SCHEME OF INSTRUCTIONS AND EXAMINATIONS

UNIVERSITY OF MUMBAI

COURSE: BE (CHEMICAL ENGINEERING)
SEMESTER: VII

YEAR: BE

Sr. No.	Subject	Scheme of Instructions 1 Hr Periods			Duration of Papers Hrs	Scheme of Examination				
		Lecture	Practical	Tutorial		Theory Paper	Term Work/ Assignment/Test	Practical	Oral	Total
7.1	Chemical Process-II	4	-	1	3	100	25	-	-	125
7.2	Reaction Kinetics	4	2	-	3	100	25	25	25	175
7.3	Instrumentation & Process Control	4	2	-	3	100	25	25	25	175
7.4	Process Engineering	4	-	1	3	100	25	-	25	150
7.5	Elective-II	4	-	1	3	100	25	-	-	125
7.6	Project-A	-	-	2	-	-	25	-	25	50
	TOTAL	**20**	**04**	**05**	-	**500**	**150**	**50**	**100**	**800**

Elective-II: 1. Bio-Technology
Technology

2. Polymer Engineering
Engineering

3. Food Process Engineering
Entrepreneurship Management

4. Petrochemical & Refining

5. Nuclear

6. Project Engineering &

COURSE: BE (CHEMICAL ENGINEERING)
SEMESTER: VIII

YEAR: BE

Sr. No.	Subject	Scheme of Instructions 1 Hr Periods			Duration of Papers Hrs	Scheme of Examination				
		Lecture	Practical	Tutorial		Theory Paper	Term Work/ Assignment/Test	Practical (with Oral)	Oral	Total

8.1	Environmental Engineering	4	2	-	3	100	25	25	-	150
8.2	Chemical Reaction Engineering	4	2	-	3	100	25	25	-	150
8.3	Modeling & Simulation in Chemical Engineering	4	2	-	3	100	25	25	-	150
8.4	Elective-III	4	-	-	3	100	25	-	-	100
8.5	Seminar	-	-	2	-	-	25	-	-	50
8.6	Project-B	-	4	-	-	-	50	-	50	100
	TOTAL	**16**	**10**	**02**	**-**	**400**	**175**	**75**	**50**	**700**

Elective-III: 1. Industrial Safety 2. Energy System Design

3. Membrane Process Design Technology 4. Pharmaceutical 5. Nanotechnology

Class: B.E. Chemical Engineering	**Semester: VII**		
Subject: 7.1 Chemical Processes-II			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
7.1.1	Module 01	
	INTRODUCTION: Unit Operations And Processes concepts Used In Chemical Industries. General principles applied in studying an industry. An overview on industries such as: vegetable oils & animal fats , Natural waxes / resins , ,essential oils & Flavor ingredients Industry , Food & Agro Products.	04
7.1.2	Module 02	

	Sugar & alcohol industries, starch industries, Paper & pulp manufacturing industries. Introduction to biodiesel processing. **Biodiesel**: Introduction to biodiesel processing, Transesterification Biodiesel process, Ingredients, Manufacturing process in detail.	05
7.1.3	Module 03	
	2. **BASIC BUILDING BLOCKS OF PETROCHEMICAL INDUSTRY** Treatment of Crude oils& the products there from; Refining vs. cracking; Manufacture of Ethylene, Propylene,Butenes ,Butadiene, Benzene – Toluene, Xylene , Isomerisation of Xylenes Separation of Xylene Isomers.	09
71.4	Module 04	
	3. **SYNTHESIS OF IMPORTANT HEAVY ORGANIC CHEMICALS & INTERMEDIATES** : Styrene , Cumene ,Phenol, Purified Terephthalic acid , Acetaldehyde &Acetic acid , Caprolactum , Vinyl Chloride , Chlorobenzene , Nitrobenzene	10
7.1.5	Module 05	
	SYNTHESIS OF POLYMERS: Polyethylene: LDPE, LLDPE & HDPE; Polyster Fibre, Nylon & PVC.	05
7.1.6	Module 06	
	OVER VIEW OF OTHER INDUSTRIALLY IMPORTANT PRODUCTS Paints, Varnishes & lacquers, Soaps & Detergents, Dyes & Intermediates, Agrochemicals ,Pharmaceuticals : Penicillin , Speciality Chemicals such as Perfume chemicals , Electronics grade chemicals , Speciality Polymers	06

Important note regarding content of instructions:

While discussing the manufacturing process, the following areas should be highlighted so that the relevance and application of the various subjects covered in the B.E. course can be underscored.

Chemistry, stoichiometry and alternate routes / raw materials involved Byproducts and purification / separation techniques.

Thermodynamics, kinetics and catalyst considerations for the process conditions Adopted

Energy considerations and conservation measures adopted .

Flow diagram and its concordance with the chemical and purification steps / Chemical Engineering Principals.

Chemical Engineering aspects of the process design / key equipment design and material of construction.

Safety and Environmental engineering aspects of the process of manufacture Recent trends in the design of processes which are more eco-friendly and inherently safer.

Major Engineering problems.

Theory Examination:-

1. Question paper will comprise of total 07 questions, each of 20 marks.
2. Only 05 questions need to be solved
3. Q.1 will be compulsory and based on the entire syllabus.

TERM WORK:

1. A minimum of 08 assignments should be given at regular intervals.
2. The performance of the students should be evaluated based on each assignment giving suitable weightage to punctuality & contents.
3. Point nos. 1 & 2 above should account for 15 marks (out of 25 marks) for term work.
4. Average of a minimum of two test should account for 10 marks (out of 25 marks) for term work
5. A minimum of two mandatory visits to chemical process industry. The faculty members are expected to accompany the students
6. Each student must prepare a four page report on the visit stressing on the process , environmental , safety measures , major equipments , process control equipments(if any) etc. while highlighting the information obtained.
7. The performance of the students during the visit and evaluation of the report together should contribute towards 10 out of 25 marks for term work.

Text Books:

1. Austin, G. T. “Shreve’s Chemical Process Industries “ 5 th Ed. , McGraw Hill

International Edition

2. Pandey, G. N. “A text book of Chemical Technology “ Vol. I and II. Vikas Publications, 1984

3. Rao, G. N. and Sitting , M. “ Dryden’s Outlines of Chemical Technology for 21st Century “East West Press, 3rd edition

Reference Books

1. Heaton, C. A. “ An introduction to industrial chemistry “ , Leonard Hill , 1984
2. Ibid , “ The chemical industry “ , ibid , 1986
3. Thomson , R. , “ Morden inorganic chemicals industries” , Royal Society of chemistry , 2nd ed. , 1994
4. Kirk-Othmer ‘s “ Encyclopedia of chemical technology “ , John Wiley and sons Inc., 4th ed. 1990
5. Ullmann’s “ Encyclopedia of Industrial Chemistry” , VCH, 1985
6. McKetta’s “ Encyclopedia of chemical processing and design “, Marcel Dekker, 1999
7. Pletcher , D. and Walsh , F. C. , “ Industrial Electrochemistry” , Chapman & Hall, 1990
8. Alok Adholeya and Pradeepkumar Dadhich, “Production and Technology of Biodiesel : seeding a change”., TERI Publication New Delhi.,2008
9. NIIR Board of consultants and Engineers. “The complete book on Jatropha (Biodiesel) with ashwagandha, stevia, brahmi and Jatamansi Herbs (cultivation, processing and uses)” Asia Pacific Business Press Inc.
10. N.S.Rathore, N.L.Panwar & A.K.Kurchania. “Jatropha: Cultivation & processing Practices”. Himanshu Pub., 2008.

B.E. CHEMICAL ENGINEERING (SEMESTER-VII)

7.2 Reaction Kinetics

Teaching Scheme: **Examination Scheme:**

Lectures: 4 Hrs./week Theory: 100 Marks, 3 Hrs.

