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SHIVAJI UNIVERSITY, KOLHAPUR.

Revised Syllabus of

(B.E. Chemical Engineering Sem –VII & VIII)

To be introduced from the academic year 2010-11
(i.e. from June 2010) Onwards

(Subject to the modifications will be made from time to time)

SHIVAJI UNUVERSITY, KOLHAPUR

Structure of B. E. (Chemical . Engg.) Semesters VII & VII

Semester –VII

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)				
		L	T	P	Total	Theory	TW	POE	OE	Total
1	Chemical Reaction Engg.-II	4	--	2	6	100	25	25	--	150
2	Chemical Process & Synthesis.	3	--	--	3	100	--	--	--	100
3	Chemical Process Design	4	--	2	6	100	25	---	25	150
4	Modeling & Simula-tion in Chemical Engineering	4	--	2	6	100	25	25	--	150
5	Elective-I	3	--	--	3	100	--	--	--	100
6	Seminar	--	--	2	2	--	25	--	--	25
7	Comprehensive tests On all subjects from S.E to B.E-I	--	--	2	2	--	50	--	--	50
8	Industrial Training (At the end of VI Semester -- 4 weeks)	--	--	--	--	--	25	--	--	25
9	Project Work	--	--	4	4	--	50	--	--	50
	Total	**18**	**--**	**14**	**32**	**500**	**225**	**50**	**25**	**800**

[Note: - Examination scheme and term work marks strictly as per above structure]

Semester –VIII

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)				
		L	T	P	Total	Theory	TW	POE	OE	Total
1	Chemical Process & Green Technology	4	--	2	6	100	25	25	--	150
2	Transport Phenomena	3	1	--	4	100	25	--	--	125
3	PEPE	4	--	--	4	100	25	--	--	125
4	Elective – II	4	--	--	4	100	--	--	--	100
5	Elective—III	4	--	--	4	100	--	--	--	100
6	Advanced separation processes	1	--	2	3	--	25	25	--	50
7	Project Work	--	--	6	6	--	50	--	100	150
	Total	**20**	**01**	**10**	**31**	**500**	**150**	**50**	**100**	**800**

[Note: - Examination scheme and term work marks strictly as per above structure]

SHIVAJI UNIVERSITY, KOLHAPUR

B E –(Chemical)

(To be introduced from June, 2010)

1. CHEMICAL REACTION ENGINEERING-II

Lectures : - 4 hrs per week

Practical : 2 hrs/batch

Examination

Theory : 100

Practical /Oral

Internal : 25

External : 25

Non Ideal Flow : (7)

Basic concept: conversion in reactors having non ideal flow; The Residence Time Distribution Functions and their Relationships Determining RTD from Experimental Tracer Curves Tubular Reactor E- and F-Curves for a Series of Stirred Tank Reactors Analysis of RTD from Pulse Input and step input Models for predicting conversion from RTD data: Zero Parameter : Segregation and Maximum mixedness model ; One Parameter : Dispersion model, Tank in Series model, Introduction to Multi parameter model.

Mixing of fluids: (4)

Self-mixing of single fluid. Early and late mixing of fluid, models for partial segregation, mixing of two miscible fluids, Model Effect of Micromixing on Conversion Time-Dependent Turbulent Mixing and Chemical Reaction in Stirred Tanks. Improve Performance of Reactors Via Computational Fluid Dynamics

Heterogeneous processes and Solid catalysts : (7)

Global rate of reaction, Catalysis, Nature of catalytic reactions, adsorption isotherm, Rates of adsorption. Determination of Surface area, Void volume and solid density, Pore volume distribution, Classification of catalysts, Catalyst preparation, Promoters and inhibitors

Fluid particle reactions (Non catalytic) : (5)

Selection of a model for gas-solid reactions Un-reacted core and Shrinking core model, Rate controlling resistances, Determination of the rate controlling steps, Application of models to design problems

Fluid - fluid reaction (6)

Introduction to heterogeneous fluid - fluid reactions, Rate equation for instantaneous , Fast and slow reaction, Equipment used in fluid- fluid contacting with reaction, Application of fluid -fluid reaction rate equation to equipment design, Towers for fast and slow reactions.

Solid catalyzed reactions : (6)

Introduction, Rate equation, Film resistance controlling, surface flow controlling , Pure diffusion controlling, Heat effects during reaction, Experimental methods for finding rates, , construction, operation and design of Catalytic reactors : Fixed bed reactor, Fluidized bed reactor, Multiphase reactors : Slurry reactor, Trickle bed reactor. Isothermal and non isothermal reactor design (batch reactor only)

Deactivating catalysts(4)

Types of Deactivation , Mechanism of deactivation, Rate equation for deactivation, Regeneration of catalyst

Scale-Up in Reactor Design: (6)

Factors affecting choice of reactor. Reactor stability Development and Scale-Up of Reactors Similarity Criteria , Scale-Up in Relation to Various Factors Heat Effect , Coefficients of Process Stability Dimensional Analysis and Scale-Up Equations Mathematical Modeling Scale-Up of a Batch Reactor

Heat Transfer Model Jacket Zoning of a Batch Reactor The Outlet Temperature of a Scaled-Up Batch System Aspect Ratio (R) in Jacket Zoning and Scale-Up of a Batch Reactor

Practical :

1. Studies on homogeneous batch reactor.
2. RTD Studies on tubular flow reactor.
3. RTD Studies on mixed flow reactor.
4. RTD Studies on mixed flow reactor in series.
5. Residence time distribution studies in structures and coils.
6. RTD Studies on packed bed reactor.
7. Determination Surface area of catalysts
8. Determination Pore volume of catalysts
9. Determination of bulk density, apparent density, and true density of catalyst.
10. Studies on general liquid reactions

Text Books

1. Octave Levenspiel, “Chemical Reaction Engineering”, 3 rd Edition, John Wiley, London.
2. S.H. Fogler,” Elements of Chemical Reaction Engineering”, PHI, 4 th Edition.
3. J.M. Smith, “Chemical Engineering Kinetics”, 3rd Edition, McGraw Hill, New York 1981.

References:

1 T.T. Carbery, “Chemical and Catalytic reaction Engineering”, McGrawHill, New York - 2001.

2. Modeling of Chemical Kinetics and Reactor Design
A. Kayode Coker, Gulf Publishing House New Delhi

3. Chemical Reactor Design
Peter Harriot Marcel Dekker, Inc. New York

4. Chemical Engineering Vol. III
Pergamon Press, Oxford, 1989.

5. Introduction to Chemical Reaction Engineering and Kinetics
Ronald W. Missen Charles A. Mims Bradley A. Saville
John Wiley & Sons, Inc.

6. Chemical Reactor Design Optimization and Scaleup
E. Bruce Nauman McGrawHill, New York - 2001.

2. CHEMICAL PROCESSES AND SYNTHESIS

Lectures: - 3 hrs per week

Examination
Theory : 100

Practical /Oral --

Practical:
Internal : --
External : --

1. **Chemical Processing and work of chemical engineer**.

2. **Industrial Gases**: Hydrogen, Oxygen, Nitrogen, Carbon Dioxide, Acetylene

3. **Glass and Refractories:** Basic raw materials, Manufacturing of refractories, Glass raw materials, Manufacturing, Types and Applications.

4. **Fuels and Fuel gases**: Natural gas, Water gas, Producer gas, LPG.

5. **Chloro – alkali and electrolytic industries**: Soda ash, caustic soda, Chlorine, Bleaching powder, Sodium bicarbonate, Aluminum, Sodium, Chlorates and perchlorates.

6. **Hydrochloric acid**: Hydrochloric acid, Aluminum sulphate and alums.

7. **Phosphate industries**: Elemental phosphorous, Raw materials and process for phosphoric acid, Manufacturing of ammonium phosphate, Baking powder.

8. **Potassium industries**: Potassium, Potassium chloride, Potassium sulfate, Potassium nitrate.

9. **Nitrogen industries**: Synthetic ammonia, Nitric acid, Ammonium nitrate, Urea

10. **Sugar and Starches** : Sugar and Starches

11. **Fermentation Industry** : Absolute Alcohol, Beer , wines & liquors , vinegar , citric acid and lactic acid .

Text Book:

1. George T. Austin, “Shreve's Chemical Process Industries”, 5th edn. , McGraw Hill Book Company, 1985.

References:

1. S.D. Shukla, G.N. Pandey, “A Text book of Chemical Technology”, 3rd Edition
2. C.E. Dryden, “Outlines of Chemical Technology”, Affiliated East-West Press, 1973.
3. D. Venkteshwaralu, “Chemical Technology”, I & III manuals of Chemical Technology Chemical Engg. Ed. Dev. III Madras, 1977.
4. Faith, “Industrial Chemicals”. Rogers, “Industrial Chemistry”.

3.CHEMICAL PROCESS DESIGN (CPD)

(New Revised)

	Examination
Lectures : - 4 hrs per week	Theory : 100 (4 hrs. Question Paper)
	Practical /Oral
Practical : 2 hrs/batch	Internal : 25 External : 25

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1. The nature and function of process design.

2. Flow sheet preparation and drawing: Sketching techniques, Equipment lettering and numbering, Equipment symbols, Instruments symbols, Stream designations for process and utility,

3.**Process Planning Scheduling and Flow Sheet Design** –Organizational structure, Process design scope, Types of flow sheets, P and I diagrams, Types of P and IDs, Issues in P and IDs, P and IDs presentation.

4. Piping Design: Pipe codes, Layout, Pipe Support design, Thermowell design -- Types, Material of construction, Installing methods and pipe thread sizes, Piping installation, Pump size selection.

5. Design Information and Data: General sources of physical properties, Predication of physical properties, Accuracy required in engineering data, Specification and design of process equipment, Rules of THUMB for design of equipment, Software use in process design.

6. Process Heat Transfer , Conduction, Convection, Radiation, Temperature.

7. Counter Flow: Double pipe heat exchanger.

8. **1- 2 Parallel counter flow: Shell and Tube heat exchangers.**

9. Flow arrangements for increased heat recovery.

10. Calculation for process conditions.

11. Condensation of single vapours.

12. Evaporation (M.E.E.)

13. Design of Agitated Batch Reactor.

14. Design of Binary Distillation Column with packed and sieve trays.

15. Design of Rotary Dryer.

16. Design of Gas-Solid Cyclone Separator.

Note: The necessary data / tables / charts / graphs are to be supplied during the theory examination by the respective institutes.

Books/References:

1. A. K. Koker, "Fundamentals of Equipment Design", Gulf Publication.
2. D.Q. Kem, "Process Heat Transfer", Tata McGraw Hill Company, New York, 1997.
3. E.E. Ludwig, "Applied Process Design for Chemical and Petrochemical Plants", Vol.I,II,III, Gulf Publication, 3rd edition London, 1994.
4. G.D.Ulrich, "A Guide to Chemical Engineering Process Design and Engineering", John Wiley and Sons, New York, 1984.
5. . M.S. Peters & K.D.Timmerhaus, "Plant Design and Economics for Chemical Engineers", 5th edition, McGraw Hill International Book Co.,2003.
6. J. J. McKetta, "Piping Design Handbook", Marcel Dekker inc., New York, 1992.
7. J. M. Smith,"Chemical Engineering Kinetics",3rd edition McGraw Hill, New York1981
8. J.M. Coulson, "Chemical Engg.", Vol. VI, Pergamon Press, Oxford, 1989.
9. McCabe W.L. and Smith J.C. 'Unit operations of Chemical Engg.' 7th ed.McGraw Hill Book Co., International ed. 2005.
10. Octave Levenspeil, "Chemical Reaction Engineering", 2nd Edition, John Wiley,
11. R. E. Treybal, "Mass Transfer Operations", 3rd Edition, McGraw Hill Company, Singapore, 1980.
12. R.H. Perry & Don W. Gress, "Perry's Chemical Engg.", Hand-book , 7th Edition McGraw Hill Company, New York, 1997.
13. S. M. Walas, "Reaction Kinetics for Chemical Engineers" McGraw Hill, New York.
14. S.D. Dawande, "Process Design of Equipment", Dennet Publication, Vol. I and II, 5th Edition 2005.
15. S.H. Fogler, "Elements of Chemical Reaction Engineering", Prentice Hall Publication, 3rd edition.
16. Vilbrant F. L. and Dryden C.E., "Chemical Engineering Plant Design", McGraw Hill Company, New York 1959.

FOR TERM WORK ONLY

Detailed drawing of the following

1. Equipment symbols
2. Instrument symbols and stream designations
3. P and I diagrams
Any one type of the following
4. Exchanger
5. Condenser
6. Evaporator
7. Agitated Reactor
8. Distillation Column
9. Rotary Dryer.
10. Gas - Solid Cyclone Separator

Note: Maximum 10 sheets needed to be drawn, out of which 4 should be drawn with the help of software AutoCAD.

4. MODELING AND SIMULATION IN CHEMICAL ENGINEERING

Lectures: - 4 hrs per week

Practical: - 2 hrs per week/batch

Examination
Theory: 100
Practical /Oral
Internal: 25
External: 25
L=Lecture

Section I

1. Basic Modeling: Introduction to modeling – Types of Models, Dependent & Independent Variables, Application and scope coverage, Modeling fundamentals, Chemical engineering modeling, several aspects of the modeling approach, general modeling procedure**.(5L)**

2. Formulation of dynamic models: Mass balance equation - Balancing procedure, Case studies: CSTR, Tubular reactor, Coffee percolator, Total mass balance – Case Studies: Tank drainage, Component balances - Case Studies: Waste holding tank, Energy balance- Heating in a filling tank, Parallel reaction in a semi continuous reactor with large temperature difference, Momentum balances – Dimensionless model equations, CSTR, Gas liquid mass transfer in a continuous reactor**.(7L)**

3. Modeling of stage wise processes: Introduction, Stirred tank reactor, Reactor Configurations, Generalized model description, Heat transfer to and from reactors, Steam heating in jacket, Dynamics of the metal jacket walls, Batch reactor – Constant volume, Semi - batch reactor, CSTR - Constant volume CSTR, CSTR cascade, bubble column reactor, Reactor stability**.(10L)**

Section II

4. Mass transfer models: such as liquid-liquid extraction, distillation, multicomponent separation, multicomponent steam distillation, absorber- stage wise absorption, steady state gas absorption with heat effects, evaporator**.(5L)**

5. Dynamic modeling: Plug flow reactor, Plug flow reactor contactors, Liquid – liquid extraction column dynamics**.(6**L)

6. Lumped and distributed system: Distributed system- Counter current heat exchanger, Flasher design, Condensation, Definition of lumped parameter model**.(4L)**

7. Simulation of chemical engineering: Process simulation, Scope of process simulation, Formulation of problem, Step for steady state simulation, Process simulation approaches for steady state simulation, Strategies, Process simulator, Structure of process simulator, Integral process simulation, Simulation tools**,** ISIM, Case studies: Studies of integrated process simulation, ICAS – Integrated Computer Aided System, Sequential modular method. **(5L)**

List of Practicals:

1. Mathematical modeling and simulation of gravity flow tank.
2. Mathematical modeling and simulation of CSTR.
3. Mathematical modeling and simulation of multicomponent distillation column.
4. Mathematical modeling and simulation of liquid – liquid extraction column.
5. Mathematical modeling and simulation of heat exchanger.
6. Mathematical modeling and simulation of lumped parameter model of column Tray.
7. Mathematical modeling and simulation of complex batch reactor.

Books:

1. C. L. Smith, R. L. Pike and P. W. Murill, “Formulation Optimization of Mathematical Models”, International Text, Pennsylvania, 1970.
2. W. L. Luyben, “Process Modeling, Simulation and Control for Chemical Engineering”, McGraw Hill Book co., 1973.
3. John Ingham, Irving, J. Dunn, Elmar, Heinzle Jiri, E. Prenosil, “Chemical Engineering Dynamics”, VCH Publishers Inc., New York, 1974.
4. Roger G. E. Franks, “Modeling and Simulation in Chemical Engineer”, Wiley Inter Science, New York, 1972.
5. R. W. Gaikwad, Dr. Dhirendra, “Process Modeling and Simulation”, Central Techno Publications, Nagpur, 2003.

5. ELECTIVE – I

1.PETROLEUM REFINERY ENGINEERING

Lectures: - 3 hrs per week

Practical: --

Examination
Theory: 100
Practical /Oral
Internal : --
External: --

Section I

1. Introduction to petroleum refineries: (3 Hrs.)
Resources of petroleum, petroleum industries in India and world.

2. Origin and exploration techniques: (3 Hrs.)
Origin of petroleum, methods of exploration, drilling rigs, drilling techniques, production methods of crude oil, etc.

3 .Pre-refining operations: (3 Hrs.)
Composition of crude, classification of crude, types of distillation methods, pretreatment of crude, atmospheric distillation, vacuum distillation, transportation of crude.

4. **Properties and specifications of petroleum products: (4 Hrs.)**
properties and specifications of fuel gas, LPG, gasoline, naphtha, jet fuel, kerosene, diesel, lubricating oils, greases, waxes, coke, etc.

5. **Separation processes**: Solvent extraction processes, solvent de-waxing. **(3 Hrs.)**

Section II

6. **Conversion process**: **(5 Hrs.)**
Thermal cracking, visbreaking, coking, catalytic cracking, thermal reforming, catalytic reforming, hydrocracking, hydroprocessing, alkylation, isomerisation and polymerization.

7. Treatment methods: (3 Hrs.)
Sweetening process, hydrodesulphurization, smoke point improvement.

8. Post production operations: (3 Hrs)
Blending of additives, storage of products, transportation of products, housekeeping, marketing of petroleum and petroleum products, safety and pollution considerations in refineries.

9. Recent trends in petroleum refineries: (3 Hrs)
Recent trends in petroleum in terms of Distillation, Packing materials, Catalyst, etc.

Note: A Case study on the petroleum refineries may be taught.

Books:

1. Gary J H, Handwerk G E, 'Petroleum refining'

2. Nelson W. L., "Handbook of Petroleum Refinery Engg.", McGraw Hill, International, Auckland,1982.

3. Hobson G.D., Phol W., "Modern Petroleum Technology-I", 5th ed., Halsted Press, Division of Wiley Eastern New York, 1984.

4. Guthre, V.B., "Petroleum Products", Hand-Book McGraw Hill.

5. Kobe, K.Q. Mcketta, J.J. "Advances in Petroleum Chemistry and Refining" Interscience.

6. J. M. Spight, "The chemistry and technology of petroleum"

5. ELECTIVE – I

2. BIO-TECHNOLOGY

Lectures : - 3 hrs per week

Examination
Theory : 100
Practical /Oral
Internal : -
External : -

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1. Introduction.
The pre – Pasteur era, Pasteur era, The antibiotic era, New Biotechnology era, Impact of New Biotechnology on production of food, Chemicals and energy, Biotechnology as interdisciplinary science, Role of Chemical Engineering in Biotechnology. **(3)**

2. Fundamentals of Biotechnology.
Cell structure and function, Prokaryotes and Eukaryotes, arch bacteria, Extremophiles, Structure and function of microbial (Bacteria, yeast, fungi, algae, virus), Plant and animal cells and cell division mitosis, meiosis. **(4)**

3. Biological macromolecules and Biochemistry.
Structure and Function of – Carbohydrates, Proteins, Nucleic Acids and Lipids, steroids, Importance of sterospecificity of biomolecules, Chemistry of life, Chemical evaluation, Intermediary metabolism – anabolism/catabolism, Primary and secondary metabolism, Central metabolic pathways (Glycolysis, Citric acid cycle, gluconeogenesis), interconversion of metabolites, Regulation of metabolic pathways, Bioenergetics, Photosynthesis. **(7)**

4. Cellular Genetics and Genetic Engineering.
Nucleic Acid metabolism (DNA, RNA synthesis) and protein synthesis, Menderian genetics, Bacterial genetics, (Transformation, Translation, Conjugation), Induction/Repression, Mutation. Genetic Engineering: Plasmid and cloning vehicles, Plasmid stability ,Genetically modified bacteria in bioreactor , strain construction , F-plasmid and genetic, Recombination , Analysis of DNA molecule, Cloning consideration, Cloning vector, host, etc. DNA isolation, SI nuclease mapping, Applications of recombinant DNA, DNA hybridization, , Fingerprinting, Foot printing, Human genome project, Ballistic missiles, Gel electrophoresis **(8)**

5. Enzymology and Enzyme Kinetics.
History, Structure and function relation of enzymes, Classification, Properties of enzymes as catalyst, General features of enzymes, Enzyme sources, Enzyme purification and characterization, Basic enzyme kinetics, The action of effecter on enzyme activity. Enzyme technology - Immobilized enzyme technology, Non – aqueous enzyme technology, Immobilized enzymes, Immobilized cells, methods of cell Immobilizations, Industrial applications of enzyme. **(5)**

6. Fermentation.
Microbial staining, Growth of virus/phages, Microbial growth kinetics, Fundamental of fermentation, submerged fermentation, solid state fermentation (Ethanol, antibiotics, enzyme dairy products), Fermentation kinetics. **(3)**

7. Media Preparation and Sterilization.

Synthetic and natural media, Media preparations, Industrial medium, Nitrogen source, Product formation, sterilization and methods of sterilization **(3)**

8. Practical Applications of Biotechnology in – Manufacturing and uses of following.

a. Amino acids: L – lysine, L – glutamate, L – phenylalanine.
b. Organic acids: Citric acids, Lactic acids, etc.
c. Antibiotics: Penicillin, Cephanlosporins, New beta – lacto technologies.
d. Bakers yeast production.
e. Uses of enzymes in sugar chemistry / mfg. of peptides.
f. Recombinant DNA technology.
g. Tissue culture: Animal and plant cell culture, monoclonal antibodies, transgenic plants and animals.
h.Introduction to bioremediation, Biosensors, Bio fuel cells, Biosurfactants, Biopolymers, Bioenergy Park
i. Waste treatment.

(4)

9. The business of Biotechnology and its scope.

Informal sectors and small entrepreneurs, some biotechnology industries/companies in India.

(2)

10. Introduction to intellectual property protection in biotechnology. (1)

References:

1. A. H. Scragg, “Biotechnology for Engineers”, Ellis Harwood Ltd.
2. Prescott, Harley & Klein “Microbiology” 6th edition McGraw Hill publication.
3. David Bourgaize et al., “Biotechnology”, Pearson Education Inc., 2003.
4. H. D. Kumar, “Text Book on Biotechnology”, Affiliated – East – West pvt. Ltd., New Delhi, 2nd Edition, 2000.
5. V.K. Joshi & Ashok Pandey “Biotechnology” food fermentation, vol 1, EPD publication, Ernakulam, Kerala.
6. Colin Ratledge et. al., “Basic Biotechnology”, Cambridge University Press, 1st edition, 2003.
7. Susan R. Barnum, “Biotechnology”, Vikas Publishing House, 1st edition, 2001.
8. Wiseman, " Principles of Bio-Technology."
9. Ayyanna, C.Ital, “Bio-technology in the 21st century”, New Delhi,TMH-1993.
10. Trehan Keshav, “Bio-technology”, Wiley Eastern Ltd, New Delhi,1991.
11. Lehninger A.L. “Biochemistry”, Worth Publications Inc., New York,1972.

5. ELECTIVE – I

3. INTRODUCTION TO CRYOGENIC ENGINEERING

Lectures: - 3 hrs per week

Practical : --

Examination
Theory: 100
Practical / Oral
Internal : --
External: --

Application areas of cryogenics, Methods of producing cryogenic temperatures and energy / exergy considerations. Gas liquefaction processes, Commercial liquefiers and cryogenic refrigerators, cryogenic recovery and purification of industrial gases. Thermophysical properties at cryogenic temperatures. Process design considerations for cryogenic separations. Storage and transportation of cryogenic fluids. Cryogenic insulations and vacuum technology, Measurement techniques and instrumentation. Materials of construction and their behavior at cryogenic temperatures.

Books:

1. R. Barron, “Cryogenic Systems”, 2nd ed., McGraw Hill, 1985.

2. G.G. Haselden, “Cryogenic Fundamentals”, Academic Press, 1971.

5. ELECTIVE – I

4. PHARMACEUTICAL TECHNOLOGY – I

Lectures : - 3 hrs per week

Examination
Theory : 100

Practical /Oral : --

Practical :
Internal : -
External : -

Discussion of monographs such as limit test, LOD, ash value, saponifiction value, ester acid value, determination of volatile oils etc., Inorganic chemicals of Pharmaceutical importance with respect to their manufactures and uses, assay methods, Chemotherapeutic agents, Antiinfectives other than antibiotics, Antifungal, antimycobacterials- Antiprotozoal

General Pharmacognosy: Definition, Historical background, Classification of Crude drugs, Scope of Pharmacognosy, Collection, Cultivation (including Tissue culture method) and Preparation for the market of Medicinal Plants. Marine Products.

Phytochemistry : Chemical constituents of medicinal plants (Alkaloids, Glycosides, Steroids, Plant Pigments, Proteins, Enzymes, Carbohydrates, Lipids, Tannins, Terpenoids, Flavonoids, etc.) Biogenesis of Natural Products: like Carbohydrates, Glycosides, Alkaloids, Lipids, Terpenoids, Tannins, etc. Various conventional and modern techniques used in extraction and isolation of crude drugs and phytochemicals. Phase Transfer Catalysis, Raw materials for general manufacture in Pharmaceutical Industry., Manufacturing plant; Including safety devices etc., Types of reactors and their configuration, typical reactor assemblies and characteristics - Emerging unit processes.

Synthesis of 15 drugs in the classes of anti – infective, antihistaminic, CNS drugs, CVS drugs and NSAIDS with aromatic
Synthesis of vitamins and peptide.

Books:

1. Pharmaceutical Dosage Forms And Drug Delivery Systems, Ansel, Philadelphia, Fea and Febiger, 1985
2. Introduction to Pharmaceutical Dosage Forms Ansel, Henry Kimpton Publishers, London.
3. Pharmaceutics: The Science of Dosage Form Design Aulton, New Delhi, B.I. Naverly Pvt. Ltd., 1995
4. Modern Pharmaceutics G.S. Banker New York, Marcel Dekker1990
5. Bentely's Textbook of Pharmaceutics Rawlins Cassell Ltd, London
6. Fundamentals of Pharmacy Blome H.E. Philadelphia, Fea and Febiger, 1985
7. Fundamentals of Pharmacy Blome H.E. Philadelphia, Fea and Febiger, 1985
8. Pharmaceutial Production Facilities: Design and Applications G.C.Cole
9. New York Ellis Horwood 1990
10. Husa's Pharmaceutical Dispensing Martin E.W. Easton Mack Pub. Co. 1971
11. Transdermal Delivery of Drugs A.Kydonieus Florida, CRC Press, 1987
12. Transdermal Controlled System Medications Y.W.Chien, New York, Marcel Dekker 1987
13. Quantitative Pharmaceutical Chemistry, Glann L. Jenkins, Adelbert M. (VI Edition) McGraw-Hill Books Company
14. Text Book of Pharmaceutical Analysis, Kenneth A., Connors, A Willey Interscience Publication, USA
15. Wolfgang Aehle, " Enzymes in Industry Production and Applications" Wiley VCH Publication, 2003
16. Heinrich Klefenz, "Industrial Pharmaceutical Biotechnology" Wiley-VCH Publication, 2002.
17. T. Scheper, "Process Integration in Biochemical Engineering" Springer Publication, 2003.
18. Oligan Repic, "Principles of Research and Chemical Development in the Pharmaceutical Industry Wiley Interscience 1998.
19. Romano Di Fabio, "From Bench to Market the Evolution Chemical Synthesis" Oxford University Press, 2000

5. ELECTIVE – I

OPTIMIZATION TECHNIQUE IN CHEMICAL ENGINEERING

Lectures : - 3 hrs per week

Examination
Theory : 100

Practical /Oral : -

Practical : - -
Internal : -
External : -

Section I

Introduction, Scope, Function of single variables, Methods of optimum point search and applications their to batch distillation column, Ammonia synthesis etc., Multivariable functions. Direct search methods, First order, Second order methods, Application to flashing of multicomponent mixture, Equilibrium composition of products of chemical reactions, Heat conduction etc. Constrained optima, Equality constraints, Inequality constraints.

Section II

Linear programming, Non – linear programming, Geometric programming, Applications to extraction and solvent recovery systems, Condenser design, Complex chemical equilibria, Dynamic programming and its applications, Distillation, variational methods and its applications.

References:

1. Optimization of Chemical Processes – T.F. Edgar and Hemmelblue, McGraw Hill Book Company.
2. Optimization – Theory and its Applications, S. R. Rao.
3. C.L. Smith, R. N. Pike, P. W. Muralli, Formulation and Optimization of Mathematical Model, International Textbook Co., Perrylvania – 1970.

6. SEMINAR

	Examination
Lectures: -	Theory: -
	Practical /Oral
Practical: 2 hrs/ batch	**Internal: 25**
	External: -

Students will be required to prepare one review report (seminar) on selected topics in Chemical Engineering and should deliver one seminar (30 minute) and submit in the form of a standard typed format to the staff member/guide

Student should submit title of seminar with min 10 reference in the first week of the semester

The prepared report should contain some major points-

(i) Introduction: Maximum 2 pages
(ii) Review of literature (including figures): 10-12 pages
(iii) Analysis of literature: students should make analysis of literature available: 4-5 pages.
(iv) Comments on the analysis : based on method used in literature/ suggestion

Evaluation based on above points as-

(i) Students will be required to make an oral presentation of the seminar report min 20 PPT slide.
(ii) Students should deliver the seminar in front of students and internal judge committee evaluates the performance.
(iii) Asking and answering questions during the seminars.
(iv) Seminar reports

The staff member/members shall guide the students in :

1. Selecting the seminar topic.

2. Information retrieval (literature survey)

a) Source of Information i.e. names of the journals, reports, books etc.

b) Searching for the information i.e. referring to chemical abstracts etc.

3. Preparing the seminar report

4. Delivering the seminar

7. COMPREHENSIVE TEST

Lectures: - -

Practical: 2 hrs./ Week

Examination
Theory: -
Practical /Oral
Internal: 50
External: -

The objectives of the comprehensive test are to assess the overall level of proficiency and the scholastic attainment of the student in the various subject's studies during the degree course by conducting weekly tests. The Staff member/members shall guide the student in preparing for the weekly tests, which consists mainly bit questions and small problems. The term work assessment shall be based on the performance of the student in the test. Minimum 10 tests should be conducted. Syllabus of various subjects for the test is:

1. Mathematics: -

Linear Algebra, Calculus, Differential equations, Complex variables, Probability and Statistics, Numerical Methods

2. Mechanical Operation: -

Size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

3. Fluid Mechanics: -

Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, Macroscopic friction factors, energy balance, dimensional analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds, elementary boundary layer theory

4. Heat Transfer: -

Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

5. Process Calculations: -

Laws of conservation of mass and energy; use of tie components; recycle, bypass and purge calculations; degree of freedom analysis.

6. Mass Transfer: -

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage wise and continuous contacting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

7. Chemical Reaction Engineering: -

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

8. Instrumentation & Process Control: -

Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response and controller tuning, cascade, feed forward control.

9. Chemical Technology: -

Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers.

10. Plant Design & Economics: -

Process design and sizing of chemical engineering equipment such as compressors, heat exchangers, multistage contactors; principles of process economics and cost estimation including total annualized cost, cost indexes, rate of return, payback period, discounted cash flow, optimization in design.

Question Pattern for the test (50 Marks, Time Duration: 2 hr): -

1. 15 objective questions of 1 mark each
2. 15 problems of 2 marks each
3. 5 objective (aptitude) questions of 1 mark each

References: -

1. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar, Vidyarthi Griha Prakashan, Pune.
2. Mc Cabe W.L. and Smith J.C. 'Unit operations of Chemical Engg.' VII ed. Mcgraw Hill Book Co., International ed. 1993
3. Himmelblau D.M., "Basic Principles and Calculations in Chemical Engineering", Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004.
4. J.M. Smith and H.C. Van Ness, "Introduction to Chemical Engg.", Thermodynamics 6th Edition, International student edition, McGraw Hill publication.
5. Eckman D.P. "Industrial Instrumentation", Willey Eastern Ltd, New Delhi, 1984.
6. Robert E. Treybal, "Mass Transfer Operations"l, Third Edition, McGraw Hill, 1980.
7. Stephanopoulos G ,"Chemical Process Control and introduction to theory and practice"
8. S.H. Fogler," Elements of Chemical Reaction Engineering", PHI, 3rd Edition.
9. George T. Austin, "Shreve's Chemical Process Industries", 5th edn. , McGraw Hill Book Company,1985.
10. M.S. Peters & K.D.Timmerhaus, "Plant Design and Economics for Chemical Engineers", 3rd edition, McGraw Hill International Book Co., 1980.

8.INDUSTRIAL TRAINING

Lectures: --

Practical: --

Examination
Theory: -
Practical /Oral
Internal: 25
External: **-**

In-Plant Training Evaluation:

The students are required to undergo at least four weeks of In-plant training during summer vacation between T.E. Part -II and B.E. Part –I. They will be required to submit a written report on their In-plant training.
The report should consist of

(i) Major products of the company

(ii) Plant description

(iii) General plant layout

(iv) Processes for Major Products (no confidential proprietary information may be included)

(v) Chemistry of processes studied (in case of chemical manufacture) based on Journal papers, Patents, Books, etc.

(vi) Safety and Health (Material Safety Data Sheets, Safety Policy)

(vii) Environmental Protection (measures used and general description of the processes and facilities used)

(viii) Standards and compliance thereof (ISO 9000, ISO 14000, OHSAS 18000, etc.)

(ix) Three Major Equipment – description with sketch (no detailed drawing to be given: just a sketch with major dimensions, nozzle location and dimensions thereof)

(x) Heat Exchangers: total number and types, Pumps and Compressors: total number and types,

(xi) Improvements proposed by the student, for example, Power savings for pumps, blowers, compressors, etc. Cycle time reduction in case of batch processes, Waste heat recovery, Waste solvent recovery, Product quality improvement, Any project assigned to you by the company (title, a short description, results and conclusions)

Students will present their work before a panel of teachers in the Institute which will be assessed internally at B.E. Part -I. The report would carry 50% weightage and the presentation would carry 50% weigh

In case, due to illness or any other reasonable problems the student fails to undergo above said training, he may be allowed to visit/ tour some industries and submit a report.

9. Project Work

Lectures: --

Practical: 4hrs./Week

Examination
Theory: -
Practical /Oral
Internal: 50
External: --

Types And Selection of Projects :

The students are required to carry out one of the following projects.

1. Processes based Project : Manufacture process of a product.
2. Equipment based Project : Detailed design and fabrication of the equipment for a given capacity and results after experimentation.
3. Experimental based Project : Experimental investigation of basic or applied research problem.
4. Industrial Problems : Any problem or project directly related to existing plants for modification of process or equipment or regarding pollution control and energy conservation etc.
5. Process Simulation / Software based project.

Objectives:

To work in a team in a planned manner on a chosen engineering topic based on the knowledge gained throughout the engineering programme.

Contents:

Three to four students will be allotted project in a group. The project is to be completed in two parts: Project I in Semester VII and Project II in Semester VIII. Each project will have one guide from the faculty. Students may be encouraged to choose a co guide from the industry, wherever possible.

A proper planning of the project work or research institute is expected. The project group should prepare activity chart and submit the same along with the reports for part I and part II. The group should also submit and present the work completed in semester I in an appropriate format. The actual contents of the project report may be decided in consultation with the project guide.

Students are expected to carry out an in-depth literature survey based on chemical/engineering abstracts, national/international journals using online/print media.

Proposed work synopsis / abstract approved by guide should be submitted within two month of the course started and approved by the guide.
Students will be required to prepare a critical review of selected projects in Chemical Engineering and allied subjects and submit in the form of a standard typed report.

Typically, the report should contain and will be evaluated based on the following points:
(i) Introduction: 2 pages maximum,
(ii) Exhaustive review of literature, Critical analysis of the literature and comments on the analysis (including figures): 12 to 15 pages: 50% weightage
(iii) Kinetics & thermodynamics study, material balance, energy balance, experimentation / detailed design of equipments - 12 to15 pages: 50% weightage.

The critical analysis of literature should include the following points: Is the project technically correct? Are assumptions reasonable; is the reasoning logical? If you think it is not, specify what you think is incorrect and suggest the correct approach. Are the methods used in the literature appropriate? Are there any internal contradictions or computational errors and are there any loopholes in the observations? If so, please explain it. Critical analysis of papers should also contain quantitative comparison of observations, results and conclusion amongst the various papers. Each student will also be required to make an oral presentation of the review. Weightage would be 40% for presentation and 60% for the report. Additional details are given in table 1.

Half part of project work should be complete within the first semester. Term work consist a reports of 30 to 40 pages which has to be submitted at the end of VII semester along with the presentation before faculty and students.
The report should be prepared using the Times Roman font (size 12) using 1.5 spacing leaving 1 inch margin on all sides producing approximately 29 lines per page. The report is to be typed on one side of the paper and need not be bound in a hard cover binding. Figures and tables should be shown as a part of the running text. Each figure should be drawn inside a rectangular box of 12 cm width and 10 cm height. The figures must be sufficiently clear and hand drawn figures will be acceptable. Particular care must be taken if a figure is photocopied from source.

Each figure must have a sequence number and caption below. Each table must have a sequence number and title at the top. The report must be precise. All important topic should be given due considerations.

The total number of pages, including tables, figures and references should not exceed 40. Chapters or subsections need be started on new pages, while getting the report typed.

The activity chart should be completed as per the following stages:

Table 1 – Activity Chart

General Project

Sr. no.	Stage	Activity /Week No.	Period
1	Synopsis / Abstract		
2	Detailed Literature Survey		
3	Process and Site selection		
4	Block Diagram		
5	Kinetics & thermodynamics feasibility		
6	Material & Energy balance		
7	Detail design of equipments / methodology of Experimentation		

SHIVAJI UNIVERSITY, KOLHAPUR
(INTRODUCED FROM JUNE, 2010)
Revised syllabus structure of Chemical Engineering
B.E. Chemical Part – II
1. CHEMICAL PROCESSES AND GREEN TECHNOLOGY

	Examination
Lectures : - 4 hrs per week	**Theory : 100**
	Practical /Oral
Practical : 2 hrs /batch	**Internal : 25**
	External : 25

Section – I

1. Explosives: Types of explosives, explosive characteristic, Industrial explosives, propellants, rockets, missiles, pyrotechnics, matches, toxic chemical weapons.

2. Food industries: Types of food processing, preservation methods, Food byproducts.

3.Pulp and paper industries: Manufacturing of pulp, Manufacturing of paper, Structural boards

4.Plastic industries: Raw materials, General polymerization processes, Manufacturing processes, Compounding and moulding operation.

5 Pharmaceutical industries: Classification of pharmaceutical products. Manufacture of antibiotics, Isolates from plant and animals, vitamins.

Section - II

6. Green Chemistry: An Overview

Introduction, underlying philosophy and focus, Twelve principles of green chemistry

7. Ecological Threats & Green Chemistry

The Greenhouse Effect, Climate Change, photochemical smog, Pragmatic Green Chemistry Challenges, Old Technology vis-à-vis Green Technology : Suitable examples to understand comparative advantage of Green Technology over Old one, Renewable resources, Process intensification , Carbon credits .

8. Green Chemistry & Nonconventional Fuels

Green chemistry in batteries, production and recycling, Fuel cell and electric vehicles, Solar energy and hydrogen production, biodiesel, bio-hydrogen

9. Green Chemistry & Sustainable development

Esterification: transesterification, autogeneous pressure of methanol, transesterification under supercritical conditions
Optimisation: catalyst concentration, methanol to oil ratio, reaction temperature, reaction time
Best practices in Green Chemistry for sustainable development with suitable examples

List of practicals:

1. Preparation of azo dye
2. Preparation of soap
3. Preparation of green, yellow, blue pigments
4. Preparation of nitrobenzene.
5. Glucose Estimation
6. Preparation of drug aspirin

Text Book:

1. George T. Austin, “Shreve's Chemical Process Industries”,5th edn., McGraw Hill Book Company, 1985.
2. Paul T. Anastaj; “Green Chemistry – Theory and Practice”
3. Albert S. Matlack ; “Introduction to Green Chemistry”

References:

1. S.D. Shukla, G.N. Pandey. “A Text book of Chemical Technology”, 3rd Edition.
2. C.E. Dryden, “Outlines of Chemical Technology”, Affiliated East-West Press, 1973.
3. D. Venkteshwaralu, “Chemical Technology”, I & III manuals of Chemical Technology Chemical Engg. Ed. Dev. III Madras, 1977.
4. Faith, “Industrial Chemicals”
5. Rogers, “Industrial Chemistry”.
6.Anastas, P.; Warner, J. Green Chemistry: Theory and Practice; Oxford University Press: London, 1998.
7.Zimmerman, J.B.; Anastas, P.T. “The 12 Principles of Green Engineering as a Foundation for Sustainability” in Sustainability Science and Engineering: Principles. Ed. Martin Abraham, Elsevier Science. available 2005.
8.Anastas, P.; Zimmerman, J. “Design through the Twelve Principles of Green Engineering,” Environmental Science and Technology, 37, 94A – 101A, 2003.

2. TRANSPORT PHENOMENA

Lectures: 3 hrs per week
Tutorial : 1

Examination:
Theory: 100
Practical /Oral:
Internal: 25

Section I

1. Viscosity and the mechanism of momentum transport: (2 Hrs.)

Newton's law of viscosity, non Newtonian fluids, pressure & temperature dependence of viscosity, estimation of viscosity from critical properties.

2. Velocity distribution in laminar flow: (4 Hrs.)

Shell momentum balances, boundary conditions, flow of a falling film, flow through a circular tube, flow through annular, creeping flow along a solid sphere.

3. The equations of change for isothermal systems: (3 Hrs.)

Time derivatives, the equation of continuity, the equation of motion, the equations of change in curvilinear, co-ordinates, use of the equations of change to set up steady flow problems.

4. Velocity distributions: (2 Hrs.)

With more than one independent variable, unsteady viscous flow, flow near a wall suddenly set in motion.

5. Inter phase transport in isothermal systems: (3 Hrs.)

Definition of friction factors, friction factors for flow in tubes, friction factors for flow around spheres, friction factors for packed column.

6. Macroscopic balances for isothermal systems: (3 Hrs.)

The Macroscopic mass balance, the macroscopic mechanical energy balances, estimation of friction loss, Use of macroscopic balances to set up steady flow problems.

7. Thermal conductivity and the mechanism of energy transport: (3 Hrs.)

Fourier's law of heat conduction, temperature and pressure dependence of thermal conductivity in gases and liquids, theory of thermal conductivity of gases at low density.

Section II

8. Temperature distributions in solids and in laminar flow: (4 Hrs.)

Shell energy balance, boundary conditions, Heat conduction with an electrical heat source, Heat conduction in cooling fins, heat conduction with exothermic reactions.

9. Temperature distributions with more than one independent variables: (2 Hrs.)

Unsteady state heat conduction in solids, Boundary layer theory.

10. Interphase Transport in Non isothermal Systems: (3 Hrs.)

Definition of heat transfer coefficients, Heat transfer coefficient for forced convection in tubes, Heat transfer coefficient for forced convection around submerged objects, through packed beds, Heat transfer coefficient for free and mixed convection, Heat transfer coefficient for condensation of pure vapors.

11. Macroscopic balances for Non-isothermal systems: (3 Hrs.)

The macroscopic energy balance, the macroscopic mechanical energy balance, use of the macroscopic balances for solving steady state problems, Summery of macroscopic balances of pure fluids, Solution to the following cases, Parallel counter flow heat exchanger, The cooling of an ideal gas.

12. Diffusivity and the mechanism of mass transports: (2 Hrs.)

Definitions of concentrations, velocities & mass fluxes, Fick's law of diffusion, Temperature & pressure dependence of mass diffusivity, Maxwell’s law of diffusion.

13. Concentration distributions in solids and in a laminar flow: (3 Hrs.)

Shell mass balance, boundary conditions, diffusion through a stagnant gas film, Diffusion with heterogeneous chemical reaction, Diffusion with homogeneous chemical reaction, Diffusion in to a falling liquid film.

14. Introduction to the Computational Fluid Dynamics: (3 Hrs.)

Philosophy of computational fluid dynamics, conservation principles of mass, energy, and momentum, simplified flow models such as incompressible, in viscid, potential and creeping flows, classification of flows, Grid Generation, Structured and unstructured grids, choice of grid, general transformation of equations, some modern developments in grid generation in solving engineering problems.

Term Work:-

Minimum of eight assignments should be given to students. 50 % of assignments should be numerical problems.

Text Book:

1. R.B. Bird, W.E. Stewart and E.N. Lightfoot, “Transport Phenomena”, John Wiley & Sons, Inc, New York.

References:

1. C.O. Bennett, J.E. Mayers, “Momentum, Heat & Mass transfer”, 3rd Edn.,McGraw Hill, Chemical Engineering Series,1985.

2. Alan S. Foust, Leonard A. Wenzel, Curtisw Clump, Louis Maus,L Bryce Andersen “Principles of Unit Operations”,2nd edn.,McGraw Hill, 1985.

3. C.J. Geankoplis " Transport Processes Momentum And Mass" Bacon Inc. 1983.

4. L.E. Sissom & D.R. Ritts ,"Elements of Transport Phenomena" McGraw Hill, J.R. Welty, R.E. Wilson & C.E. Wicks, " Fundamentals of momentum, heat & mass transfer" 2nd edn. John Wiley, New York 1973.

5. Anderson Jr J. D., “Computational Fluid Dynamics: The Basics with Applications”, McGraw Hill.1995

6. Muralidhar K. and Sundararajan T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House. 2003

7. Ranade V. V, “Computation Flow Modeling for Chemical Reactor Engineering”, Academic Press. 2002

3. PROCESS ECONOMICS AND PROJECT ENGINEERING (PEPE)
(New Revised)

Lectures : - 4 hrs per week

Practical : -

Examination
Theory : 100
Practical /Oral
Internal : 25
External : -

Section – I

1. Introduction.

2. General design considerations.

3. Process Design Development

4. Flow sheet Synthesis and Development

5. Cost and asset accounting.

6. Analysis of Cost estimation.

7. Interest, Time value of Money, Taxes and Fixed Charges.

8. Profitability, alternative investments and replacements.

9. Optimum design and Design strategy.

10. Written and Oral Design Reports.

Section – II

11.Process development and commercialization—Introduction, Exploratory research process development, development for final process design, development of established processes,

12.ProcessLicensing-Licensingprinciples,Licenseagreement,Agreement implementation.

13.Selection of contractor scope and contract types – Introduction, Detailing of scope of work, Factors in selecting scope of work, detailing of contract types, Factors in selecting type of contract.

14.Plant Startup – Introduction, Organization of startup, Budget for startup, Information centre, Planning and schedules, Log sheets and calculations, Training personnel, Planning of testing and preoperational procedures, Initial startup, Operating the plant.

15. Project conception and definition : Selection of plant capacity, Causes for time and cost over runs of a Project, Process Optimization, Selection of Alternative Processes Equipment.

16. Project Engineering : Management and Organization, Project Planning, Scheduling and Controlling , Use of bar and milestone chart, PERT/ CPM - Introduction, Activity sequencing, Network building, Time estimates, Critical path calculations.

Text Books:

1. M.S. Peters & K.D.Timmerhaus, "Plant Design and Economics for Chemical Engineers", 5th edition, McGraw Hill International Book Co.,2003.
2. Lundu, "The Chemical Plant".
3. J.M. Coulson & J.F Richardson, "Chemical Engineering", Vol.6, 5th edition Pergamon & ELES, 2003.
4. Modes J. & Philips, "Project Engineering with C.P.M. & PERT", Rein hold.
5. Srinath L.S. "PERT & C.P.M. Principles and Applications"3rd edition, East-West Publication 2003.
6. GAEL D. ULRICH, "A Guide to Chemical Engineering Process Design and E" John Wiley & Sons, 1984.
7. N. D. Vohra, "Quantitative Techniques in Management", 2nd edition Tata McGraw Hill Publishing company Ltd., New Delhi 2005.

References:

1. Rase, H.F. Barrow, M.H. "Project Engineering of Process Plants", John Wiley.
2. Schewayer, H.E. "Process Engineering Economics", McGraw Hill
3. Chilton, C.H., "Cost Engineering in Process Industries", McGraw Hill
4. Happel J. Jordan, D.G. "Chemical Process Economics".
5. Tacmin A,J. Blank L.T. "Engineering Economy"
6. V.W. Wni. & A.W. Hankins, "Technical Economics for Chemical Engineers" (AICHE)1971.

4.ELECTIVE – II

1. BIO-CHEMICAL ENGINEERING

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical :-
Internal : --
External : --

1. Introduction.
Biochemical Engineering – the interaction of two disciplines, Comparison of chemical and biochemical process, Role of biochemical engineers in development of modern formation industry, Future development, Applications of engineering advances.

2. Chemical Activities of Microorganisms.
Biological oxidation and transfer of energy, Pathways to provide energy and metabolism for growth, EMP – pathway, HMP – pathway, Anaerobic metabolism of pyravate, TCA cycle, Yield of cells, Production of amino acids, Nucleotides, Antibiotics.

3. The kinetics of enzyme catalyzed reactions.
Simple enzyme kinetics with one and two substrates, Determination of elementary step rate constant, Substrate activation and inhibitation, Multiple substrate,Modulation and regulation of enzyme activity, Enzyme deactivation, Effect of PH, Temperature, inhibitors on enzyme activity.

4. Kinetics of Substrate Utilization.
Ideal reactors for kinetics measurement, Kinetics of balanced growth, Transient growth kinetics, Structured kinetics model, Product formation kinetics.

5. Transport phenomena in microbial systems.
Gas liquid mass transfer in cellular system, Determination of OTR, mass transfer freely rising or falling bodies, Forced convection mass transfer, Estimation of overall kla, Heat transfer correlation, Mass transfer and microbial respiration, Theories of diffusional mass transfer.

6. Design and analysis of biological reactors.
Ideal bioreactors, Reactor dynamics, Microbial dynamics in chemostat culture, Mass balance in a series vessel, Mass balance with recycle, Comparison between batch and continuous cultivation, Sterilization reactors, Animal and plant cell reactor technology, Examples of design calculations.Design and construction of fermenter, Multiphase reactors.

7. Translation of laboratory culture results to plant operations, Scale down, Data translation, Performance of shaker flask, Fermentation technology, Design and operation of typical aseptic, Aerobial fermentation process.

8. Introduction of advanced topics such as.
Bioprocess simulation, Molecular modeling for protein synthesis and drug design, Protein engineering, Manufacturing process for typical pharmaceutical products.

References:

1. J.E. Bailley and D.F.Olis, “Bio-chemical Engineering Fundamentals”, McGraw Hill, New York, 1977.
2. S.Aiba, A.E. Humphrey and N.R. MHH, “Bio-chemical Engineering”, Second Edn. Academic Press, 1973.
3. F.C. Web, “Biochemical Engg.” Van Nostrand, 1964.
4. B. Atkinson, “Biochemical Reactors”, Plon Ltd., 1974.
5. Willy Berg, “Advanced Bio-Chemical Engineering”
6. Desai A.V., “Bio-energy”, Willey Eastern Ltd. New Delhi,1990.
7. Lehninger A.L., “ Bio-Chemistry” ,Worth Publication, Inc.,New York, 1972.
8. Bungay H.R.,Belfort G., “Advanced Bio-Chemical Engineering” ,John Willey And Sons,New York, 1987.

4. ELECTIVE – II

2. PETROCHEMICAL TECHNOLOGY

Lectures: 4 hrs per week

Practical/Oral

Examination
Theory: 100
Internal: -
External: -

Section I

1. **General Introduction:** **(5 Hrs.)**

   Definition of petrochemicals, history of petrochemical industry, development of petrochemical industry in India, product profile of petrochemicals, economics of petrochemical industry, general cost considerations, indigenous technology v/s foreign know-how, economics of R&D, sources of petrochemicals, natural gas & petroleum, classification of petrochemicals.

2. **Raw Materials:** **(4 Hrs.)**

   Organic chemicals, coal, biomass petroleum, etc.

3. **Chemicals from Methanol & Synthesis gas:** **(4 Hrs.)**

   Steam reforming, Oxo-Products, Methanol, Formaldehyde, Carbon-di-sulphide, Hydrogen cyanide.

4. **Chemicals from Ethane, Ethylene & Acetylene:** **(4 Hrs.)**

   Synthetic Ethanol, Acetaldehyde, Acetic acid, Vinyl acetate, Ethylene oxide, Ethylene glycols, Acrylonitrile, Ethanol amines.

5. **Chemicals from Propane & Propylene:** **(4 Hrs.)**

   Isopropanol, Acetone, Glycerol, Propylene oxide, Propylene Glycols, Isoprene, Cumene.

Section II

6. **Chemicals from Butanes & Pentanes:** **(4 Hrs.)**

   Butadiene, Butone epoxides & Butanol amines, Butyl acetate, Methyl-Ethyl Ketone, MTBE, TAME.

7. **Chemicals from aromatics:** (5**Hrs.)**

   BHC, Nitrobenzene, Do-decyl benzene, Benzoic acid, Nitrotolune, Pthalic anhydride, Isopthalic acid, TPA & DMT, Maleic anhydride, Adipic acid, Hexamethylene diamine, Aniline, Caprolactum.

8. **Polymers:** **(4 Hrs.)**

   Polymers, elastomers, synthetic fibers, PVC, Nylon & Polyesters.

9. **Future of Petrochemicals:** **(6Hrs.)**

   Integrated Petrochemical complex, Energy crises in Petrochemical industry, Natural gas as Petrochemical feedstock, Import of heavy feedstock on Petrochemicals, Ecology & energy crises, Coal as an alternative to oil, Synthetic fuels, Trends in Petrochemical Industry.

NOTE: The journals such as Hydrocarbon Processing, Chemical engg. Progress must be used for the latest technologies.

Text Books:

1. B.K. Bhasker Rao, "A Text on Petrochemicals"2nd Edition, Khanna publishers, 1996.
2. Sukumar Maiti, "Introduction to Petrochemicals" Oxford & IBH publishing Co. Pvt. Ltd., 1991.
3. Ram Prasad, "Petroleum Refinery Technology", Khanna publications.

References:

1. A.V.G. Halm, "The Petrochemical Industry", McGraw Hill 1970.
2. A.L. Waddams, "Chemicals from Petroleum", Chemical publishing Co.
3. Astle M.J., "The Chemistry of Petrochemicals", Reinhold.
4. C.E. Dryden, "Outlines of Chemical Technology", Affiliated East-West Press, 1973.
5. Faith Keys, "Industrial Chemicals".

4. ELECTIVE – II

3. COMPUTER AIDED DESIGN

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : --
Internal : --
External : --

1. Central processors : Introduction to central processors; Historical approach, Analog computers; Digital Computers; The Hardware bus; Shift Register; Output Buffer; Digital logic; CPU, ALU, Computer System Architecture; I/O ; Remote Access; Performance.

2. Data storage : Role of Storage devices; Main memory; Backing Storage; Need for memory mapping; Virtual addressing, Paging.

3. Alpha numeric and graphic I/O : Batch and Interactive processing; Data input devices; Data Output devices; Combination at I/O devices; I/O control devices; Graphic computer terminal, Graphic display; Graphics terminals; Graphic Display, Graphics terminals; Plotters; Printers.

4. Basic software : Operating System and executive; Operating system function; Models of operation; Batch Operation; Time sharing; Real time Operation; Transaction Processing; File management system; Logging on and off, Editors; Computers; Data tables; Graphic software.

5. Properties evaluation : Concepts of CAD Physical properties of compounds Thermodynamic properties at gases and binary mixtures; Viscosity; Vapour pressure, latent heat, bubble point and dew point calculation; Phase equilibria, Vapour -liquid equilibria.

6. Equipment design : Computer aided design of reactors; evaporators, absorption column, distillation column and crystallizes, Heat transfer equipment like heat exchangers, furnaces etc, Pumps, Piping, Pressure drop calculations; Mass and Energy balance.

7. Flow sheet simulation : Process flow sheet simulation; Process and information matrix, Recycle calculation sequence; Materials and Energy balance computation using modular approach; Process analysis, Process variables, selection, Equipment selection.

8. Dynamic simulation : Dynamic simulation of Reactors, distillation column, Absorbers, evaporators and crystallizes, introduction to simulation packages like GPSS, CSMP.

References:

1. M.P. Groover, E.W. Timmers, “Computer Aided Design and Manufacturing”, Prentice Hall of India Pvt. Ltd., New Delhi, 1985.

2. L. Nashelsky, “Introduction to Digital Technology”, John Wiley and Sons, New York, 1983.

3. E.J. Henley, and F.M. Rusen, “Material and Energy Balance Computations”, John Wiley, New York, 1969.

4. E.D. Oliver, “Diffusional Separation Process”, John Wiley and Sons, New York, 1966.

5. B.D. Smith, “Design of Equilibrium Stage Processes”, McGraw Hill Book Co. New York, 1963.

6. Crowe, C.M. et. al., “Chemical plant simulation-An Introduction to Computer aided steady-state process analysis”, Prentice Hall, 1971.

7. Franks, R.G.E., “Modelling and simulation in Chemical Engineering”, Wiley Inter Science, 1972.

8. Holland C.D. “Fundamentals and modelling of separation processes”, absorption, Distillatkion, evaporation and extractikon, Prentice Hall, 1975.

9. Afgan, N.H. and Schlunder, C.V., “Heat Exchangers-design and theory source book” Scripta Book, Washington, 1974.

10. Chussain, A. “Chemical Process simulation”, Wiley eastern, 1986.

11. Wester Berg, A.W. et.al. "Process Flow Sheeting", Cambridge UniversityPress, 1979.

12. Myers, A.L. and Seeden, W.D. “Introduction to Chemical Engineering and Computer Calculations” Prentice Hall, 1976.

13. Prausnitz, S., “Computer calculaltions in Multi Component vapour liquidequilibria” Prentice Hall, 1980.

14. Welison, C. and Hobson P.M., “Combination for Process Engineers”, Leonard Hill, 1973.

4. Elective – II

4. DISTILLATION

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : - -
Internal : -
External : -

Thermodynamics of equilibrium vapour liquid equilibria of ideal and non ideal solutions- Binary and Multi component systems. Correlation and prediction of VLE data (Brief outlines only). Principles of differential distillation and steam distillation. Equilibrium Flash vaporisation. Hydrocarbon water mixtures. Binary distillation Determination of minimum and total reflux calculations for the number of equilibrium stages- Analytical and graphical methods-problems with open steam sidestreams. Multiple feeds-batch columns multicomponent distillation: Preliminary calculations - selection of key components- Rigorouis calculations - Methods of Sorel. Lewis-Matheson, Thiele-Geddes and Short cut methods. Azeotropic and extractive Distillation. Separation of azeotrops selection of solvents and entrainers, column design by pseudo ternary and pseudo binary methods. Solvent recovery. Design of distillation equipment, plate and packed columns.

Books:

1. “Distillation”, Van Winkle.
2. “Distillation Design”, J. H. Kister
3. “Distillation Operations”, J. H. Kister
4. “Design of Equilibrium Stages”, B. D. Smith.

4. Elective – II

5. ENTERPRISE RESOURCE PLANNING

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : -
Internal : -
External : -

1. BPR in Indian Context
2. ERP Planning/Budgeting Process
3. ERP Implementation Issues
4. Selecting ERP product for your needs
5. Product Presentations & Demonstration from World's Best ERP Products
6. like SAP R/3 etc.
7. Experiences of ERP Live Sites
8. Post Implementation Issues

4. Elective – II

6. ARTIFICIAL INTELLIGENCE IN PROCESS ENGINEERING

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : - -
Internal : -
External : -

Introduction – History and relation of artificial intelligence (AI) to process engineering; Knowledge representation I – Predicate calculus and Semantic Networks; Search – Forward / Backward, Depth/breadth/best – first search; Production systems: History, Components; Knowledge representation II – Frames, Objects; Inexact Reasoning – Introduction, Bayesian certainty factors, Qualitative Physics, Casual Models – Introduction, Backward architecture; Expert Systems – Applications to industry; Programming Languages; Expert System Shells; Neural Nets – Introduction and applications to process engineering.

Books:

1. N.L. Nilsson, “Problem Solving Methods in Artificial Intelligence”, McGraw Hill, 1971.
2. T.E. Quantrille and Y.A. Liu, “Artificial Intelligence in Chemical Engineering”, Academic Press, 1991.
3. J. Zurada, “Introduction to Artificial Neural Systems”, West Pub. Co. Ltd., St. Paul, MN, 1992.
4. J. F. Davis, G. Stephanopoulos and V. Venkatasubramanian, “Intelligent Systems in Process Engineering”, AIChE symposium Series, Vol. 92, 1996.

4. Elective – II

7. MEMBRANE SEPARATION PROCESS AND DESIGN

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : - -
Internal : -
External : -

1. Introduction: Introduction to membrane processes, History, Definition of membrane, importance, processes.
2. Types of membranes, Membrane processes and their applications, Porous and solid membranes, Osmosis, Micro – Filtration, Ultrafiltration, Nano filtration, Reverse Osmosis, Piezodialysis, Electrodialysis, Dialysis, Membranes for gas separation, Pervaporation, Applications to these processes.
3. Liquid membranes, Supported and unsupported liquid membranes, Applications and mathematical modeling.
4. Materials and material properties, Polymers and effect of various properties of polymers such as Tg, Thermal, Chemical and mechanical stability, Elastomers and their properties, Inorganic membranes, Biological membranes.
5. Characterization of membranes: Characterization of porous membranes, Characterization of ionic membranes, Characterization of non – ionic membranes.
6. Preparation of synthetic membranes, Preparation of phase inversion membranes, Preparation techniques for immersion precipitation, Preparation techniques for composite membranes, Influence of various parameters on membrane morphology, Preparation of inorganic membranes.
7. Transport processes in membranes, Driving force, Transport through porous membranes, Transport through non porous membranes, Transport in ion-exchange membranes.

8. Polarization phenomena and fouling concentration polarization, Characteristic flux behavior in pressure driven membrane operation, Various models, Temperature polarization, Membrane fouling, Methods to reduce fouling.
9. Modules and process design plate and frame, Spiral wound, Tubular, Capillary, Hollow fiber modules and their comparison, System design.
10. Membrane reactors, Applications of membrane reactors in biotechnology
11. Economics and feasibility of membrane technology, Comparison of membrane technology with separation techniques, Scope in future, Current and existing industrial applications.

Books:

1. Basic Principles Of Membrane Technology, Marcel Mulder, Kluwer Academic Publishers, 1997
2. Membrane Separation Technology – E. J. Hoffma, Gulf Professional Publishing.
Reference:
3. Membrane Handbook – Editors W. S. Winston Ho, K. K. Sirkar, Van Nostrand Reinhold Publication.

4. Elective – II

8. NUCLEAR ENGINEERING

Lectures : - 3 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : - -
Internal : -
External : -

Section I

1. Nuclear Physics: Atomic number and mass numbers, Isotopes, Nuclear energy and nuclear forces, Binding Energy, Nuclear Stability, Radioactivity, Nuclear reactions, Radioactive isotopes, Law of radioactivity, Interaction of radiation (alpha, beta, gamma) with matter, Interaction of neutrons with matter, Absorption radiative capture, Transmutation Fission, Cross section for nuclear reactions.
Fission process, Mechanism of nuclear fission, fission cross section, fission products, Basic radio chemistry.

2. Reactor Physics: Neutron balance, Neutron diffusion, Diffusion equation, and its solution, Showing down of neutrons, Showing down power and moderating ratio. Reactor theory: Multiplication factors, Four factor formula, One group critical equation, Age, Diffusion method, Non-leakage probabilities and effective multiplication factor, Multigroup diffusion theory, Homogeneous and heterogeneous reactor systems, Time dependent reactor behavior.

3. Nuclear Reactor Engineering: Types of rectors, Ordinary water moderated reactors (BWR, PWRO), Heavy water cooled and moderated reactors, Gas cooled reactors (HTGR, AGR), Fast reactors design, Construction and control of nuclear reactors.

Section II

4. Heat transfer in nuclear reactors: Heat transfer techniques in nuclear reactors, Design and operation, Thermal stresses, Reactor shielding.

5. Reactor materials: Nuclear fuels, Moderators, Coolants, Reflectors and structural materials.

6. Reprocessing: Nuclear fuel cycle, Spent fuel characteristics, Reprocessing techniques role of solvent extraction in reprocessing.

7. Waste management and radiation protection: Types of waste, Waste management philosophy and disposal, ICRP recommendations, Radiation hazards and their prevention, Radiation dose units.

8. Status of nuclear technology in India: Indian nuclear power program, Nuclear reactors in India, India’s commitment to nuclear.

References:

1. S. Glasstone and A. Seronske, “Nuclear Reactor Engineering”, Van Nostrand – Reinhold, 1967

2. M. Bendict and T.A. Pigtor, “Nuclear Chemical Engineering”, McGraw Hill, 1981.

3. L. C. Merrite, “Basic Principles of Nuclear Science and Reactors”, Wiley Hill, 1981.

4. S. E. Liverhandt, “Introduction to Nuclear Reactor Physics”

4. Elective – III

1. ENERGY CONSERVATION AND RECOVERY

Examination

Lectures : - 4 hrs per week
Practical /Oral

Theory : 100
Practical : -
Internal : -
External : -

1. Energy conservation: An Introduction: Industrial energy use and economy, Need for planning energy, importance of energy in production and employment, Importance of energy cost in production, Energy and employment, The mystery of conservation, **(3 L)**

2. Indian energy scenario: Growth and demand of energy, Energy availability, Comparison of specific energy use in select industry, Potential and status of energy in India, Energy saving potential in industries, Potential of energy efficiency in India, Barriers**.(3 L)**

3. Energy available for industrial use and the role of conservation: Methodology for forecasting, Industrial energy supply and demand, Review of alternative approaches and major models and studies, Method for forecasting industrial energy price and availability, New energy technologies and conservations**.(3 L)**

4. Energy management and policy: Comprehensive energy conservation planning (CECP), Motivation for Comprehensive energy planning, Principles of energy conservations, Procedure for Comprehensive energy conservation planning, Significance of CECP, Tasks required for CECP and application of CECP**.(4L)**

5. Principles of energy conservation: Definition of energy conservation, Principles of energy conservations, Economics of energy conservation policy, Optimum energy conservation, Observation on energy conservation by industry.**(4L)**

Section ii

6. Energy conservation technologies: Waste heat recovery and utilization, Technologies, Cost and energy saving of waste heat recovery and utilization**.(4L)**

7. Cogeneration concept and scope: Introduction, Advantages, Constraints, Feasibility, Scope, Benefits and constraints**.(3L)**

8. Energy audit and management: Types of audit, Responsibility of energy management, Targeting and monitoring energy consumption, Scope of energy audit, General questionnaire, Case study of energy audit**.(3L)**

9 Energy conservation in utilities: Thermal and electrical utilities and case studies of stoichiometric amount of air required for the burning of fuel. Theoretical air required for Propane, equivalent evaporation evaluation, Boiler efficiency evaluation by direct and indirect method. Theoretical air requirement evaluation on CO_2 basis, Calculation of blow down percentage, Installation of economizer for boiler, Steam Balancing, Optimization of steam piping size to reduce pressure drop, Utilization of blow down water to generate flash steam, Steam use for power generation in an extraction cum condensing turbine, Excess air optimization, Waste heat recovery, Conversion of electrical furnace in to oil fired furnace, Insulation upgrade project, Annual fuel saving by proper insulation, Cost saving achieved by insulating uninsulated steam line, Calculation illustrating the most suitable insulation thickness, Improvement in specific energy generation**,(6L)**

10. Impact of climate change in India(3L)

11. Energy conservation in Sugar Industry(3L)

12. Energy conservation act 2001.(3L)

Reference books:

1. A. D. Mohan Singh, Col. S. K. Murthy (Retd.) and etc., "Energy Conservation in Industries", Module I and II, AICTE, CEP, Code 358.

2. Devid Hu. S, "Handbook of Energy Conservation", McGraw Hill Publication.

3. Rao, Diwalkar P.L., "Energy Conservation Handbook", Utility Publication, Hydrabad.

4. The Bulletion on Energy Efficiency and Management by IRADA, MITCON, MEDHA etc.

5. Amit Tagi, "A Handbook Energy Audit", Tata McGraw Hill publication, 2000

6. D. A. Reay, "Heat Recovery Systems", E and F. N. Spon ltd., 11, New Fetter Lane, London, 1979.

7. A Practical Guide to Energy Conservation, PCRA Publication, 2010.

L-INDICATES LECTURE

5. ELECTIVE – III

2. POLYMER REACTION ENGINEERING.

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : -
Internal : -
External : -

1. Introduction - Conventional and Commercial approaches, Addition polymerization Kinetics, Condensation polymer kinetics, Ionic polymerization kinetics, Relationship between kinetic chain length and average degree of polymerization.

2. Polyaddition reactions - Kinetics and rates of polymerization of styrene, Methyl methacrylate, Ethylene, Polycondensation reactions – Characteristics, Homogeneous and heterogeneous polycondensation reaction kinetics, Maximum degree of polycondensation, Industrial polycondensation

3. Kinetics of chain chemical reactions: Characteristics of chain reactions, Stationary and non stationary chain reactions, Kinetics of branched chain reactions, Auto acceleration and inhibition of chain kinetics, Kinetics of inhibition

4. Copolymerization: Introduction, Classification of copolymers, Basic principles of copolymers, Kinetics of copolymerization, Mayo's copolymer equation, Determination of feed and polymer, Determination of monomer Reactivity ratios, Copolymerization for limiting cases, Types of copolymesr behavior, Overall rate of copolymerization, Alfrey Price Q–e scheme, Statistical derivation of copolymerization equation, Range and applicability, of copolymerization, variation of copolymer composition with conversion and applications of copolymerization, Rates of copolymerization for chemical and diffusion controlled termination, Examples.

5. Introduction to Smith- Ewart's emulsion polymerization kinetics, Experimental techniques in emulsion polymerization, Rates of polymerization for case I and case II, Estimation of total number of particles, Empirical correlations for emulsion polymerization, Vinyl Chloride suspension polymerization.

6. Reactors for polymerization: Batch, PFR, CSTR with residence time, average molecular weight and control strategies, Programmed operation of polyaddition reactors, Low and high conversion reactors, Industrial polymerization reactors.

Text Books:

1. G.N. Burnett, “Mechanism of polymerisation reaction”, Interscience, 1954.
2. Anil Kumar, S.K. Gupta, “Fundamentals of Polymer Science and Engineering”, Wiley, 1978.
3. G.S. Misra, “Introductory Polymer Chemistry”, Wiley Eastern Ltd.,New Delhi,1993.
4. F. Wilkinson, “Chemical Kinetics and Reaction Mechanism”, Van Norstrand Reinhold Company Ltd, England, 1980.
5. D.J. Williams, “Polymer Science and Engg”. Prentice Hall, New York 1971.
6. F. Rodrigues, “Principles of Polymers systems”, McGraw Hill, New York 1970
7. D.C. Miles, “Polymer Technology”, Chemical Publishing New York, 1979.
8. George Odian, “Principles of Polymerization”, 2nd Edition John Wiley and Sons, New York 1981.
9. Fred Billmeyer, “A Text Book of Polymer Science”, 3rd Edition, John Wiley and Sons, New York, 1984.

5. ELECTIVE – III

3. PHARMACEUTICAL TECHNOLOGY-II

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : -
Internal : -
External : -

Medicinal chemistry, Pattern of disease and drug action, Mode of action Clinical application Chemistry of hormones, Analgesics, and antipyretics

Synthesis of drug molecules with selected types of reaction and writing the synthetics giving approximate condition and emphasis on Techno- commercially potential routes. Synthesis of some complex drug molecules (selected from vitamins and alkaloids), Synthesis of peptide drugs, Bio-organic chemistry of vitamins.

Raw materials and Manufacturing processes for steroid drugs, Manufacturing processes for some excepients, eg. cellulose, and its derivatives, Lactose, Chirality and chiral technology. One topic of current interest, Effluent treatment

Raw materials for Pharmaceutical Industry,.

Enzymes as catalyst (a) in Synthesis for Pharmaceuticals (b) Introduction to Principle of enzymes catalyst, Lipases and esterase's for hydrolytic conversion. Lipases and esterase's in organic solvents, other hydrolytic reactions, Enzyme-catalyzed oxidation reactions, Enzyme-catalyzed C-X bond synthesis, Enzyme-catalyzed reduction, Chiral Technology Preformulation, Formulation, Evolution, Large scale manufacture and packingwith focus on equipment with reference to Oral sustained and controlled release dosageforms and Aerosols.

Introduction to Novel drug Delivery Systems: Transdermal, Transmucosal, Ophthalmic, Colloidal: Liposome's, nanoparticles, emulsion systems etc

Introduction to Radio pharmaceuticals, Overview of cosmetic products

Novel Drug Delivery Systems, Oral sustained and controlled release dosage forms, Aerosols, Blood products, Glandular products, Radiopharmaceuticals, Surgical sutures, ligatures, dressings. Physiology of Central Nervous System and Drugs acting on Central Nervous System.

Books:

1. Pharmaceutical Dosage Forms And Drug Delivery Systems, Ansel, Philadelphia, Fea and Febiger, 1985
2. Introduction to Pharmaceutical Dosage Forms Ansel, Henry Kimpton Publishers, London.
3. Pharmaceutics: The Science of Dosage Form Design Aulton, New Delhi, B.I. Naverly Pvt. Ltd., 1995
4. Modern Pharmaceutics G.S. Banker New York, Marcel Dekker1990
5. Bentely's Textbook of Pharmaceutics Rawlins Cassell Ltd, London
6. Fundamentals of Pharmacy Blome H.E. Philadelphia, Fea and Febiger, 1985
7. Fundamentals of Pharmacy Blome H.E. Philadelphia, Fea and Febiger, 1985
8. Pharmaceutial Production Facilities: Design and Applications G.C.Cole
9. New York Ellis Horwood 1990
10. Husa's Pharmaceutical Dispensing Martin E.W. Easton Mack Pub. Co. 1971
11. Transdermal Delivery of Drugs A.Kydonieus Florida, CRC Press, 1987
12. Transdermal Controlled System Medications Y.W.Chien, New York, Marcel Dekker 1987
13. Quantitative Pharmaceutical Chemistry, Glann L. Jenkins, Adelbert M. (VI Edition) McGraw-Hill Books Company
14. Text Book of Pharmaceutical Analysis, Kenneth A., Connors, A Willey Interscience Publication, USA
15. Wolfgang Aehle, " Enzymes in Industry Production and Applications" Wiley VCH Publication, 2003
16. Heinrich Klefenz, "Industrial Pharmaceutical Biotechnology" Wiley-VCH Publication, 2002.
17. T. Scheper, "Process Integration in Biochemical Engineering" Springer Publication, 2003.
18. Oligan Repic, "Principles of Research and Chemical Development in the Pharmaceutical Industry Wiley Interscience 1998
19. Romano Di Fabio, "From Bench to Market the Evolution Chemical Synthesis" Oxford University Press, 2000

5. ELECTIVE – III

4. MULTIPHASE REACTOR DESIGN

Examination

Lectures : - 4 hrs per week
Practical /Oral

Theory : 100
Practical : -
Internal : -
External : -

1. Introduction: Reaction kinetics for multiphase reactions, Brief idea about multiphase reactors and design considerations, Catalyst deactivation and regeneration.

2. Review of reaction kinetics and reactor design

3. Industrial reactors: Trickle bed, Bubble column, segmented bed, Agitated slurry, Fluidized bed and slurry reactors, Constructional features and operation (Batch and continuous)

4. Models for analysis gas – liquid and gas – liquid – solid reactions, Film and penetration theories, Transport resistances and heat effects.

5. Residence time distributions (RTD) and macro mixing models, Review of methods obtaining RTD, Problems in scale-up.

6. Models for gas – liquid – solid reactors (Only model formulations with assumption and final design equations wherever available. Numerical solutions of model equation excluded).

7. Brief description of laboratory reactors and significance of laboratory data for reactor design and scale-up.

8. Intrinsic kinetics: Catalysis, Langmuir – Hinshelwood models, Catalyst pellets, Effective diffusivity, Tortuosity, Effectiveness factors, Mass transfer and reaction in packed beds, Determination of limiting step from reaction data, Introduction to chemical vapor deposition reactors.

Books:

1. Y.T. Shaha, “Gas Liquid Reactor Design”, McGraw Hill, 1979
2. Foggler, “Elements of Chemical Reaction Engineering”, Prentice Hall of India.
References:
1. Westerterp K.R., Van Swaaij and Beevackers, “Chemical Reactor Design and Operation”, John Wiley and Sons, 1978
2. Carberry, Verma, “Chemical Reactions and Reaction Engineering”, Marcell Decker, 1987
3. Gianetta and Silverton, “Multiphase Chemical Reactor – Theory, Design, Scale-up”, Hemisphere Publishing Corporation, 1986
4. Sharma and Doraiswamy, “Heterogeneous Reactions”, Vol. I and II, John Wiley, 1984

5. ELECTIVE – III

5. MASS TRANSFER WITH CHEMICAL REACTON

Lectures : - 4 hrs per week
Practical /Oral

Examination
Theory : 100
Practical : -
Internal : -
External : -

Section – I

Theory of simultaneous mass transfer and chemical reaction, Film theory, Penetration and surface renewal theory, Higbe's model and Danckwaert's model, Absorption with chemical reaction (gas-liquid systems) and extraction with chemical reaction (liquid-liquid systems), Very slow reaction regime (Kinetic regime), Slow reaction regime, Fast reaction regime, Instantaneous reaction regime, Physico - chemical data, Prediction and estimation of diffusivity and solubility of gases in pure liquids and solutions.

Section – II

Model experiments on absorption and extraction with chemical reaction, Use of wetted wall column, Laminar jet, Disc column multiple sphere absorber, Stirred cell, Application of theory for studying the kinetics of heterogeneous reaction and determination of mass transfer coefficient and interfacial areas by chemical method, Characteristic and design criteria for industrial equipment used for absorption and extraction accompanied by chemical reaction, Typical examples and case liquid – liquid systems.

References:

1. G. Astrita, "Mass Transfer with Chemical Reaction Engineering", Elasevier Amsterdam, 1966

2. P. V. Danckwarts, "Gas Liquid Reactions", McGraw Hill, 1970.

3. Dr. Sharma, M. M., "Advances in Mass Transfer"

6. ADVANCED SEPARATION PROCESSES

Lectures : - 1 hrs per week
Practical /Oral : 2 hrs.

Examination
Theory : --
Practical :
Internal : 25
External : 25

Introduction to advanced separation techniques such as :
1) Reverse Osmosis
2) Ultra filtration
3) Micro filtration
4) Pressure swing Adsorption
5) Electrostatic Precipitator
6) Supported Liquid Membranes
7) Supercritical Fluid Extraction etc.
Study of basic principles & different working modules used in above separation techniques.

List of practicals:

1. Ultrafiltration of some dilute solutions.
2. Reverse osmosis of saline solution.
3. Microfiltration of raw material.
4. Electrodialysis.
5. Pressure swing Adsorption.
6. Electrostatic precipitator.
7. Gas Chromatography.
8. Supported liquid membranes.
9. Ion Exchange.

Books:

1. C.J.King "Separation Processes" 2nd Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1986.
2. Sirkar K. & Winston H.O. "Membrane Hand Book" Van Nostrand Reinhold, New York, 1992.
3. McCabe & Smith "Unit Operations of Chemical Engineering" 5th Ed.,McGraw Hill International .
4. Richardson and Coulson,“Chemical Engineering Volume –II”,Pergamon Press,1970.
5. Schweitzer P.A , “Handbook of Separation Techniques for Chemical Engineering” 2nd edn.,McGraw Hill Book Co.,1986.
6. Souri Rajan S. "Reverse Osmosis" Logos Press Ltd.

7. PROJECT WORK

Lectures: --

Practical: 6 hrs/week

Examination:
Theory: --
Practical /Oral
Internal : 50
External: 100

The project work is to be completed under the guidance of a staff member and /or staff members and submit a typed report in duplicate.

The Project Report consists of

1) Certificate
2) Acknowledgement
3) Statement of Problem
4) Synopsis / Abstract.
5) Index.
6) Introduction.
   Importance of Project.
   Market Situation.
   Consumption Data.
   Need of such Plant.
7) Literature survey – Process Selection.
8) Theoretical conditions – Process Parameters, Composition.
9) Process Description – Process Floe-sheet (Block Diagram)
10) Basic Engg. Data.
    Physical.
    Chemical.
    Thermodynamic.
    Analytical Methods.
11) Details of Experimental Set up & Experimental Work.- Purpose method, Chemicals, Calculations, Analysis of Data, Results, Discussion.
12) Material Balance & Energy Balance.
13) Selection of Equipments & Specifications.
14) Design of Specific Equipment.
    Process design.
    Mechanical Design.

15) Control & Safety of Process.
16) Plant layout & Location.
17) Cost Estimation & Economic Analysis
18) Pollution Control, Safety, Marketing
19) Conclusion & Remarks.
20) References.
    Books.
    Journals.
21) Appendix.
    List of Tables.
    Sample Calculation.
    Data Tables, etc.

The object of the project is to make use of the knowledge gained by the student at various stages of the degree course. This helps to judge the level of proficiency, originality and capacity for application of the knowledge attained by the student at the end of the course.

Each group should consist of maximum 3 students. For term-work (Internal) 75 marks, the assessment should be by conducting frequent written tests, seminars during the year & an oral exam. at the end of the year conducted by all the staff members of the dept. The Head of the Dept. should see that the assessment procedure should be the same for all the students of the class.

For external 75 marks, the project work shall be assessed by an oral exam. to be held by at last two examiners, one internal and one external preferably from industry at
the end of the year.

The object of the VIVA VOCE examination (Internal and External Orals) is to determine whether the objectives of the project work have been met by the student as well as to assess the originality and initiative of the student as demonstrated in the project work.

EQUIVALENCE FOR B.E.(Chemical Engg.)

Sr.No.	Pre-Revised	Revised	Remarks
1	Chemical Reaction Eng.-II	Chemical Reaction Eng.-II	--
2	Chemical Eng. Processes-I	Chemical Process & Synth.	--
3	Chemical Process & Plant Design	Chemical Process Design	--
4	Modeling& Simulation in Chemical Engineering	Modeling& Simulation in Chemical Engineering	--
5	Elective-I	Elective-I	--
6	Seminar	Seminar	
7	Comprehensive tests On all subjects from S.E to B.E-I	Comprehensive tests On all subjects from S.E to B.E-I	--
8	Industrial Training (At the end of VI Semester -- 4 weeks)	Industrial Training (At the end of VI Semester -- 4 weeks)	--
9	Project Work	Project Work	Project Work of BE Part- II

B.E.CHEMICAL PART – II

Sr.No.	Pre-Revised	Revised	Remarks
1	Chemical Eng. Processes-II	Chemical Process & Green Technology	--
2	Transport Phenomena	Transport Phenomena	--
3	PEPE	PEPE	--
4	Elective – II	Elective – II	--
5	Elective—III	Elective—III	--
6	Advanced separation processes	Advanced separation processes	--
7	Project Work	Project Work	--