ANNA UNIVERSITY TIRUCHIRAPPALLI
Tiruchirappalli – 620 024

Regulations 2008

Curriculum

B.TECH. PHARMACEUTICAL TECHNOLOGY

SEMESTER III

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**MA1201**	Transforms and Partial Differential Equations	3	1	0	4
2	**PH1201**	Pharmaceutical Organic Chemistry	4	0	0	4
3	**HS1201**	Environmental Science and Engineering	3	0	0	3
4	**PH1202**	Physical Pharmaceutics	4	0	0	4
5	**CH1204**	Process Calculations	4	0	0	4
6	**CH1205**	Fluid Flow Operations	4	0	0	4
Practical						
7	**PH1203**	Pharmaceutical Organic Chemistry Laboratory	0	0	3	2
8	**PH1204**	Physical Pharmaceutics Laboratory	0	0	3	2
9	**CH1206**	Fluid Flow Operations Laboratory	0	0	3	2
					Total	**29**

SEMESTER IV

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**MA1251**	Numerical Methods	3	1	0	4
2	**PH1251**	Biochemistry	3	0	0	3
3	**PH1252**	Microbiology	3	1	0	4
4	**PH1253**	Regulatory Requirements in Pharmaceutical Industries	3	0	0	3
5	**CH1260**	Heat Transfer	4	0	0	4
6	**CH1261**	Chemical Engineering Operations	4	0	0	4
Practical						
7	**PH1255**	Microbiology Laboratory	0	0	3	2
8	**PH1254**	Biochemistry Laboratory	0	0	3	2
9	**CH1262**	Heat Transfer Laboratory	0	0	3	2
					Total	**28**

SEMESTER V

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**PH1301**	Pharmaceutical Chemistry	3	1	0	4
2	**PH1302**	Pharmaceutical Dosage Forms	4	0	0	4
3	**PH1303**	Pharmacology	3	0	0	3
4	**ME1312**	Engineering Thermodynamics	4	0	0	4
5	**CH1311**	Chemical Reaction Engineering	4	0	0	4
6	**CH1312**	Process Instrumentation	4	0	0	4
Practical						
7	**PH1304**	Pharmaceutical Chemistry Laboratory	0	0	3	2
8	**PH1305**	Pharmaceutical Dosage Forms Laboratory	0	0	3	2
9	**CH1313**	Chemical Reaction Engineering Laboratory	0	0	3	2
					Total	**29**

SEMESTER VI

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**PH1351**	Instrumental Methods of Pharmaceutical Analysis	3	1	0	4
2	**PH1352**	Separation Technology	3	0	0	3
3	**PH1353**	Process Equipment Design	4	0	0	4
4	**CH1363**	Mass Transfer Operations	4	0	0	4
5	**CS1364**	Object Oriented Programming	3	0	0	3
6	**E1******	Elective I	3	0	0	3
Practical						
7	**PH1354**	Instrumental Methods of Pharmaceutical Analysis Laboratory	0	0	3	2
8	**CH1364**	Mass Transfer Laboratory	0	0	3	2
9	**HS1301**	Communication and Soft Skills Laboratory	0	0	3	1
					Total	**26**

ELECTIVE I

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**PH1001**	Solid Dosage Form Technology	3	0	0	3
2	**PH1002**	Herbal Technology	3	0	0	3
3	**PH1003**	Pharmaceutical Production Management	3	0	0	3
4	**PH1004**	Industrial Management	3	0	0	3

SEMESTER VII

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**PH1401**	Advanced Medicinal Chemistry	3	1	0	4
2	**PH1402**	Novel Drug Delivery System	4	0	0	4
3	**PH1403**	Pharmaceutical Biotechnology	4	0	0	4
4	**CH1407**	Process Dynamics and Control	4	0	0	4
5	**CH1408**	Technology of Fine Chemicals and Bulk Drugs	4	0	0	4
6	**E2******	Elective II	3	0	0	3
Practical						
7	**PH1404**	Advanced Medicinal Chemistry Laboratory	0	0	3	2
8	**PH1405**	Novel Drug Delivery System Laboratory	0	0	3	2
9	**CH1409**	Process Dynamics and Control Laboratory	0	0	3	2
					Total	**29**

ELECTIVE II

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**CH1011**	Water Treatment and Management	3	0	0	3
2	**PH1005**	Validation in Pharmaceutical Industries	3	0	0	3
3	**PH1006**	Natural Products Chemistry	3	0	0	3
4	**PH1007**	Materials Science and Technology	3	0	0	3

SEMESTER VIII

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**CH1453**	Unit Processes in Organic Synthesis	4	0	0	4
2	**MG1301**	Total Quality Management	4	0	0	4
3	**E3******	Elective III	3	0	0	3
Practical						
4	**PH1455**	Project Work	0	0	12	12
					Total	**23**

ELECTIVE III

S.No.	Subject Code	Subject	L	T	P	C
Theory						
1	**PH1008**	Pharmaceutical Packaging Technology	3	0	0	3
2	**CH1012**	Pilot Plant and Scale up Methods	3	0	0	3
3	**PH1009**	Drugs Through Biotechnology	3	0	0	3
4	**MG1453**	Safety and Risk Management	3	0	0	3

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Regulations 2008

Syllabus

B.TECH. PHARMACEUTICAL TECHNOLOGY

SEMESTER III

MA1201 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	1	0	4

UNIT I FOURIER SERIES **9**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic analysis.

UNIT II FOURIER TRANSFORMS **9**

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **9**

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations – Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **9**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two – dimensional equation of heat conduction (insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS **9**

Z - transforms – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z - transform.

L: 45 T: 15 Total: 60

TEXTBOOKS

1. Grewal, B.S, "Higher Engineering Mathematics", 39th Edition, Khanna Publishers, 2007.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.

REFERENCES

1. Bali, N.P., Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications (P) Ltd.
2. Ramana, B.V., "Higher Engineering Mathematics" Tata McGraw Hill.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.

PH1201 – PHARMACEUTICAL ORGANIC CHEMISTRY

L	T	P	C
4	0	0	4

UNIT I CONCEPT OF AROMATICITY AND AROMATIC CHARACTER 12

General mechanism of aromatic electrophilic substitution reactions – Principle involved in alkylation and acylation – Industrial applications – Hoesch reaction – Formylation reactions – Gattermann reaction – Gattermann-Koch reaction – Vilsmeier reaction – Reimar-Tiemann reaction – Aromatic nucleophilic substitution reaction mechanisms.

UNIT II MOLECULAR REARRANGEMENTS 12

Wolff rearrangement – Schmidt reaction – Curtius rearrangement – Mechanism and applications – Oxidation mechanism – Applications of the following oxidation reactions – $KMnO_4$ – MnO_2 – Stereochemistry and applications of the following reduction reactions – Catalytic dehydrogenation – Meerwein-Ponndorf-Verley – $NaBH_4$ – Clemmenson.

UNIT III AROMATIC AMINES AND SULPHONIC ACIDS 12

Methods of introduction of the aromatic amino group into an aromatic nucleus – Diazotization reaction and reactions of aryl diazonium salts such as Sandmeyer – Ullmann – Azo coupling – Deamination – Benzidine rearrangement – Aromatic sulphonic acids – Sulphonation reaction – Chlorosulphonation.

UNIT IV POLYNUCLEAR AROMATIC HYDROCARBONS 12

Synthesis and reactions of napthalene – Anthracene – Phenanthrene – Diphenyl and triphenyl compounds and its medicinally important derivatives.

UNIT V HETEROCYCLIC AROMATIC COMPOUNDS 12

Aromaticity of pyrrole – Thiophene – Furan – Pyridine – Dipole moment – Reactive sites and stability of these heterocycles – General principles of heterocyclic synthesis – Methods of preparation and reactions of pyridines – Pyrroles – Thiophenes – Furans – Quinolines – Isoquinolines.

Total: 60

TEXT BOOKS

1. Bahl, A. and Bahl, B.S., “Advanced Organic Chemistry”, 1st Edition, S. Chand and Company, 2004.
2. Morrison and Boyd, “Organic Chemistry”, 6th Edition, Prentice Hall Publications, 2004.

REFERENCES

1. Kalsi, P.S., “Organic Reaction and Their Mechanisms”, 2nd Edition, New Age International Pvt. Ltd. Publications, 2004.
2. Tewari, N., “Advanced Organic Reaction Mechanism”, Books and Allied Publishers, 2006.
3. Finar, I. L., “Organic Chemistry”, 6th Edition, Longmans Publications, 2002.

HS1201 – ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Definition, scope and importance – Need for public awareness – Forest resources – Use and over – Exploitation – Deforestation – Case studies – Timber extraction – Mining – Dams and their ground Water – Floods – Drought – Conflicts over water – Dams – Benefits and problems – Mineral resources – Use effects on forests and tribal people – Water resources – Use and over-utilization of surface 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

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concepts 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

UNIT III ENVIRONMENTAL POLLUTION 9

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 – Solid waste management:- Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management:- Floods, earthquake, cyclone and landslides

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

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 – 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 – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

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.

Field study of local area to document environmental assets – River/Forest/Grassland/Hill/ Mountain.

Field study of common plants, insects and birds – Field study of simple ecosystems – Pond, river, hill slopes, etc. Field study of local polluted site – Urban/Rural/Industrial/Agricultural.

Total: 45

TEXT BOOKS

1. Masters, M., "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education Pvt. Ltd., 2004.
2. Trivedi, R.K. and Goe, P.K., "Introduction to Air Pollution", Techno-Science Publications, 2003.

REFERENCES

1. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd, 2006
2. Cunningham, Cooper, W.P. and Gorhani. T.H., "Environmental Encyclopedia", Jaico Publications, 2001.
3. Wager, K.D., "Environmental Management", W.B. Saunders Co., 1998.

PH1202 – PHYSICAL PHARMACEUTICS

L	T	P	C
4	0	0	4

UNIT I MICROMERITICS 12

Particle size and size distribution – Methods of determining particle size – Particle shape and surface area – Methods of determining surface area pore size and derived properties of powders.

UNIT II RHEOLOGY 12

Newtonian systems – Non newtonian systems – Plastic flow – Pseudo plastic flow – Dilatant flow – Thixotropy – Viscometers – Types of viscometers.

UNIT III COLLOIDS 12

Electrical and optical properties of colloids – Sedimentation – Stokes law – Stability of colloidal dispersions – Protective colloids – Sensitization of colloidal system – Applications of colloids in pharmacy.

UNIT IV SUSPENSIONS AND EMULSIONS 12

Interfacial properties of suspended particles – Settling in suspensions – Formulation of suspensions – Theories of emulsification – Physical stability of emulsions – Preservation of emulsions – Rheologic properties of emulsions – Special emulsion system.

UNIT V DRUG STABILITY 12

Chemical degradation of pharmaceutical products – Hydrolysis, oxidation, isomerization, polymerization, decarboxylation – Physical factors influencing chemical degradations – Temperature, moisture, light, radiation – Factors influencing and methods of reducing chemical degradation – Physical degradation of pharmaceutical products – Accelerated stability testing.

Total: 60

TEXT BOOKS

1. Martin, A., "Physical Pharmacy", 4th Edition, Lippincott Williams and Wilkins, B.I. Publications, 2002.
2. Derle, D.V., "Essentials of Physical Pharmacy", 1st Edition, Pharma Book Syndicate, 2006.

REFERENCES

1. Copper and Gunns, "Tutorial Pharmacy", 6th Edition, CBS Publishers, 2005.
2. Bentley's, "Text book of Pharmaceutics", 1st Edition, AITBS Publishers, 2006.
3. Shotton, E., "Physical Pharmaceutics", 1st Edition, Pharma Book Syndicate, 2007.

CH1204 – PROCESS CALCULATIONS

L	T	P	C
4	0	0	4

UNIT I STOICHIOMETRY 12

Introduction – Units and dimensions – Stoichiometric principles – Composition relations – Density and specific gravity.

UNIT II IDEAL GASES AND VAPOR PRESSURE 12

Behavior of ideal gases – Application of ideal gas law – Gaseous mixtures – Volume changes with change in composition – Vapor pressure – Effect of temperature on vapor pressure – Vapor pressure plots – Vapor pressure of immiscible liquids – Solutions.

UNIT III HUMIDITY AND SOLUBILITY 12

Humidity – Saturation – Vaporization – Condensation – Wet and dry bulb thermometry – Solubility and crystallization – Dissolution – Solubility of gases.

UNIT IV MATERIAL BALANCE 12

Material balance – Processes involving chemical reaction – Combustion of coal, fuel gases and sulphur – Recycling operations – Bypassing streams – Degree of conversion – Excess reactant – Limiting reactant.

UNIT V ENERGY BALANCE 12

Thermo chemistry – Calculation of heat of reaction at other temperatures – Hess's law of summation – Heat of formation, reaction, mixing, combustion – Mean specific heat – Theoretical flame temperature.

Total: 60

TEXT BOOKS

1. Bhatt, B.I. and Vora, S.M., "Stoichiometry", 4th Edition, Tata McGraw Hill Publishers Ltd, 2005.
2. Hougen, O.A., Watson, K.M. and Ragatz, R.A., "Chemical Process Principles", Vol.I, CBS Publishers and Distributors, 1995.

REFERENCES

1. Venkataramani, V. and Anantharaman, N., "Process Calculations", Prentice Hall of India (P) Ltd, 2003.
2. Himmelblau, D., "Basic Principles and Calculations in Chemical Engineering", 6th Edition, Prentice Hall of India Ltd, 2000.
3. Chopey, N.P. and Hicks, T.G., "Handbook of Chemical Engineering Calculations", 2nd Edition, McGraw-Hill Inc, 1984.

CH1205 – FLUID FLOW OPERATIONS

L	T	P	C
4	0	0	4

UNIT I PROPERTIES OF FLUIDS AND CONCEPT OF PRESSURE 12

Introduction – Nature of fluids – Physical properties of fluids – Types of fluids – Fluid statics – Pressure – Density – Height relationships – Pressure measurement – Units and dimensions – Dimensional analysis – Similarity – Forces arising out of physical similarity – Dimensionless numbers.

UNIT II MOMENTUM BALANCE AND ITS APPLICATIONS 12

Kinematics of fluid flow – Stream line – Stream tube – Velocity potential – Newtonian and non-Newtonian fluids – Time dependent fluids – Reynolds number – Experiment and significance – Momentum balance – Forces acting on stream tubes – Potential flow – Bernoulli's equation – Correction for fluid friction – Correction for pump work.

UNIT III FLOW OF INCOMPRESSIBLE FLUIDS THROUGH DUCTS 12

Flow of incompressible fluids in pipes – Laminar and turbulent flow through closed conduits – Velocity profile and friction factor for smooth and rough pipes – Head loss due to friction in pipes, fitting etc – Introduction to compressible flow – Isentropic flow through convergent and divergent nozzles and sonic velocity.

UNIT IV FLOW OF FLUIDS THROUGH SOLIDS 12

Form drag – Skin drag – Drag co-efficient – Flow around solids and packed beds – Friction factor for packed beds – Ergun's equation – Motion of particles through fluids – Motion under gravitational and centrifugal fields – Terminal settling velocity – Fluidization – Mechanism – Types – General properties – Applications.

UNIT V TRANSPORTATION AND METERING 12

Measurement of fluid flow – Orifice meter, venturi meter, Pitot tube, rotameter, weirs and notches – Wet gas meter and dry gas meter – Hot wire anemometers – Transportation of fluids – Fluid moving machinery performance – Selection and specification – Air lift and diaphragm pumps – Positive displacement pumps – Rotary and reciprocating pumps – Centrifugal pumps – Performance and characteristics.

Total: 60

TEXT BOOKS

1. Bansal, R.K., “Fluid Mechanics and Hydraulic machines”, 9th Edition, Laxmi Publications (P) Ltd., 2005.
2. McCabe, W.L., Smith, J.C. and Harriott, P., “Unit Operations of Chemical Engineering”, 7th Edition, McGraw Hill, 2004.

REFERENCES

1. Coulson, J.M. and Richardson, J.F., “Chemical Engineering”, Vol.I, 6th Edition, Butterworth – Heinemann Publishers, 2002.
2. Noel, D. and Nevers, “Fluid Mechanics for Chemical Engineers”, 2nd Edition, McGraw Hill, International Edition, 1991.
3. Liggett de Nevers, “Fluid Mechanics for Chemical Engineers”, McGraw Hill, 1994.

PH1203 – PHARMACEUTICAL ORGANIC CHEMISTRY LABORATORY

L	T	P	C
0	0	3	2

1. Determination of Impurities
2. Synthesis of some organic compounds involving single step reactions like nitration, halogenation, acetylation and hydrolysis.
3. Synthesis of organic compounds involving Two steps
4. Assay of organic compounds involving acidimetry, alkalimetry, Iodometry etc.
5. Determination of rate of reation in zero, first order reations.
6. Determination of physical constants used as criteria of purity like melting point, boiling point, weight per ml, refractive index and viscosity.
7. Determination of pH, potentiometric and dead stop endpoint technique.
8. Preparation of buffers, sensitivity, specificity, precision and accuracy.
9. Tests for Purity for official compounds mentioned in IP/BP/USP.
10. Limit test for marketed formulations.
11. Functional group analysis
12. Molecular weight calculations

Total: 45

PH1204 – PHYSICAL PHARMACEUTICS LABORATORY

L	T	P	C
0	0	3	2

1. Determination of density of Liquid.
2. Determination of surface tension/ interfacial tension of liquid.
3. Determination of critical micellar concentration of surfactant.
4. Effect of concentration on adsorption.
5. Determination of half life, rate constant and order of chemical reaction.
6. Effect of temperature on specific rate constant.
7. Determination of specific surface area of powder by adsorption method.
8. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
9. Effect of electrolytes on the stability of colloids.
10. Preparation of various types of suspensions and determination of their sedimentation parameters.
11. Determination of particle size of powders and globules.
12. Preparation and stability of emulsion.

Total: 45

CH1206 – FLUID FLOW OPERATIONS LABORATORY

L	T	P	C
0	0	3	2

1. To verify Hagen- Poiseuille Equation.
2. To relate Reynolds Number and Friction factor.
3. To study the effect of coil diameter on Friction factor.
4. Experiment on Orificemeter.
5. Experiment on Venturimeter.
6. Calibration of Rotameter.
7. To evaluate the performance of Weirs and Notches.
8. To evaluate the performance of centrifugal pump.
9. Draining time of open tank.
10. To verify Ergun's equation.
11. To characterize the behavior of Fluidized bed.
12. Performance of packed bed (Gas- Liquid).

Total: 45

SEMESTER IV

MA1251 – NUMERICAL METHODS

L	T	P	C
3	1	0	4

UNIT I SOLUTION OF ALGEBRAIC, TRANSCENDENTAL AND SYSTEM OF LINEAR EQUATIONS 9

Regula-falsi method – Newton's method – Iteration method – Direct Methods – Gaussian elimination method – Gauss-Jordan method – Iterative methods – Gauss Jacobi and Gauss – Seidel methods – Inverse of a matrix by Gauss – Jordan method.

UNIT II INTERPOLATION AND APPROXIMATION 9

Newton forward and backward difference formulae – Lagrangian Polynomials – Divided difference – Interpolation with a cubic spline.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Newton's forward and backward difference formulas to compute first and second order derivatives – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules Romberg's method – Double integrals using trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Single step methods – Taylor series and methods – Euler, modified euler methods and improved euler methods – Fourth order runge – Kutta method for solving first and second order equations.

UNIT V BOUNDARY VALUE PROBLEMS 9

Finite difference solution for the second order ordinary differential equations – Finite difference solution for one dimensional heat equation by implict and explict methods – One dimensional wave equation and two dimensional laplace and poisson equations.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, 2002.
2. Kandasamy, P., Thilakavthy, K. and Gunavathy, K., "Numerical Methods", 2nd Revised Edition, S. Chand and Co. 2003.

REFERENCES

1. Venkatraman, M.K., "Numerical Methods", National Publishing Company, 1991.
2. Sankara, R.K., "Numerical Methods for Scientists and Engineers", 2nd Edition, Prentice Hall India, 2005.
3. Balagurusamy, E., "Numerical Methods", 1st Edition, Tata McGraw Hill Pub. Co. Ltd., 1999.

PH1251 – BIOCHEMISTRY

L	T	P	C
3	0	0	3

UNIT I BIOMOLECULES **9**

Structure and properties of mono, di, oligo and polysaccharides – Fatty acids – Phospholipids – Glycolipids – Steroids – Purine and pyrimidines bases.

UNIT II BIOSYNTHESIS **9**

Biosynthesis of amino acids, neocleotides and lipids.

UNIT III INTERMEDIARY METABOLISM **9**

Glycogenesis – Glycogenolysis – Gluconeogenesis – Glycolysis – Pentose phosphate pathway – TCA cycle.

UNIT IV BIOENERGETICS **9**

Electron transport chain (Phosporylation) in mitochondria – Exergonic and endergonic reactions – Chemiosmotic hypothesis.

UNIT V ENZYMES **9**

Classification and nomenclature – Mechanism of enzyme action – Specificity of enzyme – Factors affecting enzyme activity.

Total: 45

TEXT BOOKS

1. Berg, J.M., Tymoczko, J.L. and Stryer, L., "Biochemistry", 5th Edition, McMillan Publications, 1994.
2. Voet, D. and Voet, G., "Biochemistry", 2nd Edition, John Wiley and Sons, 1994.

REFERENCES

1. David, N.L. and Michael, M.C., "Lehninger Principles of Biochemistry", 3rd Edition, CBS Publications, 1993.
2. Satyanarayana, U. and Chakrapani, U., "Biochemistry", 3rd Edition, Books and Allied Publishers, 2006.
3. Robert, K.M., Darryl, K.G., Peter, A.M. and Victor, W.R., "Harper's Illustrated Biochemistry", 26th Edition, McGraw Hill Publications, 2003.

PH1252 – MICROBIOLOGY

L	T	P	C
3	1	0	4

UNIT I INTRODUCTION TO MICROBIOLOGY 9

Classification and identification of microorganisms – Phase contrast and electron microscopy – Chemistry and structural organization of bacteria, virus, fungi, actinomycetes – Multiplication of bacteriophage, bacteria and organisms such as yeast, fungi.

UNIT II GROWTH OF MICROORGANISMS 9

Microbial nutrition and environment – Factors controlling growth of microorganisms in different media – Growth curve – Methods of enumeration of multiplying microorganisms – Culture media – Preservation of microbes – Sterilization and disinfection.

UNIT III MICROBIAL METABOLISM 9

Microbial Metabolism – Metabolic pathways - Production of secondary metabolites and their complication in industry – Beneficial micro organisms and products – Formation of toxic materials by microorganisms – A general study of food, industrial and agricultural microbiology.

UNIT IV CONTROL OF MICROORGANISMS 9

Diseases caused by microorganisms and control – Chemotherapeutic agents – Beta-lactum antibiotics – Macrolide antibiotics – Cephalosoprins – Quiolones – Sulphonamides and disinfectants.

UNIT V ENVIRONMENTAL APPLICATIONS OF MICROBIOLOGY 9

Recycling of waste biomass – Production of biogas – Leaching of ores by microorganism – Application of biofertilizers and bio-pesticides – Bioremediation.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. Katheelen, P.T., “Foundations in Microbiology”, 5th Edition, McGraw-Hill, 2004.
2. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R., “Microbiology”, Tata McGraw-Hill Edition, 1993.

REFERENCES

1. Purohit, S.S., “Microbiology (Fundamental and application)”, 6th Edition, Agrobios, 2001.
2. James, M.J., “Modern Food Microbiology”, Chapman and Hall Inc, 2005.
3. Madigan, M.T. and Martinko, J.M., “Brock Biology of Microorganisms”, 11th Edition, Prentice Hall, 2005.

PH1253 – REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES

L	T	P	C
3	0	0	3

UNIT I REGULATORY CONCEPTS 9

Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT II REGULATORY ASPECTS 9

Pharmaceuticals – Bulk drug manufacture – Biotechnology derived products.

UNIT III INTELLECTUAL PROPERTY RIGHTS 9

Patent system – Different types of patents – Filing process of application for patent – Infringement of patents – The patent rules 2003 as amended by the patents (amendment) rule 2006.

UNIT IV ICH GUIDELINES 9

Quality guidelines – Impurities in new drug substances (Q3A R) – Impurities in new drug products – Validation of analytical procedures text and methodology (Q2 R1).

UNIT V QUALITY AUDIT AND SELF INSPECTIONS 9

SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF)**.**

Total: 45

TEXT BOOKS

1. Robert, I.R., Nash, R.A., Wachter, A.H. and Swarbrick, J., "Pharmaceutical Process Validation", 3rd Edition, Maarcel Dekker Inc., 2003.
2. Willig, H., Tuckeman, M.M. and Hitchings, W.S., "Good Manufacturing Practices for Pharmaceuticals", 5th Edition, Marcel Dekker Inc., 2000.

REFERENCES

1. Subbaram, N.R., "What Everyone Should Know About Patents", 2nd Edition, Pharma Book Syndicate, 2005.
2. Banker, G.S. and Rhodes, C.T., "Modern Pharmaceutics", 4th Edition, Marcel Dekker Inc., 2002.
3. Sharma, P.P., "How to Practice GMPs", 3rd Edition, Vandana Publications, 2006.

CH1260 – HEAT TRANSFER

L	T	P	C
4	0	0	4

UNIT I FUNDAMENTAL CONCEPTS AND CONDUCTIVE HEAT TRANSFER 12

Modes of heat transfer – Fourier's law – Newton's law– Thermal conductance and resistance – Temperature field and temperature gradient – Heat transfer by conduction – General heat conduction equation – Thermal diffusivity and equivalent thermal conductivity – One dimensional steady state conduction through thick cylindrical shells – Critical thickness of insulation for cylindrical surfaces.

UNIT II CONVECTIVE HEAT TRANSFER AND BOUNDARY LAYER THEORY 12

Heat transfer coefficient – Forced convection – Free convection – Dimensional analysis and empirical correlation – Physical significance of dimensionless groups – Concept of hydrodynamic and thermal boundary layers.

UNIT III THERMAL RADIATION 12

Thermal radiation – Spectrum of electromagnetic radiation – Monochromatic emissive power of black body – Planck's distribution law – Kirchoff's law – Total emissive power – Problems of Stefan Boltzmann law and Weins displacement law – Configuration factor determination – Typical examples.

UNIT IV DESIGN OF HEAT EXCHANGERS 12

Heat exchangers – Types and variation in design – Overall heat transfer coefficient – LMTD – Correction factors for multiple pass heat exchanger – Illustrative examples – Number of transfer units and effectiveness of heat exchangers.

UNIT V HEAT TRANSFER IN EVAPORATORS 12

Evaporation – Type of evaporators – Single and multiple effect operation – Capacity and economy of multiple effect evaporators – Effect of liquid head and boiling point elevation – Duhrings rule – Material and energy balance in evaporators – Illustrative examples.

Total: 60

TEXT BOOKS

1. Nesati, O.M., "Heat Transfer: A Basic Approach", McGraw-Hill, 1985.
2. McCabe, W.L., Smith, J.C. and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw Hill, 2005.

REFERENCES

1. Donald, Q.K., "Process Heat Transfer", 1st Edition, Tata McGraw Hill Publishing Co, 1997.
2. Mikheyev, M., "Fundamentals of Heat Transfer", Mir Publishers, 1968.

CH1261 – CHEMICAL ENGINEERING OPERATIONS

L	T	P	C
4	0	0	4

UNIT I PARTICLE SEPARATION 12

Properties and characterization of particulate solids – Analysis and technical methods for size and surface area distribution of powder – Introduction – Preparation and techniques for the measurement of nanoparticles – Introduction to storage and conveying of solids – Principles of magnetic separation.

UNIT II SIZE REDUCTION 12

Size reduction equipment – Determination of energy and power requirement in milling operations – Screening equipment – Capacity and effectiveness.

UNIT III FILTRATION 12

Filtration equipment – Filtration media and filter aids – Principles of filtration and clarification – Estimation of filtration parameters for compressible and incompressible cakes and calculations – Centrifugal filtration equipment and principles of operation.

UNIT IV SETTLING AND SEDIMENTATION 12

Separation based on the motion of particles through fluids – Gravity settling processes – Sedimentation – Kynch theory of sedimentation – Equipment for sedimentation thickness – Rate of sedimentation and sedimentation zones in continuous thickeners – Design of thickeners and clarifiers – Principles of centrifugal sedimentation.

UNIT V AGITATION AND MIXING 12

Introduction to agitation and mixing of liquids- agitation equipment – Axial and radial flow impellers and flow patterns in agitated vessels- prevention of swirling – Power consumption in agitated vessels – Blending and mixing – Dispersion operations – Mixing of solids and pastes and types of mixers.

Total: 60

TEXT BOOKS

1. McCabe, W.L., Smith, J.C. and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edition, McGraw Hill, 2005.
2. Badger, W.L. and Banchero, J.T., “Introduction to Chemical Engineering”, Tata McGraw Hill, 2002.

REFERENCES

1. Raymond, A.K., “Materials Handling Handbook”, 3rd Edition, Wiley - Interscience Publications, 1985.
2. Coulson, J.M. and Richardson, J.F., “Chemical Engineering”, 3rd Edition, Butterworth Heineman Publications, 1977.

PH1255 – MICROBIOLOGY LABORATORY

L	T	P	C
0	0	3	2

1. Sterilization techniques (lecture / demonstration)
2. Preparation of various culture media.
3. Culturing of micro-organisms
   (a) Isolation of specific group of microbes symbiotic – asymbiotic, chemolithotrophs, organotrophs
   (b) Pure culture techniques – Streak plate, pour plate, isolation and preservation of bacterial culture, single spore isolation.
4. Identification of microorganisms by staining techniques
5. Identification of microorganisms by biochemical testing.
6. Quantification of microorganisms by turbidimetry
7. Quantification of microorganisms by serial dilution, MPM.
8. Preservation of cells, slants stabs, use of mineral oil, liquid paraffin, whey, glycerol, sterile water, lyophilization.
9. Environmental sample analysis – Polluted soil and effluent.
10. Food microbiology – Milk – Fermented food – Yogurt, meat, ice cream
11. Clinical microbiology – Normal mouth flora, pus, urine.
12. Determination of MIC of antimicrobial agents

Total: 45

PH1254 – BIOCHEMISTRY LABORATORY

L	T	P	C
0	0	3	2

1. Study of units for volume, weight, measurements and concentration. sensitivity, specificity, precision and accuracy.
2. Preparation of buffers and pH measurements.
3. Qualitative tests for carbohydrates.
4. Qualitative tests for amino acids.
5. Estimation of Reducing sugars by the Benedict's method.
6. Estimation of amino acids by ninhydrin method.
7. Protein estimation by various methods.
8. Acid hydrolysis of proteins
9. Enzyme assays: Phosphatase from potato, Amylase from sweet potato, Trypsin digestion of proteins, Assay of proteases, NADH Dehydrogenase, Catalase and peroxidase.
10. Extraction of lipids.
11. Phospholipids: Ashing and estimation of phosphate.
12. Estimation of cholesterol.
13. Estimation of nucleic acids.

Total: 45

CH1262 – HEAT TRANSFER LABORATORY

L	T	P	C
0	0	3	2

1. To determine the conductivity of metal rod.
2. To determine the conduction parameters using composite wall.
3. To determine individual heat transfer film coefficient in forced convection.
4. To determine individual heat transfer film coefficient in free convection.
5. To determine Stefan Boltzmann law constant.
6. To determine condensing heat transfer coefficient in vertical condenser.
7. To determine condensing heat transfer coefficient in horizontal condenser.
8. To determine rate of evaporation in open pan evaporator.
9. To determine overall heat transfer coefficient of double pipe heat exchanger by parallel flow.
10. To determine overall heat transfer coefficient of double pipe heat exchanger by counter flow.
11. To determine overall heat transfer coefficient of shell and tube heat exchanger.
12. To determine overall heat transfer coefficient of plate type heat exchanger by parallel flow.
13. Apparatus for determination of emissivity.
14. To determine the thermal conductivity of insulating powder.

Total: 45

SEMESTER V

PH1301 – PHARMACEUTICAL CHEMISTRY

L	T	P	C
3	1	0	4

UNIT I PHYSICO-CHEMICAL PROPERTIES ON BIOLOGICAL ACTION OF DRUGS 9

Physical properties – Optical isomers – Geometric isomers – Bioisosterism – Receptors – Occupational theory – Affinity theory.

UNIT II AUTONOMIC AND CENTRAL NERVOUS SYSTEM ACTING DRUGS 9

Structure – Synthesis – Uses – Pilocarpine – Neostigmine – Propanthallene – Salbutamol – Amphetamine – Phenoxy benzamine – Tolazoline – Thiopentone – Diazepam – Chlorpromazine – Haloperidol.

UNIT III CARDIOVASCULAR AND RESPIRATORY SYSTEM ACTING DRUGS 9

Synthesis – Uses – Digoxin – Digitoxin – Procainamide – Diltiazem – Isosorbide dinitrate – Captopril – Frusemide – Lovastatin – Clofibrate.

UNIT IV ANTIMICROBIAL AGENTS 9

Preparation – Therapeutic uses – Cephalosporine – Silver Sulphadiazine – Cotrimoxazole – Roxithromycin – Isoniazid – Pyrazinamide – Dapsone – Clofazimine – Idoxuridine – Zidovudine – Quinine – Primaquine – Cyclophosphamide – Methotrexate – Griseofulvin.

UNIT V PERIPHERAL NERVOUS SYSTEM AND GASTROINTESTINAL DRUGS 12

Structure – Synthesis – Uses – Gallamin triethiodide – Dantrolene Sodium – Ranitidine – Omeprazole – Metronidazole – Cinnarizine – Dicyclomine – Bisacodyl.

L: 45 T: 15 Total: 60

TEXTBOOKS

1. Ilango, K. and Valentina, P., “Text Book of Medicinal Chemistry”, Vol. I, 1st Edition, Keerthi Publishers, 2007.
2. Kadam, S.S., Mahadik, K.R. and Bothara, K.G., “Principles of Medicinal Chemistry”, Vol. I and II, Nirali Prakashan Publications, 1997.

REFERENCES

1. Chatwal, G., “Organic Chemistry of Natural Products”, Vol. I and II, 3rd Edition, Himalaya Publishing House, 2002.
2. Wolff, M.E., “Burgers: Medicinal Chemistry”, Vol. I to VI, 5th Edition, John Willy and Sons, 2005.
3. Bentley and Driver’s “Text Book of Pharmaceutical Chemistry”, 8th Edition, Oxford University Press, 2002.

PH1302 – PHARMACEUTICAL DOSAGE FORMS

L	T	P	C
4	0	0	4

UNIT I PREFORMULATION 12

Concepts – Aqueous solubility – Partition coefficient – Dissolution – Melting point – Polymorphism – Assay development – Crystal morphology – Particle size – Powder flow properties – Compression properties – Excipient compatibility – Permeability – Stability.

UNIT II LIQUID DOSAGE FORMS 12

Classification – Solubility – Importance of aqueous solubility – Choice of solvents – Additives used in liquid orals – Formulation – Manufacturing – Packing – Labeling and storage of solutions – Syrups – Dry syrups – Lotions – Liniments – Formulation and manufacturing of suspension – Emulsion – Evaluations of suspension – Emulsion – Physical – Chemical stability – Stability testing of suspension – Emulsion.

UNIT III SEMISOLID DOSAGE FORMS 12

Classification – Advantages – Disadvantages – Semisolid bases types – Mechanism of drug penetration – Factors influencing penetration – Selection – General formulation – Manufacturing procedure – Evaluation – Packaging – Labeling – Storage requirements of ointments – Paste – Gels.

UNIT IV PARENTERAL DOSAGE FORMS 12

Routes of administration – Official types of injections – Vehicles – Solutes – Containers – Devices – Formulation – Production – Sterilization – Packaging – Evaluations – Ophthalmic preparations – Formulation – Packaging – Storage – Official methods of evaluation.

UNIT V AEROSOLS 12

Advantage and disadvantage of aerosols – Components of aerosol package – Aerosol systems – Aerosol formulations – Selection of components – Aerosol filling – Quality control of pharmaceutical aerosol.

Total: 60

TEXT BOOKS

1. Aulton, M.E., "Pharmaceutics – The Science of Dosage form Design", 2nd Edition, ELBS Publications, 2002.
2. Lachman, L. and Liberman, H.A., "Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publishing House, 1991.

REFERENCES

1. Gennaro, A.R., "Remington: The Science and Practice of Pharmacy", 21st Edition, Vol. I and II, Lippincott Williams and Willkins, 2005.
2. Carter, S.J., "Cooper and Gunn's Dispensing Pharmacy for Pharmaceutical Students", 12th Edition, CBS Publishers and Distributors, 1987.
3. Banker, G.S. and Rhodes, C.T., "Modern Pharmaceutics", 4th Edition, Informa Health Care, 2002.

PH1303 – PHARMACOLOGY

L	T	P	C
3	0	0	3

UNIT I GENERAL PHARMACOLOGY 9

Routes of administration – Pharmacokinetics – Pharmacodynamics – Receptors – Theories of receptors – Occupational theory – Affinity theory – Mechanism of action of drugs – Agonist – Antagonist – Factors modifying drug action – Dosage calculations.

UNIT II SYSTEMIC PHARMACOLOGY 9

Mechanism of action – Pharmacology – Acetylcholine – Atropine – Adrenaline – Prazosin – Propranolol – Barbiturates – Benzodiazepine – Chlorpromazine – Imipramine

UNIT III CARDIOVASCULAR PHARMACOLOGY 9

Classification – Mechanism of action – Pharmacology – Digoxin – Glyceryl trinitrate – Verapamil – Clonidine – Hydralazine – Quinidine – Statins

UNIT IV ANTIMICROBIAL PHARMACOLOGY 9

Mode of action – Pharmacology – Sulphonamides – Ciprofloxacin – Penicillin G – Erythromycin – Rifampicin – Amphotericin B – Acyclovir – Chloroquine – Alkylating agents – Paclitaxel

UNIT V PERIPHERAL NERVOUS SYSTEM AND GASTROINTESTINAL PHARMACOLOGY 9

Classification – Mechanism of action – d-Tubocurarine – Succinyl choline – Cimetidine – Metoclopramide – Amoxicillin – Ondansetron – Lactulose.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. Satoskar, R.S., Bhandarkar, S.D. and Rege, N.N., “Pharmacology and Pharmacotherapeutics”, Popular Prakashan (P) Ltd., 2006.
2. Tripathi, K.D., “Essentials of Medical Pharmacology”, 4th Edition, Jaypee Brothers Medical Publishers (P) Ltd, 1999.

REFERENCES

1. Hardman, J.G. and Limbird, L.E., “Goodman and Gilman’s: The Pharmacological Basis of Therapeutics” 10th Edition, Medical Publishing Division, 2001.
2. Lawrence, D.R., Bennett, P.N. and Brown, M.J., “Clinical Pharmacology” 8th Edition, Churchill Livingstone, 1998.
3. Das, M.M., “Pharmacology for Second Professional Students” 5th Edition, Books and Allied (P) Ltd, 2004.

ME1312 – ENGINEERING THERMODYNAMICS

L	T	P	C
4	0	0	4

UNIT I FUNDAMENTAL CONCEPTS AND FIRST LAW OF THERMODYNAMICS 12

Scope of thermodynamics – Basic concepts – Thermodynamic system – State and equilibrium – Process and cycles – Temperature and zeroth law of thermodynamics – Properties of pure substances – First law of thermodynamics – First law analysis of closed systems and control volumes and its application.

UNIT II ENTROPY AND THE SECOND LAW OF THERMODYNAMICS 12

The Clausius inequality – Entropy – Causes of entropy change – Entropy change of pure substances – Thermal energy reservoirs – Heat engines – Perpetual motion machines – Reversible and irreversible processes – The Carnot cycle and principles – The Carnot Heat engine – The second law efficiency – Second law analysis of open and closed systems.

UNIT III REFRIGERATION, VAPOR and COMBINED POWER CYCLES 12

Refrigerators and Heat pumps – The Carnot refrigerator and heat pumps – The reversed Carnot cycle – Ideal and Actual vapor compression Refrigeration cycle – Selection of right refrigerants – Heat pumps – Absorption refrigerator system – The Carnot vapor cycle – Rankine cycle – Cogeneration – Second law analysis of vapor power cycles.

UNIT IV PVT RELATIONS AND THERMODYNAMIC RELATIONS 12

PVT relations for gases and liquids – Equations of state – Cubic equations of state – Thermodynamic properties from equations of state – Compressibility factor – Generalized properties of fluids – Law of corresponding state – Acentric factor – gas mixtures.

Thermodynamic relations – Maxwell's relations – Estimation of thermodynamic properties– Thermodynamic properties of homogeneous mixtures – Partial molar properties, Fugacity and fugacity coefficients – Lewis and Randall rule – Property changes of mixing, activity – Excess properties, activity coefficients.

UNIT V PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA 12

Phase equilibria – Pure component and mixtures – Van Laar, Margules equation – Group contribution method – Gibb's Duhem equation – Consistency tests – Partially miscible and immiscible systems – Azeotropes – Retrograde condensation – Thermodynamic diagrams.

Chemical equilibria – Heat effects – industrial reactions – Free energy calculations – Homogeneous and heterogeneous reactions – Equilibrium composition.

Total: 60

TEXT BOOKS

1. Smith, J.M. and Van Ness, "Introduction to Engineering Thermodynamics", 5th Edition, McGraw Hill, 1996.
2. Narayanan, K.V., "A Text Book of Chemical Engineering Thermodynamics", Prentice Hall of India, 2002.

REFERENCES

1. Hougen and Watson, "Chemical Process Principles" Vol. II, CBS Publishers, 2002.
2. Kyle, "Chemical and Process Thermodynamics", 2nd Edition, Prentice Hall of India, 2000.
3. Rao,Y.V.C., "Chemical Engineering Thermodynamics", Universities Press, 1997.

CH1311 – CHEMICAL REACTION ENGINEERING

L	T	P	C
4	0	0	4

UNIT I REACTION KINETICS 12

Chemical kinetics – Classification of chemical reactions – Concentration and temperature dependent term of rate equation – Arrhenius collision and transition state theory – Searching for a mechanism.

UNIT II INTERPRETATION OF BATCH REACTOR DATA 12

Integral and differential methods of analysis – Half-life method – Zero order reaction – Empirical rate equation of nth order – Irreversible first and second order reactions for variable and constant volume systems.

UNIT III REACTOR DESIGN 12

Ideal reactors – Batch reactor – Plug flow reactor – Mixed flow reactor – Space time – Space velocity – Performance equations and their graphical representation.

UNIT IV HEAT EFFECTS 12

Temperature and pressure effects on single and multiple reactions – Adiabatic – Non-adiabatic – Isothermal and non-isothermal operations.

UNIT V DESIGN OF REACTOR FOR SINGLE AND MULTIPLE REACTIONS 12

Single reactions – Size comparison of single reactors – Recycle reactor – Auto catalytic reactions – Multiple reactions – Irreversible reactions in series and parallel.

Total: 60

TEXT BOOKS

1. Levenspiel, O., “Chemical Reaction Engineering”, 3rd Edition, John Wiley Publications, 1999.
2. Fogler, W., “Chemical Reaction Engineering”, 3rd Edition, Prentice Hall of India, 1999.

REFERENCE BOOKS

1. Smith, J.M., “Chemical Engineering Kinetics”, 3rd Edition, McGraw Hill, 1981.
2. Dawande, S.D., “Principles of Reaction Engineering”, 1st Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., “Coulson Richardson - Chemical Engineering”, Vol. III, 3rd Edition, Butterworth- Heinemann- Elsevier, 2006.

CH1312 – PROCESS INTRUMENTATION

L	T	P	C
3	0	0	3

UNIT I PHYSICAL PROPERTY MEASUREMENT 9

Density and specific gravity – Viscosity and consistency – Refractive index analyzers – Boiling point – Flash point analyzers – Thermal conductivity.

UNIT II TEMPERATURE MEASUREMENT 9

Differential expansion and fluid expansion types – Resistance thermometers – Thermoelectric pyrometers – Radiation pyrometers – Optical pyrometers – Pyrometric cones – Ultrasonic thin wire thermometer.

UNIT III PRESSURE MEASUREMENT 9

Absolute pressure – Gauge pressure or vacuum – Liquid types and spring balanced types – Differential pressure – Manometer types – Simple U tube and inclined tube manometer and sealed bell types – Pressure transmitters.

UNITIV FLOW MEASUREMENT 9

Volumetric meters – Variable head meters – Orifice meter – Venturi meter – Pitot tube – Closed channel and open channel types – Variable area meters – Velocity and current meters – Anemo meter – Ultrasonic flowmeter – Mass meters.

UNIT V LEVEL MEASUREMENT 9

Measurement of head and level – Float methods – Hydrostatic pressure methods – Gauge Glass automatic detector – Ultrasonic probe – Electronic level gauge – Continuous capacitance gauge.

Total: 45

TEXT BOOKS

1. Nakra B.C. and Chaudhry K.K., “Instrumentation, Measurement and Analysis” Second Edition, Tata McGraw- Hill, 2004.
2. Singh S.K., “Industrial Instrumentation and Control”, Second Edition, Tata McGraw-Hill, 2007.

REFERENCES

1. Doebelin E.O., “Measurement system Application and Design”, Fourth Edition, McGraw Hill, 1998.
2. Patranabis D., “Principles of Industrial Instrumentation”, Second Edition, Tata McGraw-Hill, 2007.
3. Sawhney A.K., “A Course in Electrical, Electronics measurement and Instrumentation”, Dhanpat Rai and sons, 1999.

PH1304 – PHARMACEUTICAL CHEMISTRY LABORATORY

L	T	P	C
0	0	3	2

1. Determination of percentage purity given drug sample.
2. Estimation of amount of active ingredient present in the given sample.
3. Chromatographic identification of organic compounds.
4. Analysis and identification of functional groups of pharmaceutical substances.
5. Analysis of impurities in fine chemicals / pharmaceutical substances by conventional chemical methods.
6. Official limit tests for impurities in pharmaceutical raw materials.
7. Determination of physical constants – melting point, boiling point, weight per ml, refractive index and viscosity.
8. Purification techniques for bulk drugs.

Total: 45

PH1305 – PHARMACEUTICAL DOSAGE FORMS LABORATORY

L	T	P	C
0	0	3	2

1. Preparation of three official solutions.
2. Preparation of two official syrups.
3. Preparation of three official lotions.
4. Preparation of two official liniments.
5. Preparation of official ointments with different classes of bases.
6. Preparation of two creams.
7. Preparation of two pastes.
8. Preparation of two suspensions.
9. Preparation of two emulsions.
10. Preparation and evaluation of injection.
11. Preparation of granules and effervescent granules.
12. Determination of stability of emulsion.
13. Formulation of two powders.
14. Preparation of microcapsules by solvent evaporation method.

Total: 45

CH1313 – CHEMICAL REACTION ENGINEERING LABORATORY

L	T	P	C
0	0	3	2

1. Determination of reaction rate constant for a saponification reaction in batch reactor.
2. Determination of reaction rate constant for a saponification reaction in plug flow reactor.
3. Determination of reaction rate constant for a saponification reaction in mixed flow reactor.
4. Determination of mean residence time by RTD studies in plug flow reactor.
5. Determination of mean residence time by RTD studies in mixed flow reactor.

Total: 45

SEMESTER VI

PH1351 – INSTRUMENTAL METHODS OF PHARMACEUTICAL ANALYSIS

L	T	P	C
3	1	0	4

UNIT I UV – VISIBLE SPECTROSCOPY 9

Properties of electromagnetic spectrum – Chromophore concept – Beer's and Lambart's law – Limitations – Theory of electronic spectroscopy – Choice of solvent and solvent effects – Modern instrumentation – Design and working principle – Applications of UV-Visible spectroscopy – Nephlometry and turbidimetry – Principle – Instrumentation – Applications.

UNIT II INFRARED AND NMR SPECTROSCOPY 9

Principles of vibrational spectroscopy – Instrumentation and sampling techniques – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications.

UNIT III MASS AND ATOMIC SPECTROSCOPY 9

Principles – Instrumentation – Ionization techniques – Electron impact ionization – Chemical ionization – Applications – Atomic absorption spectroscopy – Principle – Instrumentation – Applications.

UNIT IV CHROMATOGRAPHIC TECHNIQUES 9

Chromatographic methods – Paper chromatography – Thin layer chromatography – Ion exchange chromatography – Column chromatography – High performance liquid chromatography – Applications.

UNIT V ELCTROCHEMICAL METHODS OF ANALYSIS 9

Potentiometry – Types of electrodes – Measurement of EMF and pH – Applications – Conductometry – Measurement of conductivity – Conductometric titrations.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. Beckett, A.K. and Stenlake, J.B., "Practical Pharmaceutical Chemistry", Part I and II, 4th Edition, CBS Publications, 1997.
2. Chatwal, G.R. and Anand, S.K., "Instrumental Methods of Chemical Analysis", Himalaya Publishing House, 2005.

REFERENCES

1. Willard, H.H., Merritt Jr, L.L., Dean, J.A. and Settle Jr, F.A., "Instrumental Methods of Analysis", 7th Edition, CBS Publications, 1986.
2. Skoog, D.A., Holler, F.J. and Nieman, T.A., "Principles of Instrumental Analysis", 5th Edition, Harcourt College Publishers, 2001.
3. Settle, F., "Hand Book of Instrumental Techniques for Analytical Chemistry", Pearson Education (P) Ltd, 2004.

PH1352 – SEPARATION TECHNOLOGY

L	T	P	C
3	0	0	3

UNIT I BIO-SEPARATION 9

Characterization of biomolecules – Fermentation broths – Role of downstream processing in biotechnology – Broad strategies for design of bio-separation processes.

UNIT II DOWNSTREAM PROCESSING 9

Cell disruption – Mechanical and chemical methods – Cake filtration and microfiltration – Centrifugation and sedimentation – Membrane processes – Dialysis – Ultra filtration – Reverse osmosis and electro-dialysis.

UNIT III LIQUID-LIQUID SEPARATIONS AND PROTEIN SEPARATIONS 9

Solvent extraction of small molecules – Aqueous two-phase extraction of proteins – PEG/Dextran separation – Precipitation of proteins with salts and organic solvents – Salting out method – Electrostatic interaction – Protein solvation with polyelectrolytes – Polyvalent metal ions – Sorption.

UNIT IV CHROMATOGRAPHIC SEPARATIONS 9

Adsorption processes – Principles of chromatographic separation – Gel filtration – Reversed phase – Hydrophobic interaction – Ion-exchange – Immuno-bio-affinity chromatography – Design and selection of chromatographic matrices – Modes of operations – Design of large scale chromatographic separation processes – Electrophoresis.

UNIT V PRODUCT PURIFICATION 9

Crystallization – Crystal geometry – Equilibrium and yields – Nucleation – Crystal growth – Equipments for crystallization – Continuous crystallizer – Draft tube baffle crystallizer – Drying and lyophillization – Principles – Temperature patterns – Heat transfer in dryers – Bound –Unbound water – Freeze drying or lyophillization – Equipments for drying – Tray dryer – Fluidised bed dryer – Spray dryer.

Total: 45

TEXTBOOKS

1. Geankoplis, C.J., “Transport Processes and Separation Process Principles”, 4th Edition, Prentice-Hall, Inc, 2003.
2. Mukhopadhyay, S.N., “Process Biotechnology Fundamentals”, 2nd Edition, Viva Books (P) Ltd., 2004.

REFERENCES

1. Adamovies, J.A., “Chromatographic Analysis of Pharmaceuticals”, 2nd Edition, Marcel Dekker, 1997.
2. McCabe, W.L., Smith, J.C and Harriot, P., “Unit Operations of Chemical Engineering”, 6th Edition, McGraw Hill Publications, 2001.
3. Cruger, W. and Cruger,V., “A Text Book of Industrial Microbiology”, 2nd Edition, Prentice-Hall, Inc, 1997.

PH1353 – PROCESS EQUIPMENT DESIGN

(To Consider as Practical Subject for Examination Purpose)

L	T	P	C
4	0	0	4

UNIT I HEAT EXCHANGERS **12**

Design of shell and tube heat exchangers- Double pipe heat exchangers

UNIT II EVAPORATORS **12**

Design of single and multiple effect evaporators.

UNIT III DISTILLATION **12**

Design of distillation columns – sieve and bubble cap towers.

UNIT IV ABSORPTION COLUMNS **12**

Design of absorption columns – plate & packed columns

UNIT V DRYERS **12**

Design of batch and continuous dryers.

Total: 60

TEXT BOOKS

1. Perry, R.H., "Chemical Engineers Handbook", 7th Edition, McGraw Hill Co, 1988.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. 6, Pergamon Press, 1977.

REFERENCES

1. Bhattacharya, B.C., "Introduction to Chemical Equipment Design Mechanical Aspects", 1st Edition, CBS Publishers and Distributors, 1985.
2. Dawande, S.D., "Process Design of Equipment", Central Techno Publications, 2005.
3. Donald, Q.K., "Process Heat Transfer", 1st Edition, Tata McGraw Hill Publishing Co, 1997.

Note: Necessary Data Book is to be issued while conducting Practical Examination

CH1363 – MASS TRANSFER OPERATIONS

L	T	P	C
4	0	0	4

UNIT I DIFFUSION 12

Diffusion in fluids: Molecular and eddy diffusion measurement and calculation of diffusivities – Ordinary diffusion in multi component gaseous mixtures – Interphase mass transfer – Mass transfer coefficients – Theories of mass transfer.

UNIT II ABSORPTION 12

Gas absorption: Principles of absorption and desorption – Selection of solvents for absorption – Tray tower absorber – Absorption factor – Calculation of number of theoretical stages – Murphree efficiency – Point efficiency – Tray efficiency and overall tray efficiency – Calculation of actual number of trays – Packed tower absorber – Tower packing and characteristics – Calculation of NTU-HTU- HETP and height of absorption towers.

UNIT III DISTILLATION 12

Basic concepts of distillation: Vapour-liquid equilibrium – Pressure – Temperature – Concentration – Phase diagram – Isothermal and isobaric equilibrium – Relative volatility – Ideal solutions – Raoult's law – Deviations from ideality – Minimum and maximum boiling azeotropes – Different methods of distillation: flash steam – Vacuum – Molecular – Azeotropic – Extractive distillations – Continuous fractionation: multistage tower – Bubble cap – Sieve tray and valve tray towers – McCabe Thiele method.

UNIT IV LEACHING 12

Solid-liquid extraction – Description of leaching operations and technologies – Applications of leaching – Preparation of solid – Methods of operation and classification of equipment – Solid-liquid equilibrium in leaching – Multi stage cross current and counter current leaching – Calculation of composition and number of stages.

UNIT V DRYING 12

Drying – Principle and definitions – Estimation of drying rates – Drying rate curve – Critical and equilibrium moisture content – Calculation of drying time under constant drying conditions – Different types of dryers.

Total: 60

TEXT BOOKS

1. McCabe, W.L., Smith, J.C. and Harriot. P., "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill Book Co., 2001.
2. Treybal, R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill Book Co., 1980.

REFERENCES

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering", Vol. I, II and III, Pergamon Press, 1977.
2. Bennett, C.O. and Myers, J.E., "Momentum Heat and Mass Transfer", 3rd Edition, McGraw Hill Book Company, 1983.
3. Geankoplis, C.J., "Transport Processes and Unit Operations", 3rd Edition, Prentice Hall of India Pvt. Ltd, 2000.

CS1364 – OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

UNIT I FUNDAMENTALS 9

Object oriented programming concepts – Encapsulation – Programming elements – Program structure – Enumeration types – Functions and pointers – Function invocation – Overloading functions – Scope and storage class – Pointer types – Arrays and pointers – Call-by-reference – Assertions – Standard template library.

UNIT II IMPLEMENTING ADTS AND ENCAPSULATION 9

Aggregate type structure – Structure pointer operators – Unions – Bit fields – Data handling and member functions – Classes – Constructors and destructors – Static member – This pointer – Reference semantics – Implementation of simple ADTs.

UNIT III POLYMORPHISM 9

ADT conversions – Overloading – Overloading operators – Unary operator overloading – Binary operator overloading – Function selection – Pointer operators.

UNIT IV INHERITANCE 9

Derived class – Typing conversions and visibility – Code reuse – Virtual functions – Run-time type identifications – Exception – Handlers – Standard exceptions.

UNIT V TEMPLATES AND FILE HANDLING 9

Template class – Function templates – Class templates – C++ streams – Console streams – Console stream classes – Formatted and unformatted console I/O operations – Manipulators – File streams – Classes file modes – File pointers and manipulations – File I/O – Exception handling.

Total: 45

TEXT BOOKS

1. Ira Pohl, “Object-Oriented Programming Using C++”, Pearson Education, 2nd Edition, 2003.
2. Venugopal, K.R., Buyya, R. and Ravishankar, T., “Mastering C++”, Tata McGraw Hill, 2003.

REFERENCES

1. Ashok, B. and Kamthane, N., “Object-Oriented Programming with ANSI and Turbo C++”, Pearson Education, 2006.
2. Stroustrup, “The C++ Programming Language”, Addison Wesley, 2000.
3. Hubbard, J.R., “Programming with C++”, Schaums Outline Series, Tata McGraw Hill, 2003.

PH1354 – INSTRUMENTAL METHODS OF PHARMACEUTICAL ANALYSIS LABORATORY

L	T	P	C
0	0	3	2

1. Determination of impurities by limit test.
2. Determination of λmax.
3. Determination of isobestic point.
4. Determination of the percentage purity of a drug using colorimetry.
5. Determination of percentage purity of drug in marketed tablets and capsules using UV spectrophotometer by $E^{1\%}_{1cm}$ method.
6. Determination of percentage purity of marketed or formulated tablets using UV spectrophotometer using calibration method.
7. Separation of mixtures of drugs by TLC.
8. Determination of R_f values of drugs using paper chromatography.
9. Determination of EMF using potentiometer.
10. Effect of pH on absorbance spectrum of phenolic compounds (Paracetamol).

Total: 45

CH1364 – MASS TRANSFER LABORATORY

L	T	P	C
0	0	3	2

1. Determination of the critical moisture content and drying rate.
2. Determination of the critical moisture content and drying rate under vacuum.
3. Verification of Rayleigh equation.
4. Determination of the efficiency of steam distillation.
5. Determination of diffusion coefficient.
6. Determination of HETP.
7. Optimization of the number of leaching stages.
8. Determination of the break point for adsorption.
9. Mass transfer coefficient and Reynolds number relation.
10. Verification of adsorption isotherms

Total: 45

HS1301 – COMMUNICATION AND SOFT SKILLS LABORATORY

L	T	P	C
0	0	3	1

UNIT I LISTENING AND SPEAKING PRACTICE IN COMMUNICATIVE FUNCTIONS

Introductions and meetings – Talking about studies and/ or job – Expressing likes and dislikes – Describing daily routines and current activities – Talking about past states and events – Talking about future plans and intentions – Expressing preferences – Giving reasons – Expressing opinions, agreement and disagreement – Seeking and giving advice – Making suggestions

UNIT II SPEAKING APPLICATIONS

Making an oral presentation – Preparing the presentation – Performing the presentation – Beginning – Language – Visual aids and body language – Voice – Ending – Questions – Telephone conversations – Group Discussion and Interview

UNIT III UNDERSTANDING AND PREPARING FOR INTERNATIONAL ENGLISH LANGUAGE EXAMINATIONS

Graded Examinations in Spoken English (GESE) – Spoken English for Work (SEW) – International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Business English Certificate (BEC)

UNIT IV SOFT SKILLS (1)

Preparing for and dealing with change – Motivation – Goal-setting – self-esteem – Managing time and stress – Career and life planning – Team work – Leadership traits

UNIT V SOFT SKILLS (2)

Multiple intelligences – Learning styles and personality typing – Critical and creative thinking – People, cultures and self – Intercultural communication

RESOURCES

1. Kamalesh Sadanand and Susheela Punitha, "Spoken English: A Foundation Course" for Speakers of Indian Languages, Part 2 Audio CD, Hyderabad: Orient Longman, 2008
2. Malcome Goodale, "Professional Presentations", (VCD) New Delhi: Cambridge University Press, 2005
3. Barbara Garside and Tony Garside, Essential Telephoning in English (Audio CD), Cambridge: Cambridge University Press, 2002
4. Hari Mohan Prasad and Rajnish Mohan, How to Prepare for Group Discussion and Interview (Audio Cassette) Tata McGraw-Hill Publishing
5. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London
6. International English Language Testing System Practice Tests, CUP
7. Business English Certificate Materials, Cambridge University Press
8. Personality Development (CD-ROM), Times Multimedia, Mumbai
9. Interactive Multimedia Programs on Managing Time and Stress
10. Robert M. Sherfield and et al "Developing Soft Skills" 4th Edition, New Delhi: Pearson Education, 2009

SUGGESTED ACTIVITIES IN THE LANGUAGE LABORATORY (48 HOURS/PERIODS)

1. Giving an exposure to and interactive listening and speaking practice in important communicative functions (2 lab sessions)
2. Making the student watch the performing the presentation part of the VCD (2 lab sessions)
3. Giving listening, speaking and gap-filling exercises of the telephoning audio CD (2 lab sessions)
4. Providing a model group discussion and interview (2 lab sessions)
5. Using the international □nglish language test materials with a view to familiarizing the students with the nature and the format of the examinations (4 lab sessions)
6. Using the content given in personality development, time and stress management CDs (4 lab sessions)

SUGGESTED ACTIVITIES IN THE CLASSROOM (12 HOURS/ PERIODS)

1. Holding discussions on the topics mentioned in Units IV and V
2. Students submitting assignment on topics discussed earlier

Total: 45

ELECTIVE I

PH1001 – SOLID DOSAGE FORM TECHNOLOGY

L	T	P	C
3	0	0	3

UNIT I POWDERS AND GRANULES 9

Advantages and disadvantages of powdered and granulated products – Mixing and dividing of powders – Problems in manufacturing powders – Effervescent granules – Reasons for granulation – Granulation mechanisms – Pharmaceutical granulation equipments.

UNIT II TABLETS AND COATING 9

Types of tablets – Formulation – Manufacturing of tablets – Tableting problems – Evaluation of Tablets – Tablet coating **–** Film coating – Sugar Coating – Enteric coating – Evaluation of coated tablets – Applications.

UNIT II CAPSULES 9

Classification – Hard gelatin capsules – Composition and size – Materials and method of production of hard gelatin capsule – Formulation and filling of capsules – Soft gelatin capsules – Rationale – Manufacturing and formulation of soft gelatin capsules – Evaluation of capsules.

UNIT IV MICROENCAPSULATION 9

Types of microcapsules – Application of microencapsulation in pharmaceutical sciences – Microencapsulation by coacervation – Phase separation – Multi-orifice centrifugation – Spray congealing – Polymerization – Air suspension technique – Pan coating and other techniques – Evaluation of microcapsules.

UNIT V ADVANCES IN TABLETING TECHNIQUES 9

Compression coating – Inlay tablets – Layer tablets – Mouth dissolving tablets – Tablets in tablets.

Total: 45

TEXT BOOKS

1. Aulton, M.E., "Pharmaceutics – The Science of Dosage form Design", 2nd Edition, ELBS Publications, 2002.
2. Lachman, L. and Liberman, H.A., "Theory and Practice of Industrial Pharmacy", 3rd Edition, Varghese Publishing House, 1991.

REFERENCES

1. Liberman, H.A., Lachman, L. and Schwartz, J.B., "Pharmaceutical Dosage Form: Tablets", 2nd Edition, Volume II, Mercel Dekker, 1999.
2. Gennaro, A.R., "Remington: The Science and Practice of Pharmacy", Vol. I and II,21st Edition, Lippincott Williams and Willkins, 2005.
3. Banker, G.S. and Rhodes, C.T., "Modern Pharmaceutics", 4th Edition, Informa Health Care, 2002.

HI1002 – HERBAL TECHNOLOGY

L	T	P	C
3	0	0	3

UNIT I INDIAN SYSTEMS OF MEDICINE 9

Ayurveda – Unani – Homeopathy – Siddha – Yoga and naturopathy – Classification of herbs – Taxonomy – Harvesting – Post harvesting – Conditions of storage.

UNIT II IN-VITRO CULTURE OF MEDICINAL PLANTS 9

Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plat tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

UNIT III EXTRACTION, ISOLATION AND ANALYSIS OF PHYTOPHARMACEUTICALS 9

Infusion – Decoction – Digestion – Maceration – Percolation – Successive solvent extraction – Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox – Selection of a suitable extraction process – Carbohydrates – Proteins – Alkaloids – Glycosides.

UNIT IV SCREENING METHODS FOR HERBAL DRUGS 9

Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Cardiac glycosides – Analgesic activity – Antipyretic activity – Anti cancer activity – Evaluation of hepatoprotective agents – Anti ulcer drugs.

UNIT V STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS 9

Importance of standardization – Problems involved in the standardization of herbs – Standardization of single drugs and compound formulations – WHO guidelines for quality standardized herbal formulations – Estimation of parameter limits used for standardization – Conversation strategies of medicinal plants – Conservation types – Government policies for protecting the traditional knowledge.

Total: 45

TEXT BOOKS

1. Agarwal, S.S. and Paridhavi, M., “Herbal Drug Technology” Universities Press (India) Private Limited, 2007.
2. Wallis, T.E., “Textbook of Pharmacognosy” 5th Edition, CBS Publishers and Distributors, 1985.

REFERENCES

1. Evans, W.C., “Trease and Evans Pharmacognosy” 15th Edition, Elsevier Health Sciences, 2001.
2. Lanza, R.P. and Atala, A., “Methods of Tissue Engineering” Elsevier Publications, 2006.
3. Daniel, M., “Herbal Technology: Concepts and Advances” Satish Serial Publishing House, 2008.

PH1003 – PHARMACEUTICAL PRODUCTION MANAGEMENT

L	T	P	C
3	0	0	3

UNIT I PILOT PLANT AND SCALE-UP TECHNIQUES 9

Pharmaceutical Pilot plant – Pilot plant design – Case studies for tablets – Capsules – Aerosols – Liquid orals – Parenterals – Sustained release preparation – Semi-solid preparation – Basic requirements – Design of product – Facility – Equipment selection and personnel.

UNIT II PRODUCTION, PLANNING, SCHEDULING AND FORECASTING 9

Production systems – Production department – Production process routing and loading – Scheduling – Despatching of records – Production control.

UNIT III FORMULATION PRODUCTION MANAGEMENT 9

Plant site selection and layout – Material handling for various pharmaceutical products – Service facilities – Preventive maintenance in pharmaceutical companies – Group and individual replacement.

UNIT IV MATERIAL MANAGEMENT 9

Materials – Quality and quantity – Value analysis – Purchasing – Centralized and decentralized – Vendor development – Buying techniques – Purchasing cycle and procedures – Stores management – Salvaging and disposal of scrap surplus – Selective inventory control – RQM and EOQ – Modern inventory management systems – Cost and savings in inventory.

UNIT V HUMAN RESOURCE DEVELOPMENT 9

Human resource planning – Job analysis and design – Recruitment – Personnel selection – Orientation and placement – Training and development – Supervision – Performance appraisal – Remuneration and salaries – Compensation – Industrial relations – Motivation – Labour welfare.

Total: 45

TEXT BOOKS

1. Vidyasagar, G., “Pharmaceutical Industrial Management”, 3rd Edition, Varghese Publications, 2001.
2. Subramaniam, C.V.S., “Textbook of Pharmaceutical Production Management”, Vallabh Prakashan, 2000.

REFERENCES

1. Lachman, L. and Liberman, H.A., “The Theory and Practice of Industrial Pharmacy”, 3rd Edition, Varghese Publications, 1986.
2. Evans, J., Sweeny, A. and Wiliams, H “Applied Production and Operations Management”, 3rd Edition, West Publishing Company Ltd., 1992.
3. Drucker, P.F., “Management (Task, Responsibility and Practices)”, Allied Publication, 1993.

PH1004 – INDUSTRIAL MANAGEMENT

L	T	P	C
3	0	0	3

UNIT I PERSONNEL MANAGEMENT 9

Principles and functions – Handling union – Negotiation process – Labour legislation in India – Managerial decision making process, tools and techniques – Role of employee through empowerment – Industrial management program – Public relation.

UNIT II TQM TOOLS AND TECHNIQUES 9

Bench marking process – Concept, reason, application – Quality function deployment and its benefits – Study of manufacturing costs and techniques for financial control – Tools and techniques for six sigma philosophy – Tacuchi law functions – Statistical process control.

UNIT III QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEMS 9

Philosophy of Total Quality Management – ISO registration procedure and benefits – Concepts of ISO 9000, 14000, 18000 standards – Internal quality audit – Quality improvement and customer satisfaction – Importance of documentation procedure – Plant safety and industrial hygiene.

UNIT IV ENGINEERING ECONOMICS 9

Micro and Macro economics – Accounting procedures and preparation of financial statements – Principles of lean manufacturing philosophy – Study of global market – Methods to overcome competitiveness.

UNIT V PROCESS ECONOMICS 9

Amortisation, Capital recovery, Depreciation - Economics of selecting alternatetives – Rate of return and payout time – Budgeting – Operation Management – Strategic analysis – Problem solving technioques – Preparation of technical reports – Process Improvement.

Total: 45

TEXT BOOKS

1. Peters and Haus, T., “Plant Design and Economics for Chemical Engineering”, 4th Edition, McGraw Hill Book Co., 1991.
2. Monappa, A. and Saiyadain, M.S., “Personnel Management”, 2nd Edition, Tata McGraw Hill Publishing Company Ltd., 2003.

REFERENCES

1. Kermath Case, J.A. and Prat, D., “Principle of Engineering Economics”, 4th Edition, John Wiley Publishers, 1997.
2. Schwyer, H.E., “Process Engineering Economics”, 1st Edition, McGraw Hill Book Co., 1962.
3. Bhat, K.S., “Total Quality Management”, 1st Edition, Himalaya Publishing House, 2002.

SEMESTER VII

PH1401 – ADVANCED MEDICINAL CHEMISTRY

L	T	P	C
3	1	0	4

UNIT I QUANTITATIVE DESCRIPTION OF PHYSICOCHEMICAL PROPERTIES 9

Quantitative description of physicochemical properties of drug molecules with reference to electronic effects in drugs – Hydrophobic properties of drugs – Methods of calculating partition coefficient – 3D structure of drugs – Other physicochemical parameters in relation to biological action.

UNIT II QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIP 9

History and development of QSAR – Classification of QSAR methodology – Hansch analysis – Free Wilson analysis – Applications advantages and pitfalls of QSAR.

UNIT III DESIGN OF ENZYME INHIBITORS 9

Forces involved information of enzyme substrate and enzyme inhibitor complexes – Design of rapid reversible inhibitors – Multisubstrate inhibitors – Mechanism based inhibitors – Application with recent examples from literature.

UNIT IV DOCKING OF FLEXIBLE MOLECULES 9

Docking of flexible molecules in protein/enzyme active sites – Docking by energy minimization superimposition – Molecular dynamic – Monte Carlo – Distance geometry and build-up methods – Applications with recent examples from literature.

UNIT V COMPUTER-AIDED DEVELOPMENT OF THREE-DIMENSIONAL PHARMACOPHORE MODES 9

Direct and indirect ligand design – The pharmacophore concept – Steps in 3-D-pharamacophore identification – Selection of pharmacophore elements – Representation of pharmacophore elements as ligand points or site points – Receptor exclude and receptor essential volumes.

L: 45 T: 15 Total: 60

TEXT BOOKS

1. Kadam, S.S., Mahadik, K.R. and Bothara, K.G., "Principles of Medicinal Chemistry", Vol. I and Vol. II, 7th Edition, Nirali Prakashan Publications, 1999.
2. Remers, W.A. and Delgado, J.N., "Wilson and Gisvold's Textbook of Pharmaceutical Organic Chemistry", Lippincott William and Wilkins, 2004.

REFERENCES

1. Wolff, M.E., "Burger's Medicinal Chemistry", 5th Edition, Vol. I – V, John Willey and Sons, 2003.
2. Hansch, C., "Comprehensive Medicinal Chemistry", Vol.4, Pergamon Press, 1998.
3. Leach A.R., "Molecular Modeling and Drug Design" 2nd Edition, Pearson Prentice-Hall, 2001.

PH1402 – NOVEL DRUG DELIVERY SYSTEM

L	T	P	C
4	0	0	4

UNIT I POLYMERS 12

Polymers used in controlled drug delivery modules – Classification – Advantages and disadvantages of polymers – Polymerization mechanisms – Degradation mechanism – Polymer characterization.

UNIT II SUSTAINED RELEASE DRUG DELIVERY SYSTEMS 12

Physicochemical and biological properties of drugs – Oral dosage forms – Diffusion systems – Systems utilizing dissolution – Osmotic systems – Ion exchange resins.

UNIT III TARGETED DRUG DELIVERY SYSTEM 12

Nanoparticles – Liposomes – Resealed erythrocytes – Immunologically based system – Antibodies for drug delivery – Magnetic microspheres.

UNIT IV MODULE FOR GASTRO INTESTINAL TRACTS 12

Approaches to increase gastric retention – Factors affecting gastric retention – Formulation development of floating drug delivery system – Expanding systems – Systems for colon specific delivery – Targeting approaches to colon.

UNIT V MUCOADHESIVE DRUG DELIVERY SYSTEMS 12

Buccal drug delivery – Concepts – Advantages – Disadvantages – Permeability enhancers – In vitro and in-vivo evaluation – Nasal drug delivery system – Pulmonary drug delivery system – Applications.

Total: 60

TEXT BOOKS

1. Robinson, J.R. and Lee, V.H.L., “Controlled Drug Delivery Systems”, 2nd Edition, Marcel Dekker, 1992.
2. Vyas, S.P. and Khar, R.K., “Controlled Drug Delivery Concepts and Advantages”, 1st Edition, 2002.

REFERENCES

1. Chein, Y.W., “Novel Drug Delivery Systems”, 2nd Edition, Marcel Dekker Inc, 1992.
2. Gennaro, A R., “Remington: The Science and Practice of Pharmacy”, Vol. I and II, 21st Edition, Lippincott Williams and Willkins, 2005.
3. Jain, N.K., “Advances in Controlled and Novel Drug Delivery”, 1st Edition, CBS Publishers and Distributors, 2001.

PH1403 – PHARMACEUTICAL BIOTECHNOLOGY

L	T	P	C
4	0	0	4

UNIT I FERMENTATION TECHNOLOGY 12

Industrial fermentation processes and products – Role of bioprocess engineer – Unit operations in an integrated bioprocess – Process flowsheet – Survey of organisms – Processes – Products – Market economics of modern industrial biotechnology.

UNIT II RAW MATERIALS FOR FERMENTATION PROCESS 12

Isolation of microorganisms – Preservation and improvement of industrial microorganisms for overproduction of primary and secondary metabolites – Medium requirements for fermentation process – Carbon, nitrogen, minerals, vitamins, and other nutrients – Simple and complex media.

UNIT III PRIMARY METABOLITES 12

Primary metabolite – Methods for the production of citric acid – Itaconic acid – Lactic acid-Acetic acid – Gluconic acid – Tartaric acid .

UNIT IV SECONDARY METABOLITES 12

Production of low molecular weight secondary metabolites – Penicillins – Cephalosporins - Streptomycin – Kanamycin – 1,2-benzoquinones – Ciprofloxacin – Gatifloxacin.

UNIT V PRODUCTION AND CONTROL OF BIOTECH DERIVED PRODUCTS 12

Recombinant DNA products – Insulin – Growth hormones – Erythropoietin – Cytokines –Diagnostic proteins – Protein A – Protein G – Antibodies.

Total: 60

TEXT BOOKS

1. Stanbury, P.F., Whitaker, A. and Hall, S.J., “Principles of Fermentation Technology”, 2nd Edition, Aditya Books (P) Ltd, 1995.
2. Shuler, M.L. and Kargi, F., “Bioprocess Engineering Basic Concepts”, 2nd Edition, Prentice Hall of India, 2004.

REFERENCES

1. Purohit, S.S., Saluja, A.K. and Kulkarni, H.N., “Pharmaceutical Microbiology”, 1st Edition, Agrobios (India), 2003.
2. Hugo, W.B. and Russel, A.D., “Pharmaceutical Microbiology”, 6th Edition, Blackwell Science, 2003.
3. Casida Jr, L.E., “Industrial Microbiology”, 2nd Edition, Wiley Eastern Ltd, 1968.

CH1407 – PROCESS DYNAMICS AND CONTROL

L	T	P	C
4	0	0	4

UNIT I FIRST ORDER SYSTEMS 12

Linear open to loop systems – Laplace transformation – Transform of standard functions – First order and linearised first order systems – Response to various disturbances – Inversion – Theorems in laplace transformation – Applications.

UNIT II HIGHER ORDER SYSTEMS 12

First order in series – Linearization and its application in process control – Higher order systems – Second order and Transportation lag – Response to various disturbances.

UNIT III CLOSED LOOP CONTROL SYSTEMS 12

Closed loop control systems – Development of block diagram for feed – back control systems – Servo and regulator problems – Transfer function for controllers and final control element – Principles of pneumatic and electronic controllers – Transient response of closed-loop control systems and their stability.

UNIT IV FREQUENCY RESPONSE 12

Introduction to frequency response of closed-loop systems – Routh analysis – Control system design by frequency – Bode diagram – Stability criterion – Tuning of controller settings.

UNIT V SPECIAL CONTROLS 12

Cascade – Feed forward and ratio control – Dead time compensation – Internal model control – Control valves – Process identification.

Total: 60

TEXT BOOKS

1. Coughnowr, D.P., “Process Systems Analysis and Control”, 2nd Edition, McGraw Hill , 1991.
2. Smith, C.A. and Corripio, A.B., “Principles and Practice of Automatic Process Control”, 2nd Edition, John Wiley, 1997.

REFERENCES

1. Harriot, P., “Process Control”, Tata McGraw Hill, 1984.
2. George Stephanopolous., “Chemical Process Control”, Prentice – Hall of India Pvt. Ltd., 1990.
3. Patranabis, D., “Principles of Process control”, 2nd Edition, Tata McGraw – Hill Publishing Co. Ltd., 1981.

CH1408 – TECHNOLOGY OF FINE CHEMICALS AND BULK DRUGS

L	T	P	C
4	0	0	4

UNIT I INTRODUCTION OF FINE CHEMICALS AND BULK DRUGS 12

Concept of fine and Bulk drugs and their salient features – Evolution of process – Process chemistry – Research and development strategies in pharmaceutical industries.

UNIT II PRODUCTION, PLANNING AND CONTROL 12

Flow sheets – Types of flow sheets – Flow symbols – Line symbols – Concept of all purpose and multipurpose plants – Plant design – Layout – Construction – Process economics – Materials of construction – Effluent treatment – Solvent recovery for fine chemicals – Bulk drugs.

UNIT III BASE CHEMICAL PRODUCTION 12

Industrial Production of following base chemicals – Mineral acids (sulpuric acid, nitric acid, phosphoric acid) – Naphthalene – Ammonia – Caustic soda – Industrial alcohol – Butyl alcohol – Benzene – Phenol.

UNIT IV DRUG INTERMEDIATES AND FINE CHEMICAL PRODUCTION 12

Manufacture of following chemicals and their applications – Urea – Acrylonitrile – Ethylacetate – Butadiene – Quinoline – Aniline – Tetrahydrofuran – Titaniumdioxide – Vanillin.

UNIT V BULK DRUGS 12

Raw Materials – Production Techniques – Reaction Flow Sheet – Equipments – Utilities for the production of drugs below – Paracetamol – Aspirin – Ibuprofen – Diazepam – Darvon – Niacinamide – Chloramphenicol.

Total: 60

TEXT BOOKS

1. Gopal Rao, M. and Sittig, M., “Dryden’s Outlines of Chemical Technology”, 3rd Edition, Affiliated East West Press Pvt. Ltd., 2001.
2. Austin, G.T., “Shreve’s Chemical Process Industries”, 5th Edition, McGraw Hill Book Company, 1984.

REFERENCES

1. Moulijin, J.A., Makkee, M. and Diepan, A.V., “Chemical Process Technology”, John Wiley and Sons, 2001.
2. Shah, K.M., “Hand Book of Industrial Chemistry”, Vol. I and II, Multi-Tech Publishing Co, 1999.
3. Pandey, G.N., “A Text Book of Chemical Technology”, Vol. II, Vikas Publishing House (P) Ltd., 2000.

ELECTIVE II

CH1011 – WATER TREATMENT AND MANAGEMENT

L	T	P	C
3	0	0	3

UNIT I INTERNAL TREATMENT PROCESS 9

Character and properties – Water problem and solution – Water Sedimentation - Coagulation – Filtration – Disinfection – Theory, necessity, process, equipment, application, location, limitation.

UNIT II EXTERNAL TREATMENT PROCESS 9

Softening by Ion – exchange process, Demineralization – Cation exchange materials – Removal of ion, Manganese, odour, colour taste – Deaeration – Oxidation – Fluoridation – Dealkalisation – Desalination by Reverse osmosis.

UNIT III BOILER WATER AND COOLING WATER 9

Concept – Importance – Location – Commonly used desalination process – Distillation – Electrodialysis – Reverse osmosis – Freezing – Solar distillation- Purpose – Problem associated with water quality and equipment – Steam system fundamentals – Hot water closed system – Measurement and control of pH, corrosion, fouling – Microbial analysis – Ozone control – Study of microorganism – Energy efficient operations and maintenance.

UNIT IV WASTE WATER TREATMENT 9

Waste water in Industry- Home and Agriculture – Various waste water treatment processes – Optimization – Benefits and costs – Microbial and sanitation water treatment – Biofilm formation and removal – Microbial trend analysis – Pretreatment system and equipment.

UNIT V WATER MANAGEMENT IN INDIA 9

Water resources and planning – Water policy – Indian scene – Main aspects of water management – Hydrological cycle – Hydrosphere – Water transport – Water exchange – Causes and problems in irrigation, rural water, urban water – Water conservation resource management – Rain Harvesting.

Total: 45

TEXT BOOKS

1. P.C.Bansil "Water Management in India", Concept Publishing company, New Delhi, First Edition, 2004.
2. G.S.Bridie and J.S.Bridie "Water Supply and Sanitary Engineering", Dhanpat Raj Publishing company (P) Ltd., New Delhi, 7th Edition, 2003.

REFERENCES

1. Austin G.T., "Shreve's Chemical Process Industries", Fifth Edition, McGraw Hill, 1998.
2. S.C. Rangwala, "Water supply and Sanitary Engineering", Eighteenth Edition, Charotar Publishing House, 2003.
3. Pandey G.N., "Text Book of Chemical Technology", Vikas Publishing House Pvt. Ltd., New Delhi, 1992.

PH1005 – VALIDATION IN PHARMACEUTICAL INDUSTRIES

L	T	P	C
3	0	0	3

UNIT I DRUGS AND COSMETICS ACT AND GMP FOR API 9

Drugs and cosmetics act, 1948 – Organization and personnel – Buildings and facilities – Equipment – Documentation and records – Material management – Production and in-process control – Packaging and labeling – Storage Distribution.

UNIT II IMPURITIES IN DRUG SUBSTANCES AND DRUG PRODUCTS 9

Quality USP description of impurities – Validation and impurity issue related to manufacturing – Processing of drug substances – Enantiomers as impurities – Polymorphs as unwanted components.

UNIT III CLEANING FOR API MANUFACTURING FACILITIES 9

Regulatory requirements – Multiple vs dedicated equipment – Unique nature of API – Multiple level approach to cleaning – Nature of contaminants – Selection of a worst case – Cleaning techniques – Sampling – Analytical methods – Limits and acceptance criteria, documentation.

UNIT IV STABILITY TESTING 9

Reasons for stability testing – Modes of degradation – Shelf lives and expiration dates – Possible strategies to improve shelf lives – Stability testing of new drug substances and products (Q_1A) – Photo stability testing of new substances and products (Q_1B) – Validation on analytical procedures (Q_2A).

UNIT V GMP FOR BIOLOGICAL PRODUCTS 9

Organization and personnel – Buildings and facilities – Equipment – Documentation – Production and in-process control – Packaging and labeling – Storage – Distribution – Disposal of bio medical waste.

Total: 45

TEXT BOOKS

1. Ira, R.B. and Harpaz, D., "Validation of Active Pharmaceutical Ingredients", 2nd Edition, CRC Press, 2001.
2. Anjaneyulu, Y. and Maraya, R., "Quality Assurance and Quality Management in Pharmaceutical Industry", Pharma Book Syndicate, 2005.

REFERENCES

1. Willig, S.H., "Good Manufacturing Practice for Pharmaceuticals", 5th Edition, Marcel Dekker, 2005.
2. Iyer, S., "Guidelines on cGMP and Quality of Pharmaceutical Products", 1st Edition, D.K. Publications, 2003.
3. Carstensen, J.T. and Rhodes, C.T., "Drug Stability Principles and Practice", 3rd Edition, Marcel Dekker, 1995.

PH1006 – NATURAL PRODUCTS CHEMISTRY

L	T	P	C
3	0	0	3

UNIT I PROTEINS AND AMINO ACIDS **9**

Classification – Properties – Reaction and preparation of amino acids – Essential amino acids.

UNIT II TERPENOIDS **9**

Classification – General methods of determining the structure – Chemistry and uses of citral – Menthol – Thymol – Camphor – α-Terpineol – α-pinene.

UNIT III ALKALOIDS **9**

Classification – General methods of structural elucidation – Chemistry and pharmacological activity of atropine and related compounds – Quinine and quinidine – Reserpine – Morphine and related compounds – Papaverine.

UNIT IV GLYCOSIDES **9**

Basic ring system – Nomenclature and stereochemistry of steroid nucleus – Chemistry of digitoxin, digoxin, lanatosides, diosgenin and sarasapogenin, hecogenin and sennosides.

UNIT V VITAMINS **9**

Chemistry and pharmaceutical uses of vitamin A, D, E, K, B_1, B_2, B_6, B_{12} and folic acid.

Total: 45

TEXT BOOKS

1. Finar, I.L., "Organic Chemistry", 5th Edition, Vol. II, Longman Scientific and Technical Publishers, 2000.
2. Chatwal, G.R., 'Organic Chemistry of Natural Products", Vol. I and II, Himalaya Publishing House, 2001.

REFERENCES

1. Evans, W.C., "Trease and Evans Pharmacognosy", 15th Edition, Elsevier Health Sciences, 2001.
2. Agarwal, O.P., "Chemistry of Natural Products", Vol. II, Goel Publications, 2008.
3. Nelson, D.L. and Cox, M.M., "Lehninger's Principles of Biochemistry" 4th Edition, W.H.Freemen and Co., 2005.

PH1007 – MATERIAL SCIENCE AND TECHNOLOGY

L	T	P	C
3	0	0	3

UNIT I BONDING IN SOLIDS 9

Structure of atoms and molecules – Bonding in solids – Types of bonds and their energies – Classification of engineering materials – Engineering requirement of materials – Selection of materials – Level of structure.

UNIT II CRYSTAL STRUCTURE AND IMPERFECTIONS 9

Crystal structure – Crystal geometry – Structure of solids – Methods of determining structures – Imperfection in crystals – Types of imperfection – Point imperfection – Diffusion – In solids – Fick's law – Self diffusion.

UNIT III PROPERTIES AND CORROSION 9

Electrical and magnetic properties of materials – Chemical, thermal and technological properties of materials – Corrosion – Theories of corrosion – Control and prevention of corrosion.

UNIT IV ENGINEERING METALS 9

Ferrous metals – Iron and steel – Iron – Carbon equilibrium diagram – Non ferrous metals and alloys – Aluminium – Copper – Zinc – Lead – Nickel and their alloys with special reference to their application in chemical industries.

UNIT V INORGANIC AND ORGANIC MATERIALS 9

Inorganic materials – Ceramics – Glass and refractories – Organic materials – Wood – Plastics and rubber with special reference to the applications in chemical industries.

Total: 45

TEXT BOOKS

1. Lawrence H. and Van Vlack., "Elements of Material Science and Engineering", Addison Wesley Publications, 1971.
2. Hajra Choudhury, S.K., "Material Science and Processes", 1st Edition, Indian Book Distribution Co, 1977.

REFERENCES

1. Manas, C., "Science of Engineering Materials", 1st Edition, McMillan Co. India Ltd., 1979.
2. Raghavan, V., "Materials Science", 5th Edition, Prentice Hall of India, 2004.
3. Paul, E.D., Black, J.J. and Ronald, A.K., "Materials and Process in Manufacturing", 8th Edition, Prentice Hall of India, 2008.

PH1404 – ADVANCED MEDICINAL CHEMISTRY LABORATORY

L	T	P	C
0	0	3	2

1. Design of structures using chemsketch
2. Finding C log P value for drug structures
3. Determination of pKa value of drugs and drugs intermediates
4. Determination of partition co-efficient and calculation of partition co-efficient values of various drugs
5. Determination of physicochemical properties of synthesized drugs
6. Determination of electronic properties of drug molecules using simulation softwares
7. Finding potential lead molecules using docking software
8. Studies on QSAR for the synthesized drugs

Total: 45

PH1405 – NOVEL DRUG DELIVERY SYSTEM LABORATORY

L	T	P	C
0	0	3	2

1. Preparation and evaluation of liposomes
2. Formulation and evaluation of egg albumin microspheres by single emulsion technique
3. Formulation and evaluation of microspheres by emulsion solvent evaporation method
4. Formulation and evaluation of microcapsules through coacervation phase separation by solvent evaporation method
5. Formulation and evaluation of solid dispersion by fusion method
6. Formulation and evaluation of solid dispersion by melting point solvent technique
7. Preparation and evaluation of magnetic microsphere
8. Formulation and evaluation of transdermal films
9. Formulation and evaluation of sustained release matrix tablets
10. Comparison of in vitro release studies of marketed sustained release tablets
11. In vitro release studies of marketed enteric coated tablets

Total: 45

CH1409 – PROCESS DYNAMICS AND CONTROL LABORATORY

L	T	P	C
0	0	3	2

1. ON-OFF control of thermal process
2. Flow control loop and Flow Transmitter
3. Level Control loop and Level Transmitter
4. Pressure control loop and Pressure Transmitter
5. Control valve characteristics
6. Verifying the response of Non-Interacting and interacting level System
7. Optimum controller setting using Ziegler's Nichols Methods
8. Optimum Controller Tuning on Level Process Station
9. pH control system
10. First order and second order system
11. Computer controlled heat exchanger (Shell and tube and Double pipe)
12. Pneumatic control valve positioned trainer
13. Cascade control trainer
14. I/P and P/I converter

***Minimum 10 experiments shall be offered.**

Total: 45

SEMESTER VIII

CH1453 – UNIT PROCESSES IN ORGANIC SYNTHESIS

L	T	P	C
4	0	0	4

UNIT I SULFONATION AND SULFATION 12

Sulfating – Sulfonating agents – Applications – Chemical and physical factors in sulfonation and sulfation – Thermodynamics mechanism – Kinetic considerations – Industrial equipments and techniques – Sulfonation of benzene – Aniline.

UNIT II NITRATION 12

Nitrating agents – Aromatic nitration – Thermodynamics – Kinetics of nitration process – Nitration of benzene – Toluene – Phenol – Glycerine – Naphthalene – Industrial equipments for nitration – Preparation of m-dinitrobenzene – Chloro-nitro benzenes – Continuous nitration process.

UNIT III AMINATION BY REDUCTION 12

Methods of reduction – Bechamp method – Reduction mechanism – Preparation of aniline, p-phenylenediamine – Catalytic hydrogenation process – Catalyst involved in the reduction process – Reduction mechanism – Manufacture of aniline using catalytic reduction – Manufacture of p-aminophenol – Electrolytic reduction.

UNIT IV HALOGENATION 12

Halogenating agents – Thermodynamic and kinetic considerations – Chlorination of methane – Ethane – Propane – Photohalogenation – Manufacture of allyl chloride – Chloroacetic acid – Chloral hydrate – Ethylene chlorohydrin – Chloromethane – Vinyl chloride.

UNIT V OXIDATION 12

Oxidation reactions – Oxidizing agents – Liquid phase and vapour phase oxidation with air and oxygen – Catalysts used – Kinetics and thermodynamic consideration – Manufacture of phthalic anhydride – Acetaldehyde – Acetic acid – Benzaldehyde – Salicylic acid.

Total: 60

TEXT BOOKS

1. Groggins, P.H., “Unit Processes in Organic Synthesis”, 5th Edition, McGraw Hill Ltd., 1995.
2. Morison, R.T. and Boyd, R.N., “Organic Chemistry”, 6th Edition, Prentice Hall of India (P) Ltd, 2006.

REFERENCES

1. Mukharjee, S. and Singh, S.P., “Reaction Mechanism in Organic Chemistry”, 3rd Edition, Mc Millan India Ltd., 2000.
2. Jerry, M., “Advanced Organic Chemistry – Reactions, Mechanism and Structure”, 4th Edition, John-Wiley and Sons, 1992.
3. Bruckner, R., “Advanced Organic Chemistry- Reactions Mechanisms”, Academic Press, 2002.

MG1301 – TOTAL QUALITY MANAGEMENT

L	T	P	C
4	0	0	4

UNIT I INTRODUCTION 12

Definition of quality – Dimensions of quality – Quality planning – Quality costs – Analysis techniques for quality costs – Basic concepts of total quality management – Historical review – Principles of TQM – Leadership – Concepts – Role of senior management – Quality council, quality statements – Strategic planning – Deming philosophy – Barriers to TQM implementation.

UNIT II TQM PRINCIPLES 12

Customer satisfaction – Customer perception of quality – Customer complaints – Service quality – Customer retention – Employee involvement – Motivation – Empowerment – Teams – Recognition and reward – Performance appraisal – Benefits, continuous process improvement – Juran trilogy – PDSA cycle – 5S, kaizen – Supplier partnership – Partnering, sourcing – Supplier selection – supplier rating – Relationship development – Performance measures – Basic concepts – Strategy – Performance measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC) 12

The seven tools of quality, statistical fundamentals – Measures of central tendency and dispersion, population and sample, normal curve – Control charts for variables and attributes – Process capability– Concept of six sigma – New seven management tools.

UNIT IV TQM TOOLS 12

Benchmarking – Reasons to benchmark – Benchmarking process – Quality function deployment (QFD) – House of quality, QFD process – Benefits, taguchi quality loss function – Total productive maintenance (TPM) – Concept – Improvement needs – FMEA – Stages of FMEA.

UNIT V QUALITY SYSTEMS 12

Need for ISO 9000 and other quality systems, ISO 9000:2000 quality system – Elements – Implementation of quality system – Documentation, quality auditing – QS 9000, ISO 14000 – Concept, requirements and benefits.

Total: 60

TEXT BOOKS

1. Besterfield, D.H., “Total Quality Management”, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2007.
2. Kanishka Bedi, “Quality Management”, Oxford Press, 2006.

REFERENCES

1. Shridhara Bhat, K., “Total Quality Management”, Himalaya Publishing House, 1st Edition, 2002.
2. Lal, H., “Total Quality Management – A Practical Approach”, New Age International Publishers, 2004.
3. Nagarajan, R.S., “Total Quality Management”, New Age International Publishers, 2005.

ELECTIVE III

PH1008 – PHARMACEUTICAL PACKAGING TECHNOLOGY

L	T	P	C
3	0	0	3

UNIT I PHARMACEUTICAL PACKAGING 9

Status – Scope in pharmaceutical industry – Classification of packaging material – Primary and secondary packaging – Functions of packaging.

UNIT II PRIMARY PACKAGING MATERIAL 9

Glass containers – Metals containers – Fiber and paper board for bulk – Films and foils for lamination – Equipments used in strip and blister packaging.

UNIT III SECONDARY PACKAGING MATERIALS 9

Folding cartons and sets of boxes – Materials of construction – Design – Specifications – Packaging inserts – Specifications – Test methods – Quality control – Cushioning materials – Applications – Tapes and adhesives – Cap threads – Cap liners – Bands – Shrink bands – Stoppers and plugs.

UNIT IV QUALITY CONTROL OF PACKAGING MATERIALS 9

Specifications – Quality control tests – Methods and evaluation of packaging of materials – Labels and labeling – Sterilization of containers.

UNIT V STABILITY AND REGULATIONS 9

Stability of Packaging materials – Law and regulations governing packaging.

Total: 45

TEXT BOOKS

1. Deak, D.A., Evans, E.R. and Hall, I.H., “Pharmaceutical Packaging Technology”, Taylor and Francis, 2000.
2. Harburn, K., “Quality Control of Packaging Materials in the Pharmaceutical Industry”, Informa Healthcare, 1990.

REFERENCES

1. Anonymous, “Quality Assurance of Pharmaceuticals: A Compendium Of Guidelines And Related Materials”, 2nd Edition, World Health Organization, 2004.
2. Styres, L.K., “Modern Packaging Encyclopedia”, Packaging Catalog Corporation Publications, 1969.
3. Selke, S.E.M., “Understanding: Plastics Packaging Technology”, Hanser Verlag Publications, 1997.

CH1012 – PILOT PLANT AND SCALE UP METHODS

L	T	P	C
3	0	0	3

UNIT I NECESSITY AND PURPOSE **9**

Function – Size estimation – Location personnel requirements – Operation programming – Sampling data – Report of results – Cost factor – Safety factors.

UNIT II PRINCIPLE **9**

Principle of similarity – Dimensional analysis – Scale up equations – Extrapolations – Analog models.

UNIT- III DESIGN **9**

Pilot plant design for flow ducts – Mixing equipments – Heat transfer equipments.

UNIT- IV METHODS **9**

Design methods for packed towers – Batch and continuous distillation columns.

UNIT- V EQUIPMENTS **9**

Pilot plants for reactors – Furnaces – Filters and mechanical operations equipments.

Total: 45

TEXT BOOKS

1. Bisio, A. and Kabel, R.L., "Scale Up of Chemical Processes", John Wiley Publishers, 1990.
2. Johnstone, R.E. and Thring, M.W., "Pilot Plants Models and Scale Up Methods in Chemical Engineering", McGraw Hill Book Co., 1987.

REFERENCES

1. Ernest, J. and Staffin, K.H., "Stage-wise Process Design", John Wiley Publications, 1989.
2. Levin, M., "Pharmaceutical Process Scale-Up", Informa Healthcare, 2002.
3. Hynes, M.D., "Preparing for FDA Pre-approval Inspections", Informa Healthcare, 1998.

PH1009 – **DRUGS THROUGH BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

UNIT I GENETIC ENGINEERING 9

Recombinant DNA Technology – Aims – Genetic engineering applications – Genetic engineering tools – General techniques of genetic engineering – Transformation and analysis of recombinants.

UNIT II VECTORS 9

Design of Plasmid vectors – Bacteriophage vectors – Cosmids – Eukaryotic vectors – Genomic and DNA Libraries – Screening procedures.

UNIT III IMMUNOGLOBULINS 9

Antigens – Adjuvants – Monoclonal antibodies – Hybridoma cells – Applications of monoclonal antibodies – Idiotypic antibodies – Enzymes linked immuno-sorbant assay – Radiimmuno assay.

UNIT IV IMMUNOTHERAPY 9

Vaccine technology – DNA based vaccines – Pathogenesis of infections microorganism – Antobody Engineering – Applications – Catalytic antibodies – Humanised monoclonal antibodies.

UNIT V GENE THERAPY 9

Strategies – Future scope – Potential – Recent developments in biopharmaceuticals – Production through biotechnology – Geneome-based medicine – Molecular modeling – Drug designing.

Total: 45

TEXT BOOKS

1. Taybor, J.M., "Genetic Engineering Technology in Industrial Pharmacy – Principles and Applications", Marcel Dekker, 1989.
2. De Roberts, E.D.P. and De Robers, E.M.F., "Cell and Molecular Biology", 8th Edition, Lea and Febiger, 1987.

REFERENCES

1. Trevan, M.D., Boffey, S., Goulding, K.H. and Stan Burg, P., "Biotechnology: The Biological Principles", Tata McGraw Hill, 1987.
2. Rehin, H.J. and Reed, G., "Biotechnology – A Comprehensive Treatise", Verlag Chemic, 1983.
3. Manfred, E.W., "Burger's Medicinal Chemistry and Drug Discovery", Vol.I, John Wiley, 1995.

MG1453 – SAFETY AND RISK MANAGEMENT

L	T	P	C
3	0	0	3

UNIT I INDUSTRIAL SAFETY 9

Concepts of safety – Hazard classification chemical, physical, mechanical, ergonomics, biological and noise hazards – Hazards from utilities like air, water, steam.

UNIT II HAZARD IDENTIFICATION AND CONTROL 9

HAZOP, job safety analysis – Fault tree analysis – Event tree analysis – Failure modes and effect analysis and relative ranking techniques – Safety audit – Plant inspection – Past accident analysis.

UNIT III RISK MANAGEMENT 9

Overall risk analysis – Chapains model, E and FI model– Methods for determining consequences effects: Effect of fire, Effect of explosion and toxic effect – Disaster management plan – Emergency planning – Onsite and offsite emergency planning – Risk management – Gas processing complex, refinery – First aids.

UNIT IV SAFETY PROCEDURES 9

Safety in plant design and layout – Safety provisions in the factory act 1948 – Indian explosive act 1884 – ESI act 1948 – Advantages of adopting safety laws.

UNIT V SAFETY IN HANDLING AND STORAGE OF CHEMICALS 9

Safety measures in handling and storage of chemicals – Fire chemistry and its control – Personnel protection – Safety color codes of chemicals.

Total: 45

TEXT BOOKS

1. Blake, R.P., “Industrial Safety”, Prentice Hall, 1953.
2. Lees, F.P., “Loss Prevention in Process Industries”, 2nd Edition, Butterworth Heinemann, 1996.

REFERENCES

1. Geoff Wells, “Hazard Identification and Risk Assessment”, I.ChE.
2. John Ridley and John Channing, “Safety at Work”, 6th Edition. Butterworth-Heinemann, 2003.
3. Raghavan, K.V. and Khan, A.A., “Methodologies in Hazard Identification and Risk Assessment”, Manual by CLRI, 1990.

PH1455 – PROJECT WORK

L	T	P	C
0	0	12	12

The project may be considered as the ultimate exercise presented to the final semester student before graduation to measure accumulated technical knowledge and experience. At the same time, the project itself should provide the students with some new skills, innovation and information, and strengthen the acquired ones.

The project programme consists of different assignment, allotted time, submission of report under internal faculty guidance and evaluation by external member along with internal faculty.

The activities performed during a project may cover one or more of the following;

- Data collection
- Critical literature review
- Laboratory experience and tests
- Mathematical modeling
- Software application
- Industrial visits
- Design and/or assembly
- Process analysis

The major project may be assigned to a group of three students. The project topic allotted may be of theoretical, experimental or industrial projects to be carried out under the supervision of internal guide and external guide (in case of industrial projects).

Major projects are to be executed strictly as per the project schedule prepared during VIII semester. A committee of departmental faculty members comprising the project guide, one more faculty member and the head of department will monitor and review the progress achieved by the student at various stages. The internal assessment will be done by the committee based on the progress achieved on completion of the project work.

On completion of the project work, each student has to prepare a project report and submit the same in triplicate to the department. The project work and the report will be evaluated by the internal assessment committee for a total of 100 marks. The external university examination, which carries a total of 300 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.