Practical's: 2 Hrs./week Practical: 25 Oral: 25

Tutorials: Nil Term Work: 25 Marks

Total: 175 Marks

Detailed Syllabus:

Sr No	TOPICS	No of Hours
7.2.1	**MODULE 1** **A] INTRODUCTION** 1. Examples of various types of reactions. 2. Reversible Vs irreversible reactions. 3. Homogenous Vs heterogeneous reactions. 4. Catalytic Vs non-catalytic reactions 5. Auto catalytic reactions 6. Rate constants 7. Order/ molecularity. **B] REACTION KINETICS OF HOMOGENEOUS SYSTEMS** 1. Formulation and solution of rate equations for batch reactors for simple and complex reactions. 2. Effect of thermodynamic equilibrium.	**8 hrs**

	3. Temperature dependency-Various Theories. 4. Reaction mechanism and it influence on kinetics, search for plausible mechanism via reaction kinetics	
7.2.2	**MODULES 2 AND 3** **METHODS OF ANALYSIS OF EXPERIMENTAL DATA** For Constant volume & variable volume batch reactor 1. Integral method of analysis of experimental data. 2. Reversible and irreversible unimolecular, first order Reaction 3. Concept of half-life /fractional life. 4. Reversible and irreversible, bimolecular second order reactions. 5. Pseudo-First order reactions. 6. Empirical rate equation for n^{th} order reactions. 7. Over all order of irreversible reactions (INITIAL RATE METHOD) 8. Reversible and irreversible reactions in parallel. 9. Homogenous catalyzed reactions. 10. Auto Catalytic reactions. 11. Reversible and irreversible reaction in series. 12. Shifting order reactions 12. Differential method of analysis. 13 Analysis of complete rate of reactions. 14. Partial analysis of rate of reaction.	**16 hrs**
7.2.3	**MODULE 4** **A] HEAT AND PRESSURE EFFECTS**	**8 HRS**

	1. Temperature dependency of reaction rate constant. 2. Heat of reaction and its variation with temperature. 3. Variation of equilibrium constant and equilibrium conversion with temperature. 4. Effect of temperature on adiabatic and non-adiabatic conversion in batch reactor **B] PROPERTIES OF SOLID CATALYSTS** 1. Physical adsorption and chemisorption. 2. Surface area and pore size distribution.	
7.2.4	**MODULE 5** **CATALYTIC HETEROGENEOUS REACTIONS** 1. Langmuir-Hinshelwood model. 2. General mechanism of solid catalyzed fluid phase reactions. 3. Special cases when a. Film resistance controls. b. Surface phenomenon controls. c. Surface reaction controls d. Pore diffusion controls. 4. Intrinsic kinetics and various cases of adsorption and reaction stage controls. 5. Concept of effectiveness factor of catalyst and its dependence on catalyst properties and kinetic parameters.	**8 hrs**
7.2.5	**MODULE 6**	**10 hrs**

	A] NON-CATALYTIC HETEROGENEOUS REACTIONS **1. General mechanism of reaction.** 2. Various models. 3. Specific cases with respect a. Film diffusion controlling. b. Ash diffusion controlling. c. Chemical reaction controlling. **B] KINETICS OF FLUID-FLUID REACTIONS**. 1. Reaction with mass transfer.	

TERM WORK

1. A minimum of 05 assignments should be given at regular intervals.
2. The following parameters should be considered for laboratory performance evaluation
    a. Punctuality.
    b. Diligence
    c. Contents of journals (Originality of discussion)
        3. Points No. 1 and 2 above should account for 15 marks

(out of 25 marks for term work)

4 Average of the minimum of two tests should account for 10 marks (out of 25 marks) for term work

5 Each and every experiment should conclusively demonstrate/verify the theory. Experimental results should corroborate with theoretical /estimated/reported values. The students should explain variation between observed and expected results based on technical grounds and systematic error evaluations. Each experiment should contain the discussion

of the result obtained.

6. A minimum of 08 experiments should be performed. The suggested list is as follows

1. To study effect of concentration & temperature on reaction rate.

2. To study the saponification of ethyl acetate by sodium hydroxide in a batch reactor.

3. To determine the rate constant of acidic hydrolysis of methyl acetate

4. To determine of Arrhenius constants for acidic hydrolysis of methyl acetate

5. To study the pseudo first order reaction and find out the rate constant by differential analysis and integral analysis.

6. To investigate the acidic hydrolysis of sucrose

7. To determine void Volume, Porosity & Solid density of catalyst particle.

8. To investigate the reaction between H_2O_2 & HI and find out the order of reaction

9. To determine reaction rate constant for the reaction between potassium persulphate and potassium iodide.

10. To study the reaction between sodium thiosulfate & Hydrogen peroxide in an ADIABATIC BATCH REACTOR

11. To investigate the autocatalytic reaction between potassium permanganate and oxalic acid.

12. To study condensation polymerisation kinetics

TEXT BOOKS

1. Levenspiel, O.,"Chemical Reaction Engineering", 3rd Edition., John Wiley

& Co.

2. Smith J.M., "Chemical Engineering Kinetics", McGraw Hill.
3. Laidler, K.J., "Chemical Kinetics", Tata McGraw Hill, 1997.

REFERENCE

1. Hougen O.A., Watson K.M., " Chemical Process Principals", Part 3-Kinetics and Catalysis, John Wiley, 1964.

2. Hill C.G., "Chemical Reaction Engineering".
3. Walas, "Reaction Kinetics for Chemical Engineers", Mcgraw Hill, 1959.

Sharma M.M & L.K Doraiswamy, "Heterogenous Reactions", Vol 1

4. Fogler, H.S. "Elements of Chemical Reaction Engineering." 4th Edition,

PHI, 2008.

CLASS: B.E. CHEMICAL ENGINEERING		SEMESTER : VII	
SUBJECT : INSTRUMENTATION AND PROCESS CONTROL			
Periods Per Week (Each 60 Min.)	Lectures	04 Hrs/week	
	Practical's	02 Hrs/week	
	Tutorials	Nil	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	02	25
	Oral Examination	---	25
	Term Work	---	25
	Total		175

Detailed Syllabus		Lectur
7.3.1	Module 1 Concepts of Control Systems Feedback and Feed forward control, Dynamics of open-loop units, first, second and higher- order systems, interacting and non-interacting systems, Transfer functions and their properties.	08
7.3.2	Module 2. Dynamics of Control Loops. Open-loop and Closed-loop transfer functions, Dynamic behavior of closed-loop systems, Stability of control-loops, Routh's Criteria .	08
7.3.3	Module 3. Analysis of Control Loops. Root-locus methods, rules for plotting root-locus for negative feedback systems, Frequency response methods, Bode plots, Bode and Nyquist stability criteria.	08
7.3.4.	Module 4	

	Control System Design **Time domain specifications, Open and Closed-loop tuning, Use of control software like Simulink and Scilab in Control system analysis and design.**	**08**
7.3.5	**Module 5** **Control System Hardware** **Measuring instruments for flow, temperature, level and pressure. Control valve characteristics, sizing and selection of control valves**	**10**
7.3.6	**Module 6** **Strategies for Control in Practice.** **Advanced control strategies like ratio, cascade, distributed control and direct digital control. Applications to industrial units.**	**10**

Theory Examination:

1 Question paper will comprise of seven questions, each of 20 marks.

2 Only five question need to be solved.

3 Question one will be compulsory and it will be based on entire syllabus.

4 [One question will based on one modules] in this way there will be remaining

Six questions of 20 marks each out of four will have to solve.

Term Work:

1. A minimum of five assignments should be given at regular intervals.

2. The following parameters should be considered for laboratory performance evaluation.

A] Punctuality

B] Diligence

C] Contents of journal (originality of discussions)

3. Point nos. 1 and 2 above and the average of a minimum of two tests should account for term work.

4. Each and every experiment should conclusively demonstrate/verify the theory.

Experimental results should corroborate with theoretical/estimated/reported values. The students should explain variations between observed and expected results based on technical grounds and systematic error evaluations. Each experimental report should contain a discussion of the results obtained.

5. A minimum of 08 experiments distributed equitably with respect to the syllabus should be performed.

A suggested list is as follows:

1. Dynamics of a liquid level tank

2. Dynamics of a temperature measuring system.

3. Dynamics of a mixing process.

4. Dynamics of an under damped second order system.

5. Dynamics of interacting first order systems in series.

6. Dynamics of non interacting first order systems in series.

7. On-Off Controller

8. Proportional controller

9. Proportional + integral controller

10. PID controller

11. Tuning of P, PI and PID controllers for chemical engg. process systems.

Text Books:

1. Stephanopoulos, G., Chemical Process Control, Prentice Hall of India., 1990.

2. Coughnanowr., Process Systems Analysis and Control.

3. William L.Luyben, Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill International Edition. 1990.

4. Nakra B.C and K.K Chaudhary., Instrumentation, Measurement and analysis, Tata McGraw Hill, 1985.

5. James B.Rigs Chemical Process Control.

6. Principles of Industrial Instrumentation, D.Patranabis, TataMcGraw

Hill.

Reference Books:

1. Considine, Process/Industrial instruments and Control Handbook. McGraw Hill, 1993.

2. B.Wayne Bequette Process Control Modeling, Design and Simulation, Prentice Hall of India Pvt.Ltd.

3. B.Liptak, (Editor in Chief) Instrument Engineers' Handbook, Butterworth Heinemann.

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VII	
7.4 Process Engineering			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	--	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	---
	Oral Examination	-----	25
	Term Work	----	25
	Total	---	150

Sr. No.	Detailed Syllabus	Hours
7.4.1	Module 1 Design Process	
	Objectives, Design Opportunities and Design Team, Steps in Product and Process Design, Detailed Process Synthesis Using algorithmic Methods, Detailed Design, Equipment Sizing, Written Design Report, and Oral Presentation. Environmental Factors in Process Design and Design Approaches toward Safe Chemical Plants. Role of Computers, Spreadsheets, Mathematical Packages, Process Simulators, Computational Guidelines.	08
7.4.2	Module 2 Molecular Structure Design	
	Introduction, Property Estimation Methods, Computer Data Banks, Property Estimation	08
7.4.3	Module 03 Process Creation	
	Introduction, Preliminary Database Creation, Thermo Physical Property Data, Environmental and Safety Data, Chemical Prices, Preliminary Process Synthesis: Synthesis Steps, Continuous or Batch Processing, Examples	06
7.4.4	Module 04 Process Synthesis	
	Manufacture of Vinyl Chloride, Synthesis Tree, Development of the Base Case Design, Simulation to assist Process creation, Principles of Steady State Flowsheet Simulation, Process and Simulation Flowsheets, Unit Subroutines, Calculation order, Recycle, Recycle Convergence Methods, Flash with Recycle Problem, Flash Vessel Control, Equation Oriented Architectures.	08
7.4.5	Module 05	
	.Synthesis and Simulation of the Toulene Hydrodealkylation Process. Steady State Simulation of the Monochlorobenzene Separation Process. Principles of Batch Flow Sheet Simulation, Process and Simulation Flowsheets, Equipment Models	08
7.4.6	Module 06	
	Heuristics for Process Synthesis, Reactor Design and Reactor Network Synthesis: Reactor Models, Reaction Stoichiometry, Extent of Reaction, Equilibrium Kinetics: Ideal Kinetic Reaction Models- CSTRs and PFRs, Rector Design for Complex Configurations, Construction of the Attainable Region, The Principle OF Reaction Invariants.	06

TERM WORK:

1. A minimum of 08 assignments should be given at regular intervals.

2. The performance of the students should be evaluated based on each assignment giving suitable weightage to punctuality and contents (15 out of 25marks).

3. An average of a minimum of two tests should be account for term work (10 out of 25marks)

Text Books:

1. Sieder, W.D.,Seader J.D. & Lewin D.R., Process Design Principles : synthesis analysis & evaluation John Wiley & sons , 1998.
2. Walas, S.M " Chemical Process Equipment : selection & design, Butterworth , London , 1989.
3. "Conceptual Design of Chemical Processes".,J.M., Douglas, McGraw Hill International Editions , 1988.

Reference Books

1. "Strategy of process Engg." John D.F.Rudd & C.C. Watson. Wiley & Sons International, 1968.
2. Systematic Methods Of Chemical Process Design , Loren T Biegler , Grossman E.I., Westberg , A.W. Prentice Hall Intl ed.,1997.
3. Walas , S.M. "Phase Equillibria in Chemical Engg.", Butterworth , Boston 1985.
4. Perry J.H. & Chilton, "Perry's Chemical Engg. Handbook", 6th ed.,McGraw Hill , 1984 (or later ed.,when available).

B.E. CHEMICAL (SEM-VII)

Class: BE. Chemical Engineering	Semester: VII		
7.5 Elective - II: (i) Bio Technology			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
7.5.1	Module 1	
	Bio Technology Concept, Definition, Biotechnogy-an interdisciplinary pursuit, Public perception of Biotechnology, Biotechnology and the developing world? Classification of micro-organisms, the cell, its organelles and their respective functions, basic metabolism of cells, DNA- structure and function, RNA-structure and function.	06
7.5.2	Module 2:	
	Enzyme Technology: Proteins, Protein Structure & Function, Protein interactions, The nature of enzymes, application of enzymes, Technology of enzyme production, immobilized enzymes.	08
7.5.3	Module 03	
	Biotechnology and Medicine: Introduction, Pharmaceuticals and bio-pharmaceuticals, Antibiotics, Vaccines and monoclonal antibodies, gene therapy.	08
7.5.4	Module 04	
	Biotechnology and Environment: Introduction, Microbial ecology/ environmental biotechnology, waste water and sewage treatment, landfill technologies, composting, bioremediation, microbes and the geological environment, sustainability.	06
7.5.5	Module 05	
	Genetics and Biotechnology: introduction, Industrial genetics, protoplast and cell fusion technologies, genetic engineering, Introduction to Bio-informatics, potential lab biohazards of genetic engineering, Bioethics.	06
7.5.6	Module 06	
	Biotechnology in Agricultural, food and Beverage Industries: Introduction, Plant Biotechnology, Diagnostics in Agriculture, Food and Beverage Fermentation, Specialty Fermentation products e.g. biopolymers, bio-pesticides, miscellaneous microbial derived food products.	06

TERM WORK:

1. A minimum of 08 assignments involving a report based on literature survey and an oral presentation to the class on one of the assignments during tutorial sessions are envisaged. In addition numerical problems on various topics as included above.

2. The performance of the students should be evaluated based on report and presentations.

3. Point nos. 1 and 2 above along with an average of a minimum of two tests should account for term work.

TEXT BOOKS/ REFERENCE BOOKS

1. Shuller M.L. and F. Kargi. 1992. Bioprocess Engineering, Prentice-Hall, Englewood Cliffs, NJ.
2. Bailey. J.E. and Ollis D.F. 1986, Biochemical Engineering Fundamentals, 2nd Edition, McGraw-Hill, NewYork.
3. Kumar H.D., Modern Concepts of Biotechnology, Vikas Publishing House Pvt. Ltd.
4. Gupta P.K., Elements of Biotechnology, Rastogi Publications
5. Inamdar , Biochemical Engineering, Prentice Hall of India.

B.E. CHEMICAL (SEM-VII)

Class: BE. Chemical Engineering		Semester: VII	
7.5 Elective - II: (ii) Polymer Engineering			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Ho
7.5.1	Module 1	
	1. **Introduction: (3 Hrs.)** Defining polymers; Basic chemistry of polymers; Classification and types; Bonding in polymers, Molecular weight and molecular weight distribution; Thermoplastic / Thermosetting polymers, Elastomers, Resins, Adhesives, Coatings, fibers, Composites; Solvents, Solutions, Blends, Melts; Additives, Fillers; Examples of industrial and high performance polymers. 2. **Step-growth (condensation) polymerization**: **(3 Hrs.)** Features; Definition of functionality; Functionality principle, Derivation of Carother's	06

	equation; Effect of stoichiometric imbalance on molecular weight; mechanism; Kinetics	
7.5.2	Module 2:	
	Free –radical addition (chain –growth) polymerization: (6 Hrs.) Mechanism; Kinetics of homogeneous polymerization; Experimental determination of rate of polymerization; Instantaneous average chain lengths; Temperature dependence of chain length and rate; Gel effect or Auto acceleration; Kinetic chain length; Chain transfer; Inhibitors and Retarders.	08
7.5.3	Module 03	
	Copolymerisation Basic concept, Technical significance, steady state assumptions in free radical copolymerisation, The copolymer equation, Instantaneous molar composition of copolymer formed; Monomer reactivity ratios; Significance and method of determination, Types of copolymers; Variation of composition with conversion; Average, copolymer composition : cumulative composition of copolymer, Mechanism: Kinetics of Block and graft copolymers.	08
7.5.4	Module 04	
	Polymerization systems Design criteria, Bulk polymerization (quiescent and stirred) , solution polymersation, Suspension polymerization , Emulsion polymersation ; Smith- Ewart kinetics; Derivation from Smith – Ewart kinetics, Interfacial polycondensation; Comparison of the various processes – Advantages and disadvantages : Heat transfer and mixing in polymerization reactors.	06
7.5.5	Module 05	
	Polymer rheology and morphology Definition of rheology , Newtonian and non-Newtonian fluids – Flow curves , Apparent Viscosity , Power law , Viscoelasticity , free Volume or molecular hole concept , Definition of morphology, Requirements for crystallinity , Effects on mechanical and optical properties. Polymer degradation General types : thermal , mechanical , oxidative , hydrolytic , ultrasonic , high energy radiation – photo degradation, Antioxidants and stabilizers.	06
7.5.6	Module 06	
	Polymer processing Blow molding- injection molding- compression molding, Extrusion, Calendering – sheet forming or Thermoforming, casting, Coating: powder coating technique , Fluidized bed coating technique – Laminating , fiber spinning , biaxial orientation , Reinforced reaction injection molding , Filament winding , Pultrusion – design considerations with polymers-processing characteristics- Engineering challenges in processing.	08

TERM WORK:

1. A minimum of 08 assignments should be given at regular intervals.

2. The performance of the students should be evaluated based on each assignment giving suitable weightage to punctuality and contents.

3. Point nos. 1 & 2 above and an average of a minimum of two tests should be account for term work

Textbooks:

1. Gowarikar V.R. et.al., "Polymer Science" Wiley Eastern 1984.
2. Rodriguez F., " Principles of Polymer Systems " 2/e, Hemisphere McGraw Hill 1982
3. Ghosh P," Polymer Science & Technology of Plastics & Rubbers" Tata McGraw Hill 1990.
4. Crawford R.J.," Plastic Engineering"(Maxwell Macmillan International) 1987.

Reference Books:

1. Encyclopedia of Polymer Science & Engineering., Wiley 1988.
2. Rosen S.L. Fundamental Principles of Polymeric materials, 2nd e.d., John Wiley & Sons Inc.1993.
3. McCrum N.G et.al. ,Principles of Polymer Engineering , 2nd ed., Oxford Sciences 1997.
4. Rodrigues F., Principles of Polymer Systems McGraw Hill Book Co., 1970
5. Bhatnagar M.S., a Textbook of Polymers Vol.I , S.Chand & Co. Ltd.,New Delhi 2004
6. Bhatnagar M.S., a Textbook of Polymers Vol.II , S.Chand & Co. Ltd.,New Delhi 2004

B.E. CHEMICAL (SEM-VII)

Class: BE. Chemical Engineering		Semester: VII	
7.5 Elective - II: (iii) Food Engineering			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus
7.5.1	Module 1
	Introduction: Current status of the Indian a) agriculture b) Food Industry c) Food processing industry. Market opportunities for the Indian Processed Food Industry, Engineering challenged in the Food Processing Industry : Product and Process development , Major challenges in India , R & D Opportunit within the Food Industry.
7.5.2	Module 2:
	Basic Food Biochemistry and Microbiology: Food Constituents: Water, Proteins, Carbohydrates, Lipids, Vitamins, Minerals, Flavors, Nutritional & sensory characteristics, Food fortification. Water activity enzymes: Production from microorganisms and application in food processing, Lipid oxidation Growth of microorganisms and food spoilage, D & Z values, Food safety, Indian laws regulating Foods

	and Food Processing
7.5.3	Module 03
	Ambient Temperature Processing: Raw material preparation, Size reduction of solid fibrous foods an in liquid foods., Emulsification and Homogenization ,Theory and equipment , Mixing and Forming , Extraction and expression , Membrane concentration Fermentation : Theory , Types, Equipment Effect on foods.
7.5.4	Module 04
	Heat Processing using Heat or water: Theory, Equipment, Effect on foods, blanching, extrusion, pasteurization, Heat Sterilization, In-container Ultra high temperature (UHT)/aseptic processes.
7.5.5	Module 05
	1. Heat Processing using Hot air: Theory, Equipment, Effect on foods, Dehydration, Baking and Roasting. 2. **Heat Processing using Hot oils**: Theory, Equipment, Effect on foods Frying 3. **Heat Processing by direct & radiated energy:** Theory, Equipment, Effect on foods Dielectric heating microwave.
7.5.6	Module 06
	1. Processing by removal of heat: Theory, Equipment, Effect on foods chilling, freezing , freeze by drying and freeze concentration. 2. **Food Preservation & Storage Food contamination Modified Atmosphere Storage (MAS) Hurdl Technology.** **3. Post Processing Applications Packaging**: Modified Atmosphere packaging (MAP) , coating and enrobing , Filling & sealing of containers.

TERM WORK:

1. A minimum of 08 assignments should be given at regular intervals. Suggested topics for tutorials are: Numericals on pasteurization, Heat sterilization, Chilling freezing, Freeze-drying, Freeze-concentration, membrane concentration, Manufacturing and processing of the following topics should be covered: Fruit juice processing, Canned food, Jam & Jelly, Oil seed processing, Alcoholic beverages, Milk & milk products, Milk powder, Cheese, Ice-cream, Tea, coffee, cocoa, Soya products, protein isolates and concentrates, Bread, Biscuit, confectionary (hard boiled sweets and chocolates)

2. The performance of the students should be evaluated based on each assignment giving suitable weightage to punctuality and contents.

3. Point nos. 1 & 2 above and an average of a minimum of two tests should be account for term work

Text Book:

1. Fellows,P., Food Processing Technology: Principles and Practice , 2nd ed., Woodhead Publishing Ltd., England , 2000.

Reference Books:

2. Toledo,R.,Fundamentals of Food Process Engineering , 2nd ed., CBS Publishers & Distributors , New Delhi , 1997.

3. Sharma K., et.al.,Food Process Engineering, Theory and Laboratory Experiments , John Wiley and Sons Inc., Canada 2000.

4. Pandey and Srivastava , Chemical Process Technology , Vol.2

5. Singh,R.P. & Heldman , D.R., Introduction to Food Engineering, 3rd ed., Academic press, UK 2001.

6. Lelieveld, H.L.M., et.al., Hygiene in Food Processing , Woodhead Publ. Ltd., England 2003.

7. Subbulakshmi G. & Udipi S.A., Food Processing and Preservation, New age International Pvt.Ltd., India 2001.

8. Valentas, k.J.et.al., Food Processing Operations and scale up , Marcel Dekker,N.Y 1991.

9. Tamb,I.A. and Singh R.P., Food Storage Stability CRC Press 1998.

Course B.E (Chemical Engineering)

Year B.E Revised syllabus Semester VII

7.5 Elective –II: (iv) Petrochemical and Refining Technology.

LOAD PER WEEK:	LECTURES	: 4Hrs.
	PRACTICALS	: Nil.
	TUTORIALS	: 1Hrs.
EVALUATION SYSTEM:	Theory Examination	: 3 Hrs. 100 Marks
	Practical Examination	: ---
	Oral Examination	: --
	Term Work	: 25 Marks
	TOTAL	: 125 Marks

SCOPE: The subject intends to expose the students to the following. Formation of petroleum and origin. Petroleum processing data. Fractionation of petroleum. Treatment techniques and products specification. Thermal & Catalytical processes. Asphalt Technology.

Module 1:

Origin formation and composition of petroleum. Origin theory, Reserves and deposits of world. Types of crude and Indian crude types.Exploration-reserves, raw materials and transportation. (**5hrs)**

Module 2:

Refinery products & Feed Stocks. Overall Refinery Flow. Low Boiling products. Gasoline specifications. Fuels:-Distillate Fuels; Jet Fuels, Automotive Diesel Fuels. Oils:- Heating Oils, Residual Fuel Oils. Crude Oil Properties. Composition Of Petroleum, Crude suitable for Asphalt Manufacture.

Crude Distillation Curves, Distillation characteristics.Petrochemical feedstock

(**10Hr**s)

Module 3:

Fractionation of petroleum. Dehydration & Desalting Of Crudes. Heating of Crudes- Pipe still Heaters. Blending Of Gasoline. Over Lead corrosion in-Distillation unit.

(5Hrs)

Module 4:

. Treatment Techniques & Products specifications. Fraction-impurities. Treatment

of Gasoline Treatment of Kerosene Treatment of Lubes. Wax and Purification.

(**7Hrs)**

Module 5: . Catalytic Cracking & Thermal processes. Fluidised- Bed catalytic Cracking. Catalytic Reforming. Coking, Hydrogen Processes-Hydro cracking, Hydrosulpherization, Hydro-Treatment. Alkylation Processes, Isomerisation Processes, Polymer Gasoline.

(7Hrs)

Module 6:

. Asphalt Technology. Source of Asphalt. Air Blowing of Bitumen upgradation of

Heavy Crudes. Specialty products like Grease, liquid paraffin, paraffin jelly.

(4Hrs)

TERM WORK:

1. A minimum of 08 assignments involving a report based on literature survey and an oral presentation to the class during tutorial sessions are envisaged.
2. Suggested topics for tutorials are: Upgradation Techniques for petroleum products. Recent development in refining processes;. Synthetic zeolites used in FCC. ; Pollution due to refinery; scope of petrochemical Industry;. Indian petrochemical industry; Various Testing methods of Petrochemical Product; Various gases obtained for the refinery & their uses. Etc.
3. The performance of the students should be evaluated based on report and presentation.
4. Point nos. 1 & 2 above and an average of minimum of two tests should account for term work.

TEXT BOOKS:

1. "MODERN PETROLEUM REFINIG PROCESSES." B.K Bhaskara Rao.

REFERENCE:

1. **"**PETROLEUM REFINERY ENGINEERING" 4 Th ed; McGraw-Hill By W.L Nelson.
2. **"**PETROLEUM CHEMISTRY AND REFINING." Edited by – James G. speight, Taylor & Francies.
3. **"**CHEMICAL PROCESS INDUSTRIES." AUSTIN, G.T.Shreves.
4. Encyclopedia of chemical processing & design by john J. McKetta;Marcel Dekker,Inc.
5. Chemical Weakly for supply & Demand figures and current prices and price trends

B.E. CHEMICAL (SEM-VII)

Class: BE. Chemical Engineering		Semester: VII	
7.5 Elective - II: (v) Nuclear Engineering			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
7.5.1	Module 1	
	Nuclear Energy Fundamentals: Atomic structure and radio isotopes, radio activity, nuclear fission, nuclear fission reactors, History of reactor development, reactors for power production.	06
7.5.2	Module 2:	
	Nuclear reactions and radiations: radio activity, interaction of alpha and beta particles with matter, interaction of neutrons with matter, neutron cross section.	08
7.5.3	Module 03	
	Nuclear reactor theory: The neutron cycle, critical mass, neutron diffusion, the diffusion equation, flux distribution in a spherical and rectangular core, slowing down of neutrons, reactor period, transient conditions and reflectors.	08
7.5.4	Module 04	
	Engineering Considerations of nuclear Power: Extension of theory to design, design criteria, selection of materials, reactor fuel, moderator materials, coolant system, reactor control and operation, fuel preparation, reprocessing of spent fuel.	08
7.5.5	Module 05	
	Environmental effects :radiation hazards, radiation monitoring, radio waste treatment systems, reactor shielding.	06
7.5.6	Module 06	
	Safety: General Principles of reactor safety, rector protection system, reliability and risk assessment.	04

TERM WORK:

1. A minimum of 08 assignments involving a report based on literature survey and an oral presentation to the class on one of the assignments during tutorial sessions are envisaged. In addition numerical problems on various topics as included above.

2. The performance of the students should be evaluated based on report and presentations.

3. Point nos. 1 and 2 above along with an average of a minimum of two tests should account for term work.

TEXT BOOKS/ REFERENCE BOOKS

1. Nuclear Reactor Engineering, Samuel Glasstone and Alexander Seasonske, 3rd Edition, CBS Publisher, USA
2. Elements of Nuclear Engineering Glenn Murphy, John Wiley and Sons Inc.
3. Basic Nuclear Engineering, K Sriram,1990, Wiley Eastern Ltd.
4. Nuclear Power Technology, Vol I, II and III, W Marshall, 1983, Oxford University Press, New York.

B.E. CHEMICAL (SEM-VII)

Class: BE. Chemical Engineering		Semester: VII	
7.6 Elective - II: (vi) Project Engineering & Entrepreneurship Management			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	01	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	--
	Total	---	100

Sr.	Detailed Syllabus	Hours

No.		
7.5.1	Module 1	
	Introduction: Definition of project, Project Management, Project Life cycle, Project Types, Project over runs. The project manager Role & Responsibilities. Demands on PM	06
7.5.2	Module 2:	
	Project initiation: Feasibility reports of various types, Project selection criteria, Technology selection criteria, site selection criteria, Project Licensing, Basic &. Detailed engineering. Guarantees, Liabilities, Risk, Insurance, various types of estimates.	06
7.5.3	Module 03	
	1. Project clearances: Various Laws &. Regulations. List of various clearances, Intellectual property Rights, Patents need for clearances & its influence on project, Management, LOI. 2. Project organization: Various forms like pure project, matrix, and mixed type. Project Team, responsibilities of various members 3. Project planning: WBS: Responsibility charts, Contracts of various types. Role of Contractor, Sub-contractor, consultant, selection criteria & appointment procedure	08
7.5.4	Module 04	
	. Project scheduling & execution: CPM and PERT (Critical Path, Float, Total Float, AON, AOA Diagram), GANTT charts, LOB, Resource Allocation, ABC analysis, VED analysis, EOQ, CAT & RAT (Numerical problems included)	10
7.5.5	Module 05	
	Project monitoring &. Control: Time &. Cost control tools &. Techniques, fund flow Control, Project quality control- Importance of environmental &. Safety aspects, Project management systems Project termination: Commissioning. start UP: stabilization. close out	10
7.5.6	Module 06	
	Definitions of entrepreneurship, concept of entrepreneur & entrepreneurship, characteristics of Entrepreneurship, Aspect of entrepreneurship, environment for entrepreneurship. Factors affecting entrepreneurship. Classification & types of entrepreneurship**:** Classification depending on type of business, technology, Motivation, growth. Stages of development. **Management :** Concept of management , objective of, basic functions of management , emergence of management thought. Brief description of contribution by Fredrick Taylor, Henry Fayol , Elton Mayo & Gilbreth. Principles of organization , forms of organization : Line . Line & Staff . Functional & Matrix.	12

TERM WORK:

1. A minimum of 08 assignments should be given at regular intervals.

2. The performance of the students should be evaluated based on each assignment giving suitable weightage to punctuality and contents.

3. Point nos. 1 & 2 above and an average of a minimum of two tests should be account for term work

TEXT BOOKS:

1. S Choudhury, "PROJECT MANAGEMENT" Tata McGraw Hill
2. P K Joy, "TOTAL PROJECT MANAGEMENT " Macmillan
3. Jack Meredith and Samuel," PROJECT MANAGEMENT" a MANAGERIAL approach. John Wiley and sons.
4. R Hisrich & M P Peters , Entrepreneurship Tata McGraw Hill
5. Vasant desai, "Dynamics of entrepreneurial development & management", Himalaya Publishing House.

REFERENCE BOOKS:

1. Jhamb," INVENTAR Y MANAGEMENT" Everest publishing house.
2. J.K.Sharma." OPERATION RESEARCH" MacMillan
3. Enterpreneurship Development, Colombo Plan Staff College for Technical Education, Tata Mc Graw Hill.

B.E. CHEMICAL (SEM-VII)

Class: BE. Chemical Engineering		Semester: VII	
7.5 Project-A			
Periods Per Week (60 Min)	Lectures	--	
	Practical's	--	
	Tutorials	02	
		Hours	Marks
Evaluation System	Theory Examination	--	--
	Practical Examination	-----	--
	Oral Examination	-----	25
	Term Work	----	25
	Total	---	50

Detailed Syllabus:

1. Projects topics for semester VII are allotted at the beginning of the semester. The specific project topic can be of any one of the following categories.
    - Design of a process system for the manufacturing of a product.
    - Experimental work leading to development / refinement of a process resulting in a product / service.
    - Design of a process system to achieve a specific engineering objective.
2. A teacher / faculty member will be assigned as a supervisor to the project, while it is desirable to allot project each to individual students, the maximum number of students in a group not to exceed 3 (three)
3. For students in a group, the project should be so split up as to assigned individual team member specific subtasks for which that member will be uniquely responsible and on which performance of the member will be assessed.
4. The project work will be typically consisting of the following (based of type of project).
    - Critical survey of literature on the subject / books covering books, encyclopedia, patents, and journals.
    - Setting up of experimental apparatus, design of experiments, setting up analytical facility / protocol / procedure, data processing plan post experimentation.
    - Field work including visiting manufacturing industries / EPC companies for collecting relevant information for the project task.

5. Each student group is required to prepare a detailed typed report consisting of maximum 60 pages A4 size, inclusive of index, abstract, illustration, charts, P & ID and other diagrams, flow sheets, photographs, etc.

Term Work:

1. Term work evaluation of this work will base on monthly progress review. The monthly report filled each student will be considered for grading the term work.
2. The student will make an oral presentation of this report to his peers and a panel of at least three internal teachers including the supervisor. The assessment of this oral presentation will carry 40 % marks of term work.
3. The project oral of 25 marks is to be conducted as per rule by an approved internal and external examiner.

CLASS: B.E. CHEMICAL ENGINEERING VIII		**Semester-**	
SUBJECT: 8.1 Environmental Engineering			
Periods Per Week (Each of 60 minutes)	Lectures	04	
	Practical	02	
	Tutorial	Nil	
		Hours	Marks
Evaluation System	Theory Examination	03	100
Environmental Pollution	Practical Examination	03	25
	Oral Examination	----	----
	Term Work		25
	Total		150

Detailed Syllabus		**Lectures**
8.1.1	Module 1	06

	Introduction 1. Environmental pollution, Importance of environmental pollution control, Concept of ecological balance, Role of environmental engineer, Hydrological & nutrient cycles, Environmental Legislation & Regulations, Industrial pollution emissions & Indian standards, Water (prevention & control of pollution) act, Air (prevention & control of pollution) act	
8.1.2	Module 2 **Water Pollution** 8.1.2.1 Classification, sources & effect of water pollutant on human being & ecology, Sampling, measurement & standards of water quality, Determination of organic matters: DO, BOD, COD, TOC, Determination of inorganic substances: nitrogen, phosphorus, trace elements, alkalinity, Physical characteristics: suspended solids, dissolved solids, colour & odour, Bacteriological measurements.	07
8.1.3	Module 3 **Waste Water Treatment** 8.1.3.1 Primary treatment: pretreatment, settling tanks & their sizing, Secondary treatment: micro-organisms growth kinetics, aerobic biological treatment, activated sludge process, evaluation of bio-kinetic parameters, trickling filters, sludge treatment & disposal, Tertiary treatment: advanced methods for removal of nutrients, suspended & dissolved solids, Advanced biological systems, Chemical oxidation, Recovery of materials from process effluents.	07
8.1.4	Module 4 **Air Pollution** 8.1.4.1 Air pollutants, sources & effect on man & environment, acid rain, smog, greenhouse effect, Ozone depletion, global warming, Temperature lapse rate & stability, Plume behaviour, Dispersion of air pollutants, Gaussian plume model, Estimation of plume rise, Air pollution sampling & measurement, Analysis of air pollutants.	07
8.1.5	Module 5	07

	Air Pollution Control Methods & Equipment 8.1.5.1 Source correction methods for air pollution control, Cleaning of gaseous effluents, Particulate emission control, Equipment, system & processes for (a) Particulate pollutants: gravity settler, cyclones, filters, ESP, scrubbers etc. (b) Gaseous pollutants: scrubbing, absorption, adsorption, catalytic conversion	
8.1.6	Module 6 **Waste Management** 8.1.6.1 Solid waste including plastic, nuclear & hazardous waste management **Noise Pollution** 8.1.6.2 Noise pollution: measurement & control, effect on man & environment	06

Theory Examinations:

1. Question paper will comprise of 7 questions, each of 20 marks
2. Only 5 questions need to be solved
3. Question 1 will be compulsory and it will be based on entire syllabus
4. One question will based on one module. In this way there will be remaining 6 questions of 20 marks each. Out of that 4 questions need to be solved

Term Work:

Students are expected to perform at least 08 experiments from the following.

One test examination and five assignments are necessary for the complete term work.

The distribution of marks for term work shall be as follows:

Journal 05 marks

Test 10 marks

Effluent Treatment Plant Visit 10 marks

The final certification and acceptance of the term work ensures the satisfactory performance of practical work and minimum passing of the term work.

Practical Exam:

Term Work/Practical

A minimum of seven of the following experiments must be performed

1. Determination of dissolved oxygen
2. Determination of BOD
3. Determination of phenol
4. Determination of COD
5. Determination of metal (any one) in waste water
6. Determination of chloride ion in given water
7. Determination of turbidity in given sample
8. Measurement of particulate matter in air
9. Measurement of gaseous pollutant (any one) in air
10. Measurement of various types of residues or solids in the given sample
11. Measurement of sound level

TEXT BOOK

Rao, C.S.. "Environmental Pollution Control Engineering", New Age International (P) Limited

REFERENCE BOOKS

1. Peavy, H. S., Rowe, D.R., Tchobanoglous, G. "Environmental Engineering", McGraw-Hill Book Company Limited
2. Metcalf et al. "Waste Water Treatment, Disposal & Reuse", Tata McGraw Hill Publishing Company Limited
3. Mahajan, S.P. "Pollution Control in Process Industries" , Tata McGraw Hill Publishing Company Limited

B.E. CHEMICAL (SEM-VIII)

8.2 Chemical Reaction Engineering

Teaching Scheme: **Examination Scheme**:

Lectures: 4 Hrs./week Theory: 100 Marks, 3Hrs.

Practicals: 2 Hrs./week Practical: 25 Oral: Nil

Tutorials: Nil Term Work: 25 Marks

Total: 150 Marks

Detailed Syllabus:

No.	Topics	No. of Hours
8.2.1	MODULE 1 A] Introduction : Ideal batch reactor and concept of batch time flow reactor and concept of space time / space velocity and holding time / residence time. Ideal mixed flow reactor (MFR) and plug flow reactor (PFR). B] Design for single reactions : Single reactor performance of reversible and irreversible first order, pseudo first order, second order reactions for MFR, PFR. Graphical and analytical techniques.	10 Hrs
8.2.2	MODULE 2 A] Combination of reactors PFR in series / parallel, unequal size MFR in series, performance of the above for the first order and second order reactions. Recycle reactor and auto catalytic reactor. Problems based on semi batch reactor and recycle reactor are to be solved. B] Design for complex reactions : Irreversible reactions in series and parallel with same or different order in various combination. Reversible reactions in series parallel. Applications.	8 Hrs.
8.2.3	MODULE 3 Temperature and Pressure effects: Single reaction- endo / exothermic effects. Effect of temperature on thermodynamic equilibria and heat of reaction. Effect of temperature on reactor performance for adiabatic and non adiabatic operation. Case of exothermic reactions in mixed reactor, Optimum temperature progression. Multiple reactions- effect on product distribution. Temperature and scale effect on productivity of reactor. Various problems	8 Hrs

	based on design of non-isothermal reactor are to be solved by using various numerical methods.	
8.2.4	MODULE 4 Non-Ideal flow Reactor : Concept of residence time distribution, Segregation, micro and macro mixing in reactors. Methods of obtaining RTD, E, F, C curves, mathematical and experimental techniques. Models of non ideal flow-Dispersion model for the case of small or large extent of dispersion. Effect of dispersion on conversion for general irreversible reaction case. Recycle Model. Multi parameter models. Diagnostic methods of analysis of flow patterns in reactors. Discussion Role of micro and macro mixing and segregation in ideal (MFR, PFR) and non ideal reaction cases.	8Hrs
8.2.5	MODULE 5 A] Experimental reactors for heterogeneous Reactions B] Non-Catalytic Fluid Solid Reactions in Flow Reactors : (Excluding the portion covered under the reaction kinetics) Application to design of continues solid flow reactors, various design considerations, Application of fluid bed reactors and their design consideration, heat transfer effects.	8 Hrs
8.2.6	MODULE 6 A] Solid Catalyzed Fluid Phase Reactors : Phenomenon observed in operation of packed, fluid bed, slurry and such reactors. Product distribution in multiple and complex reaction. Thermal Effects, phenomena of stability, unstability and run away and it's analysis. Strategies for stable operation of reactors. Design consideration of fluid-solid catalytic reactors, incl. Fluid bed reactors. B] Design of gas-liquid and liquid-liquid and gas-liquid-solid Reactors: Heterogeneous reactors, Bubble heterogeneous reactors, cocurrent and counter-current flow packed bed reactors.	8 Hrs

TERM WORK

1) A minimum of Five assignments should be given at regular intervals.

2) The following parameters should be considered for laboratories performance evaluation

a) Punctuality b) Diligence c) Content of Journal (Originality of Discussion)

3) Point Nos. 1 and 2 above should be account for 15 Marks (Out of 25 Marks) for term work.

4) Average of two minimum two test should account for 10 marks (Out of 25 Marks) for term work.

5) Each and every experiment should conclusively demonstrate / verify the theory. Experimental result should corroborate with theoretical / reported / estimated values. The student should explain the variations between observed and expected results based on technical grounds and systematic error evaluation. Each experimental report should content a discussion of the result obtained..

6) A minimum of eight experiments should performed. A suggested list is given below

1. To study the Saponification of ethyl acetate in a constant flow stirred tank reactor (CSTR).
2. To study the Saponification of ethyl acetate in a Plug flow reactor (PFR).
3. To study first order reaction of Saponification of ethyl acetate in a Plug flow reactor (PFR).
4. To study first order reaction in 3 CSTRs connected in series.
5. To study the Saponification of ethyl acetate in a PFR-CSTR combination in series.
6. To study RTD characteristics of CSTR (impulse input/ step input).
7. To study RTD characteristics of packed column (impulse input).
8. To study RTD characteristics of PFR (impulse input).
9. To study RTD characteristics of packed column (step input).
10. To find the residence time distribution function for a step change in a PFR.
11. To study semibatch reactor

Note : For experimental no 1 to 5 the following are to performed

i) Conversion for various flow rate ii) Verification and Comparison for various reactors from experimental data by using formulae as well as graphical method. For experiments 6 to 11 comparison of all types of curves.

Text Books :

1. Smith J. M. “Chemical Reaction Engineering” 3/e Tata McGraw Hill, 1980.

2. Levenspiel D. “Chemical Reaction Engineering”, Wiley Eastern, 2/e, 1972.

3. Fogler H. S. “Elements of Chemical Engineering” PHI, 1972.

Reference Books:

1) Walas, “Reaction Kinetics for Chemical Engineer”, McGraw Hill, 1959.

2) Doraiswamy & Sharma, “Heterogeneous Reaction” Vol-1&2, John Wiley, 1984.

3) Walas “Chemical Reaction Engineering”, Hand Book of Solved problems, Gordon & Breach, 1995

4) Froment G. F. & Bischoff K. B. “Chemical Reactor Analysis and Design ” Wiley series in chemical engineering; 2nd Ed.

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VIII	
8.3 Modeling & Simulation in Chemical Engineering			
Periods Per Week (60 Min)	Lectures	04	
	Practical’s	02	
	Tutorials	--	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	25
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	150

Sr. No.	Detailed Syllabus	Hours
8.3.1	Module 1 Mathematical Models of Chemical Engineering System	
	Introduction, Uses of Mathematical Model, Scope of Coverage, Principles of Formulation, Fundamental Laws, Mathematical models, their classification (deterministic vs stochastic, linear vs nonlinear, lumped parameter vs distributed parameter, dynamic vs steady state with examples) Model building (writing down equations only)	08
8.3.2	Module 2 Process Models in Chemical Engineering	
	Series of Isothermal, Constant- Holdup CSTRs, CSTRs with Variable	08

	Holdups, Two Heated Tanks, Gas Phase, Pressurized CSTR, Nonisothermal CSTR, Batch Reactor, Reactor with Mass Transfer, Binary Distillation Column, Problems	
8.3.3	Module 03 Numerical Methods	
	1. Linear Algebric Equations; Crammers Rule,Gauss Elimination Methods, LU Decomposition, Gauss Seidal Iterative Method 2. Nonlinear Algebric Equations: Bisection Method, Newton Raphson Method, Secant Method. 3. Numerical Integration: Eulers Method, Runge Kutta Method(Ist, IVth)	06
8.3.4	Module 04	
	Simulation of single units (modules) Degrees of freedom (with and without system constraints. Coupling and decoupling of equations. Precedence ordering for Design /simulation (partitioning and tearing). Selection of design variables algorithm and persistent recycles.	08
8.3.5	Module 05	
	Simulation of complete flow sheet. Degrees of freedom for flow sheet with connecting equations. Approaches to simulation (i) Sequential modular. Precedence ordering of modules (partitioning and tearing of flow sheets) (ii) Simultaneous Modular with linearized modules.	08
8.3.6	Module 06	
	Simulation Examples :Gravity Flow Tank, Three CSTR in Series, Nonisothermal CSTR, Binary Distillation Column, Batch Reactor	06

TERM WORK:

1. A minimum of Five assignments should be given at regular intervals one must include modeling of a process unit not available in text-books.
2. the following parameters should be considered for laboratory performance evaluation. A) punctuality B)diligence c) contents of journal (originality of discussions)
3. point nos 1 and 2 above along with an average of a minimum of two tests should account for 10 marks (out of 25 works) for term work.

PRACTICALS

Minimum 08 practicals has to be performed.In Practical Examination students must be able to Simulate any of the following Process Equipment Using Computer Programm or Simulation Package like Aspen Plus/ Design-II/ Chemcad/ GPROMS etc.

SUGGESTED PRACTICALS

1. Equations of state using Newton's method
2. Equation of state using successive substitution method
3. Regression for parameter estimation using a set of data points
4. Equilibrium flash distillation (Multicomponent Ideal)
5. Batch Reactor
6. Three CSTR in Series Stage wise contacting equipment
7. Solving a simple flow sheet by simultaneous approach
8. Simulation of batch Distillation(binary ideal).
9. Gravity Flow Tank
10. Heat Exchanger
11. Plug Flow Reactor
12. Use Design II/ chemcad/ Aspen Plus in simulation or similar software for simulation

Text Books:

1. Process Modelling, Simulation and Control for Chemical Engineers, by William Luyben, McGraw Hill, Second Edition.
2. Chemical Process Dynamics, John Ingham, Irvin Dunn,VCH Publication, Cambridge.
3. Process Simulation & Control using Aspen, Amiya K Jana, Prentice Hall of India
4. Numerical Methods and Modelling for Chemical Engineers, Davis M.E. ,Wiley, New York 1984
5. Basic Principles and Calculations in Chemical Engineering, David M. Himmelblau, Sixth Edition,Prentice Hall India.

Reference Books

1. Applied Mathematics in Chemical Engineering by H.S.,Mickley.,T.S. Sherwood.,and C.S.Reed,second edition, Tata MacGraw Hill New Delhi 1975
2. Process Dynamics by Wayne Bequette Prentice Hall Internationals Inc., 2000
3. Systematic Methods of Chemical Process Design by Lorenz T.Beigler, E. Ignacio

Grossman and Arthur W. Westerberg Prentice Hall International Inc 1997

4. Numerical Methods for Engineers, Santosh Kumar Gupta, Tata McGraw hill, 1995

8.4 Elective - III: (i) Industrial Safety			
Periods Per Week (Each 60 Min.)	Lectures	04 Hrs/week	
	Practicals	Nil	
	Tutorials	01 Hrs/week	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	Nil	---
	Oral Examination	Nil	---
	Term Work	---	25
	Total		125

Detailed Syllabus		Lectures
8.4.1	**Module 1** **Introduction** : Concepts, Definitions. Safety Program, Types of accidents. Causes, direct and indirect effects if accidents. Types of damages. Role of safety consideration in Chemical plant Design and Operation. Protective and safety equipments. Measure of risk liabilities of accidents laws. Rules and regulation for prevention of accidents. Disaster control organization, OSHA, Process Safety Management.	07
8.4.2	**Module 2** **Toxicology and industrial hygiene**. Typical toxins and their biological effects. Outline of their ingestion to and elimination from biological system. Toxicological parameter – Their definitions and outline of the measurement methods. Evaluation exposure to toxicants and its impacts. Source models release and flow of toxic gases and liquids flashing liquids. Dispersion models- Factor affecting dispersion and their modeling. Design and equipments for protection of toxic release in Chemical plants. Management of toxic release scenario.	07
8.4.3	**Module 3.** **Fire and Explosion** : The fire triangle and the factor contributing to fire and explosion. Definitions, Relevant materials, characteristics and properties. Concept of	07

	Ignition, Ignition energy. Phenomenon and source of ignition, auto ignition, auto oxidation, adiabatic compression, electrostatic ignition. Role of fuel spray, mists dusts on ignition process. Explosions: various types and conditions for their occurrences. Inerting and Purging of equipments, ventilation of rooms, control of static electricity process control system, Sprinkler system, Fire fighting system.	
8.4.4.	**Module 4** **Relief and Relief system** : Definitions. Relief requiring scenario. Relief's types and location. Relief's systems, various options and their sizing and application for single and multiple flows. Deflagrations venting for dusts and vapors explosions. The role of Mechanical integrity in Chemical Process Safety.	06
8.4.5	**Module 5** **5.1 Hazards Identifications**. HAZOP, HAZAN and such methods. Safety review and other methods, example. Safety audits. Process Hazards Checklist, Hazards Surveys. **5.2 Risks Assessment**: Review of probability theory in respect of failures, coincidences etc. leading to unsafe situations. Concepts of event tree and fault tree. Analysis of trees of risk assessment, its advantages and disadvantages for simple examples of application of risk assessment technique.	07
8.4.6	**Module 6** **6.1 Accidents Investigation** : Learning from accidents. Methods of investigating and diagnosing aids for recommending. Root Cause and Root Cause Analysis, Case studies of well known accidents such as Flixborough, Bhopal, Seveso Italy, Pasadena Texas etc. **6.2 Safety Management**: The essence of safety management, the challenge to safety management. Function of safety management.	06

Theory Examination:

1 Question paper will comprise of seven questions, each of 20 marks.

2 Only five question need to be solved.

3 Question one will be compulsory and it will be based on entire syllabus.

4 [One question will based on one modules] in this way there will be remaining Six questions of 20 marks each out of four will have to solve.

Term Work:

1. A minimum of 08 Tutorials involving a report based on literature survey and an oral presentation to the class on topic from any one Tutorial during tutorial session is envisaged. In addition numerical problems on various topics as included above.
2. The performance of the students should be evaluated based on report and presentations.
3. Points no 1 and 2 above with an average of a minimum of two tests should accounting for term work.
4. One compulsory Industrial Visit with respect to safety aspect.

TEXT BOOKS:

1] Crowl D. Y, Louvar J.F. "Chemical Process Safety Fundamentals with Applications" Prentice Hall, Englewood, 1990.

2] Pandya C.L, Hazards in Chemical Units, Oxford ISH 1991.

3] Grimaldi J. H, Simonds, R.H, "Safety Management. 5/e AITBS, Delhi,1990

4] Roy E. Sandlers, "Chemical Process Safety", Learning from Case Histories, Butterworth, 1999.

REFERENCE BOOKS:

1] Kleitz T.A, "What went wrong?" 3/e, Gulf publishing 1995.

2] Lees F.P, “Loss Prevention in Process Industries” Vol 1-2 and 3,

Butterworth 1995.

3] Safety Related Acts, Rules and Regulations.

4] Gupta R. S. “Handbook of Fire Technology”: Orient Longman, 1993.

5] Withers, J, “Major Industrial Hazards-Their Appraisal & Control,” Wiley, New Delhi, 1988.

6] CLRI, “Hazard Assessment & Disaster Mitigation in Chemical Process Industries,” Oxford IBH, 1994.

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VIII	
8.4 Elective - III: (ii) Energy Systems Design			
Periods Per Week (60 Min)	Lectures	04	
	Practical’s	----	
	Tutorials	---	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
8.4.1	Module 1	
	Energy Audit: Introduction; methodology and steps taken; Target setting, Reduction in losses, Improvements in the operations, Operating equipment near its best efficiency, more efficient equipment; preventive maintenance for energy efficiency; high frequency equipments. Energy efficient process technologies.	08
8.4.2	Module 2:	

	Energy Integration in the Process Industries: Design Of Heat Exchanger Networks (HENS): Minimizing utilities in heat Temperature interval method using graphical displays. Linear Programming method. Stream matching at minimum utilities. Stream matching at the pinch concepts of optimum approach temperature, Superstructures for minimization of annualized cost.	08
8.4.3	Module 03 Heat Integration in Process Units:	
	Multiple Effect Evaporators: With and without vapor recompression. Distillation Column: Effect of pressure on heat integration, multiple effect distillation, Heat pumping, vapor recompression and reboiler flashing, Superstructures for minimization of annualized cost.	06
8.4.4	Module 04 Heat Integration in Process Units:	
	Distillation Column: Effect of pressure on heat integration, multiple effect distillation, Heat pumping, vapor recompression and reboiler flashing, Superstructures for minimization of annualized cost.	06
8.4.5	Module 05	
	Co-generation of Energy: Introduction, advantages of co-generation, Waste heat boilers, Different types of co-generation power plants, Steam turbine systems, Gas turbine systems. Combined gas steam turbine systems, Diesel engine systems. (8 Hrs.)	08
8.4.6	Module 06	
	Renewable sources of energy: Solar energy- Photo voltaic cells, solar boilers, solar refrigerators, Wind energy; Fuel cells; Biogas, Biodiesel, Biomass gasification etc. Introduction to Tidal, Geothermal sources of Energy, Comparison with Nuclear Energy.	06

Term Work:

1. A minimum of 08 Tutorials involving a report based on literature survey and an oral presentation to the class on topic from any one Tutorial during tutorial session is envisaged. In addition numerical problems on various topics as included above.

2. The performance of the students should be evaluated based on report and

presentations.

3 Points no 1 and 2 above with an average of a minimum of two tests should accounting for term work.

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TEXT BOOKS:

1. Seider W. D., and Seader J. D. and Lewin D. R., "Process Design Principles", John Wiley and Sons. Inc., 1988.

2. Douglas J. M. "Conceptual Design of Chemical Process", McGraw Hill Book Co., 1988.

3. Biegler L. T., Grossman E. I. and Westerberg A. W., "Systematic Methods of Chemical Process Design", Prentice Hall International Ltd., 1997.

REFERENCE BOOKS:

1. Larmine James, "Fuel Cells Explained", John Wiley and Sons., 2000.

2. Kreith F., "Principles of Solar Energy", McGraw Hill Book Co., 1978.

3. Freris L. L., "Wind Energy Conversion System", Prentice Hall, 1990.

4. Turner, "(Ed.) Energy Management Hand Book", John Wiley and Sons., 2000

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VIII	
8.4 Elective - III: (iii) Membrane Process Design			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	----	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
8.4.1	Module 1	
	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, nanofiltration, reverse osmosis, piezodialysis, electrodialysis, dialysis, and membranes for gas separation, pervaporation. