Chemical & Pharmaceutical Industry", Asian Books, 2004.

REFERENCES

1. Dewick, P.M. "Medicinal Natural Products : A Biosynthetic Approach", John Wiley, 2002.
2. Zhang, Lixin "Natural Products : Drug Discovery and Therapeutic Medicine", Humana, 2005.
3. Ikan, Raphael "Natural Products : A Laboratory Guide", Academic Press, 2005.

IB9309 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT L T P C
3 0 0 3

AIM

To introduce process economics and industrial management principles to chemical engineers.

OBJECTIVES

- The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

UNIT I PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION 15

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizationsMethod study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION 10

Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT8

Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 4

Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL 8

Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer.

Elements of quality control, role of control charts in production and quality control.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Peters, M. S. and Timmerhaus, C. D., " Plant Design and Economics for Chemical Engineers ", 5th Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., " Introduction to process Economics ", 2nd Edn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., " Production and Costing ", Khanna Publishers, New Delhi, 1988.

REFERENCES

1. Allen, L.A., " Management and Organization", McGraw Hill.
2. Perry, R. H. and Green, D., " Chemical Engineer's Handbook ", 7th Edition., McGraw Hill.

IB9402 PROTEIN ENGINEERING L T P C
3 0 0 3

UNIT I BONDS AND ENERGIES IN PROTEIN MAKEUP 5

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

UNIT II AMINO ACIDS AND THEIR CHARACTERISTICS 5

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), , Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) and peptide synthesis.

UNIT III PROTEIN ARCHITECTURE 12

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine

Super-secondary structure: Apha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures, Quaternary structure: Modular nature, formation of complexes.

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 15

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications.

UNIT V PROTEIN ENGINEERING 8

Advantages and purpose, overview of methods, underlying principles with specific examples: thermal stability T4-lysozyme, recombinant insulin to reduce aggregation and inactivation, *de novo* protein design.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Voet, D. and Voet, G., "Biochemistry". 3rd Edition, John Wiley and Sons, 2001.
2. Branden C. and Tooze J., "Introduction to Protein Structure", 2nd Edition, Garland Publishing, 1999.
3. Creighton, T.E. "Proteins : Structure and Molecular Properties", 2nd Edition, W.H. Freeman, 1993.

REFERENCES

1. Whitford, David "Proteins : Structure and Function". John Wiley & Sons, 2005.
2. Holland, I Barry & etal., "ABC Proteins : From Bacteria to Man". Academic Press Elsevier, 2003.
3. Alberghina, L. "Protein Engineering in Industrial Biotechnology". Harwood Academic Publications, 2000.
4. Moody P.C.E. and Wilkinson A.J. "Protein Engineering". IRL Press, Oxford, 1990.
5. Rees, A.R., Sternberg, M.J.E. and Wetzel, R. "Protein Engineering : A Practical Approach". IRL Press, 1992.

PH9024 BIO INFORMATICS L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Basic UNIX commands – telnet – ftp – protocols – hardware – topology -search engines – search algorithms.

UNIT II DATABASES 9

Data management – data life cycle – database technology – interfaces and implementation – biological databases and their uses

UNIT III PATTERN MATCHING & MACHINE LEANING 9

Pairwise sequence alignment – local vs. global alignment – multiple sequence alignment – dot matrix analysis – substitution matrices – dynamic programming – bayesian methods – tools – BLAST – FASTA- machine learning – neural networks – statistical methods – Hidden Markov models.

UNIT IV PHYLOGENY 9

Introduction; mutations; irrelevant mutations; controls; mutations as a measure of time; distances; reconstruction; distances between species; estimating time intervals from distances.

UNIT V ADVANCED TOPICS IN BIOINFORMATICS 9

Biomolecular and cellular computing – micro array analysis – systems biology.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bergeron,B. “Bioinformatics Computing”. PHI, 2002.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., “Instant Notes In Bioinformatics”. BIOS Scientific Publishers, 2000.
3. Gibas, C. and Jambeck,P. “Developing Bioinformatics Skills”, O'Reilly, 1999.

REFERENCES

1. Baxevanis, A.D. “Bioinformatics : A Practical Guide to the Analysis of Genes and Proteins”, John Wiley, 1998.
2. Gusfield, Dan “Algorithms on Strings, Trees and Sequences : Computer Science and Computational Biology”. Cambridge University Press, 1997.
3. Lesk, A.M. “Introduction to Bioinformatics”, Oxford University Press, 2003.
4. Attwood, T.K. “Introduction to Bioinformatics” Addison Wesley Longman, 1999.
5. Gautham, N. “Bioinformatics : Databases and Algorithms”, Narosa, 2006.

IB9024 METABOLIC ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT 9

Enhancement of Product yield and Productivity,Extension of substrate Range, Extension of Product spectrum and Novel products, Improvement of Cellular properties, Xenobiotic degradation.

UNIT II MATERIAL BALANCES AND DATA CONSISTENCY 9

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

UNIT III METABOLIC FLUX ANALYSIS 9

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

UNIT IV METABOLIC CONTROL ANALYSIS 9

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

UNIT V ANALYSIS OF METABOLIC NETWORKS 9

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

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephanopoulos, G.N. “Metabolic Engineering : Principles and Methodologies”. Academic Press / Elsevier, 1998.
2. Lee, S.Y. and Papoutsakis, E.T. “Metabolic Engineering”. Marcel Dekker, 1998.
3. Nielsen, J. and Villadsen, J. “Bioreaction Engineering Principles”. Springer, 2007.

REFERENCES

1. Voit, E.O. “Computational Analysis of Biochemical Systems : A Practical Guide for Biochemists and Molecular Biologists”. Cambridge University Press, 2000.
2. Scheper, T. “Metabolic Engineering” Vol 73 (Advances in Biochemical Engineering Biotechnology) Springer, 2001.
3. Rhodes, P.M. and P.F. Stanbury “Applied Microbial Physiology “ A Practical Approach”. IRL Press, 1997.
4. Caldwell, D.R. “Microbial Physiology & Metabolism”. Wm. C. Brown, 1995.
5. Rehm, H.J. and G. Reed, “Biotechnology : Products of Primary Metabolism Vol.6 and Biotechnology : Products of Secondary Metabolism Vol.7, VCH / Wiley, 1997.

FT9029 OPERATION RESEARCH L T P C

3 0 0 3

UNIT I **9**

Concept and Scope of Operation Research (OR) – Development of OR - Phases of OR – Models in OR. Linear Programming: Methods of solution – Graphical and SIMPLEX methods of solution – VARIATIONS – Duality in LP – Revised SIMPLEX method – Application for business and Industrial Problems.

UNIT II **9**

Integer programming: Formulation – Graphical Representation – Gomory’s Cutting Plane Method. Transportation and Assignment Problems: Initial solution – Methods of improving the initial solution – travelling salesman Problem. Dynamic Programming – Principle of Optimality

UNIT III **9**

Sequencing and Scheduling Problems: Job sequencing – Jobs through Two Machines, Two Jobs through Machines and n Jobs through Machines. PERT and CFM techniques – Critical Path – Normal and crash time. Resource allocation – Resource Leveling and Smoothing

UNIT IV **9**

Inventory Problems: Deterministic model –Costs – Decision Variables – Economic order Quantity – Instantaneous and Non – Instantaneous receipt of goods with and without Shortage – Quantity Discount – Probabilistic inventory Model – Inventory systems– Safety Stock – Reorder Level (ROL) Reorder Point (ROP) determination.

UNIT V **9**

Maintenance and Replacement Problems: Models for routine maintenance and preventive maintenance decisions – Replacement models that deteriorate with time and those that fail completely. (srp/rm/vec)

TOTAL : 45 PERIODS

TEXT BOOKS

1. Sharma, S.D. “Operation Research” Kedarnath Ramnath & Co.,
2. Gillet, Billy E. “Introduction to Operation Research”, TMH Publishing Co.,
3. Gupta, P.K. and Manomohan “Operation Research and Quantitative Analysis”, S.Chand & Co.,

REFERENCE

1. Hambleis, S. and Stevens “Operation Research” McGraw – Hill, Taha, H.A. “Operation Research”, Macmillian,

PH9025 PRINCIPLES OF DRUG DESIGN L T P C
3 0 0 3

UNIT I INTRODUCTION TO THE DRUG DISCOVERY/DEVELOPMENT 9

Definition of Drug Discovery 2. Stages of drug discovery 3. Strategic Issues in drug discovery . Drug Development 1. Chemistry 2. Preclinical Studies 3. Transition from Preclinical to Clinical 4. Planning the Drug Development Process 5. Clinical Research C.. Source of Drugs 1. Drugs from Natural Sources (Natural Products) a. Plants b. Animals c. Microorganisms (Fungi, Bacteria) 2. Drugs from Organic Synthesis II.

UNIT II APPROACHES TO NEW DRUG DISCOVERY 9

A. Drugs Derived from Natural Products B. Existing Drugs as a Source for New Drug Discovery C. Using Disease Models as Screens for New Drug Leads D. Physiological Mechanisms: the Modern "Rational Approach" to Drug Design E: Approaches to Lead Optimization 1. Bioisosteric replacement 2. Conformation restriction a. Increase selectivity b. Increase affinity 3. Pharmacophore 4. Molecular dissection 5. Metabolic stabilization

UNIT III ENZYMES AS TARGETS OF DRUG DESIGN 9

(A. Enzyme kinetics 1. The Michaelis-Menten Equation 2. Steady state of an enzyme-catalyzed reaction 3. Validity of the Steady-state assumption, Graphs of the Michaelis-Mention Equation 5. Practical aspects of kinetic studies B. Enzyme inhibition and activation 1. Reversible and irreversible inhibition 2. Linear inhibition 3. Plotting inhibition results 4. Inhibition by a competing substrate 5. Enzyme activation C. Approaches to the Rational Design of Enzyme Inhibitors 1. Transition state analogues 2. Mechanism-based inhibitors 3. Affinity labels VI.

UNIT IV RECEPTORS AS TARGETS OF DRUG DESIGN 9

A. Receptor Theory B. Receptor Complexes and Allosteric Modulators C. Second and Third Messenger Systems D. Molecular Biology of Receptors F. Receptor Models and Nomenclature F. Receptor Binding Assays G. Lead Compound Discovery of Receptor agonists and antagonists 1. Natural Product Sources 2. Pharmacophore-based Ligand Libraries 3. Diversity-based ligand libraries 4. High-throughput screening.

UNIT V DESIGN OF PEPTIDOMIMETICS AND COMPUTER –AIDED DRUG DESIGN 9

Limitations of Peptides as Drugs B. Cyclization of Peptides C. Constrained Amino Acids D. Molecular Mimics for Secondary Structures E. Amide Bond Isosteres F. Nonpeptide Ligands for Peptinergic Receptors VIII. Molecular Mechanics Force Fields 1. Introduction 2. MM2/MM3/MM4 force fields 3. CFF93 force field 4. AMBER 5. CHARMM (BIO+)

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kothekar, V. "Essentials of Drug Designing", Dhruv Publications, 2005.
2. Chakraborty, Chiranjib "Pharmacogenomics : An Approach to New Drug Development", Biotech Books, 2004.
3. Krogsgaarao – Larsen, Povl, "Textbook of Drug Design and Discovery", 3rd Edition, Taylor & Francis, 2004.

REFERENCES

1. Wu – Pong, Susanna "Biopharmaceutical Drug Design and Development", Humana Press, 1999.
2. Welling, P.G. "The Drug Development Process : Increasing Efficiency and Coast Effectiveness", CRC / Taylor & Francis, 1996.

3. Schoenwald, R.D. “Pharmacokinetics in Drug Discovery and Development”,CRC Press, 2002.
4. Blaisdell, Peter “Twenty – First Century Pharmaceutical Development”,Interpharm Press, 2001.
5. Silverman, R.B. “The Organic Chemistry of Drug Design and Drug Action” 2nd Edition, Academic Press, 2004.
6. Jain, N.K. “Pharmaceutical Product Development”, CBS, 2006.

PH9026 IMMUNOTECHNOLOGY L T P C
3 0 0 3

UNIT I INTRODUCTION 4

Animal handling and restraint; managing immunocompromised animals; immunisation; blood collection; removal of lymphoid organs from mice; adjuvants: basics and mode of action.

UNIT II ANTIBODY PRODUCTION AND PURIFICATION AND APPLICATIONS 10

Production of antibodies: polyclonal and monoclonal; purification and fragmentation of antibodies; western blot analysis; immunoelectrophoresis; immunoprecipitation; ELISA, non-radio isotopic methods of detection – chemiluminescence assays.

UNIT III TECHNIQUES IN CELLULAR IMMUNOLOGY 12

Isolation and identification of mononuclear cell populations: fractionation; depletion; enrichment – FACS, MACS; T-cell activation assays – measurement of CTL activity; proliferative assays, estimation of cytokines; B-cell activation assays; macrophage activation assays.

UNIT IV TECHNIQUES FOR IMMUNOPATHOLOGY 7

Preparation and storage of tissues; identification of various cell types; immunohistochemistry, immunofluorescence, immunoenzymatic and immunoferritin techniques; immunoelectron microscopy; microarrays and expression analysis.

UNIT V THERAPEUTIC ANTIBODIES AND ANTIGENS 12

Engineered antibodies; antibody based fusion proteins; gene targeting – knockout animals; catalytic antibodies and catELISA; vaccine technology.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Male, David, Jonathan Brostoff, David B Roth and Ivan Roitt, “Immunology”, 7th Edition, Mosby / Elsevier, 2006
2. Kindt, T.J., R.A.Goldsby and B.A. Osborne, “Kuby Immunology”, 6th Edition, W.H. Freeman, 2007.
3. Weir, D.M. and J. Stewart “Immunology” 8th Edition, Churchil Livingstone, 2000.

REFERENCES

1. Harris, W.J. and Cunningham, C. “Antibody Therapeutics”. Springer, 1995
2. Wawrzyuczak, E.J. “Antibody Therapy”. BIOS Scientific Publication, 1995.
3. Borrebaeuk, Carl A.K. “Antibody Engineering”. 2nd Edition, Oxford University Press, 1995.
4. Shepherd, P. and Dean, C. “Monoclonal Antibodies”. Oxford University Press, 2000.
5. Rastogi, S.C. “Immunodiagnostics : Principles and Practice”. New Age International, 1996.

6. Lydyard, P.M. “Instant Notes in Immunology”, Viva Books, 2000.
7. Abbas, A.K., A.H. Lichtman and Shiv Pillai “Cellular and Molecular Immunology”, 6th Edition, Saunders / Elsevier, 2007.
8. Davis, J.M. “Basic Cell Culture : A Practical Approach”, IRL Press, 1994.
9. Master, J.R.W. “Animal Cell Culture”, 3rd Edition, Oxford University Press, 2000.
10. Glick, B.R. and J.J. Pasternak, “Molecular Biotechnology : Principles and Applications of Recombinant DNA”, 3rd Edition, ASM Press.

PH9027 PHARMACOGENOMICS L T P C
3 0 0 3

UNIT I INTRODUCTION TO PHARMACOGENOMICS 9

Pharmacogenetics-The roots of pharmacogenomics, It is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development.

UNIT II THE HUMAN GENOME 9

Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis, Genomic differences that affect the out come of host pathogen interactions: A template for the future of whole genome-based pharmacological science.

UNIT III ASSOCIATION STUDIES IN PHARMACOGENOMICS 9

Viability and ADR in drug response: contribution of genetic factor, Multiple inherited genetic factors influence the out come of drug treatments, Plasma binding proteins, Drug targets.

UNIT IV GENOMICS APPLICATIONS THAT FACILITATE THE DERSTANDING OF DRUG ACTION AND TOXICITY 9

Genomics, Proteomics, Bioinformatics, The pharmaceutical process, applications of pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization.

UNIT V PHARMACOGENOMICS AND DRUG DESIGN 9

The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug targets leading to change in the ligand binding pocket.

TOTAL : 45 PERIODS

TEXT BOOK

1. Chaknaborty, Chiranjib and Atanu Bhatta Charya “Pharmacogenomics : An Approach to New Drug Development”, Biotech Books, 2004.

REFERENCES

1. Rothstein, Mark A. “Pharmacogenomics: Social, Ethical and Clinical Dimensions”, John - Wiley & Sons, 2003.
2. Licinio, Julio and Ma-Liwong “Pharmacogenomics : The Search for Individualized Therapies”, Wiley – VCH, 2002.

PH 9028 DRUG BIOEVALUATION L T P C
3 0 0 3

UNIT I BIOASSAY OF DRUGS AND BIOLOGICAL STANDARDIZATION 9
Importance, principles and methods of bioassay. Pyrogen testing, discovery and development of New Drugs. Bioassay methods of important drugs.

UNIT II DRUGS ACTING ON THE HEMOPOIETIC SYSTEM 9
a) Haematinics. b) Anticogulants, Vitamin K and hemostatic agents. c) Fibrinolytic and anti-platelet drugs d) Blood and plasma volume expanders.

UNIT III DRUGS ACTING ON THE URINARY SYSTEM 9
a) Fluid and electrolyte balance. b) Diuretics.

UNIT IV DRUGS ACTING ON THE RESPIRATORY SYSTEM 9
a) Anti-asthamatic drugs including bronchodilators. b) Anti-tussives and expectorants. c) Respiratory stimulants

UNIT V DRUG ACTING ON THE GASTROINTESTINAL TRACT 9
a) Antacids, Antisecretory and Anti-ulcer Drugs. b) Laxatives and antidiarrhoeal drugs. c)Appetite stimulants and suppressants. d) Emetics and anti-emetics. e) In Miscellaneous; carminatives, demulcents, protectives, mucolytics, Adsorbants, Astringents, Digestants and Enzymes.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Tripathi, K.D. "Essentials of Medical Pharmacology", 6th Edition, Jaypee Brothers Medical Publishers, 2008.
2. Bennett, P.N. and M.J. Brown "Clinical Pharmacology", 9th Edition, Churchill Livingstone, 2003.
3. Dipalma, J.R. and G.J. Digregorio "Basic Pharmacology in Medicine", 3rd Edition, McGraw – Hill Publishing, 1989.

REFERENCES

1. Hardman, J.G. and L.E. Limbird "Goodman & Gilman's The Pharmacological Basis of Therapeutics", 10th Edition, McGraw – Hill, 2001.
2. Myeek, M.J. etal., "Lippincott's Illustrated Reviews Pharmacology", 2nd Edition, Lippincott Williams & Wilkins, 2000.
3. Rang, H. P. etal., "Pharmacology", 5th Edition, Churchil Livingstone, 2003.

IB9401 DOWNSTREAM PROCESSING L T P C
3 0 0 3

UNIT I DOWNSTREAM PROCESSING 10
Introduction to downstream processing principles characteristics of biomolecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts.

UNIT II PHYSICAL METHODS OF SEPERATION 6
Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS 12
Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 12

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bioaffinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 5

Crystallization, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Belter, P.A., Clussler, E.L. "Bioseparation – Downstream Processing & Biotechnology". John – Wiley Interscience, 1998.
2. Asenjo, Juan A. "Separation Processes in Biotechnology". Taylor & Francis / CRC, 1990.
3. Scopes, R.K. "Protein Purification : Principles and Practice". Narosa Publication, 1994.

REFERENCES

1. Ghosh, Raja "Principles of Bioseparations Engineering". World Scientific, 2006.
2. "Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

PH9029 CLINICAL RESEARCH AND REGULATIONS L T P C
3 0 0 3

UNIT I DRUG DEVELOPMENT MODULE 12

Drug development overview ,Phases of clinical research ,Pre-clinical (Non-clinical) development.Discovery and selection of compounds,Toxicology,,Pharmacology
Clinical Development programmes;Basics of clinical research statistics

UNIT II CLINICAL RESEARCH MODULE I 7

Understanding the evolving role of the Clinical Trial Administrator (CTA)/Clinical Project Assistant (CPA);Good Clinical Practice (GCP) and international harmonisation
Case Report Forms;Protocols ;Informed Consent ;Ethics Committees/Institutional Boards. Role of the Sponsor including the Clinical Research Associate/Monitor

UNIT III CLINICAL RESEARCH MODULE II 8

Clinical trial set up ;Trial Master Files and study filling,Data Management. Review of the EU Clinical Trial Directive;How to prepare for Regulatory Inspections or Audit; Fraud in clinical research

UNIT IV ADVANCED CLINICAL RESEARCH MODULE 9

Project Management ;How to develop a proactive approach to supporting clinical trials
Building a successful working relationship with your manager(s) and the rest of the clinical research team;Team effectiveness: working as an effective clinical research team ;Working in partnership with CROs .Legal aspects of clinical research ;Laboratory tests Communication skills,Cross-cultural communication with other offices and departments internationally.Time management and optimising your effectiveness

UNIT V REGULATORY AFFAIRS AND SAFETY MODULE 9

Regulatory requirements for international clinical research
Regulatory requirements for biotechnology products, medical devices and veterinary products ;Health economics ;Safety reporting;Responding to drug safety alerts
Postmarketing surveillance

TOTAL: 45 PERIODS

TEXT BOOKS

1. Matoren, Gary M. "The Clinical Research Process in the Pharmaceutical Industry", Marcel Dekker, 1984.
2. Abraham, John "Regulation of the Pharmaceutical Industry", Palgrave, 2003.
3. Blaisdell, Peter, "Twenty – First Century Pharmaceutical Development", Interpharm Press, 2001.

REFERENCE

1. Gad, Shayne C. "Drug Safety Evaluation", John – Wiley & Sons, 2002.

GE9071 CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT **L T P C 3 0 0 3**

AIM

To study the various issues related to Creativity, Innovation and New Product Development.

OBJECTIVES

- To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

UNIT I INTRODUCTION **9**

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION **9**

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

UNIT III NEW PRODUCT DEVELOPMENT **9**

Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

UNIT IV NEW PRODUCT PLANNING **9**

Design of proto type - testing - quality standards - marketing research - introducing new products

UNIT V MODEL PREPARATION & EVALUATION **9**

Creative design - Model Preparation - Testing - Cost evaluation - Patent application

TOTAL: 45 PERIODS

TEXT BOOKS

1. Brain Twiss, "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. Harry B.Watton, "New Product Planning", Prentice Hall Inc., 1992.

REFERENCES

1. Harry Nystrom, "Creativity and Innovation", John Wiley & Sons, 1979.
2. N.Khandwalla – "Fourth Eye (Excellence through Creativity) - Wheeler Publishing", Allahabad, 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.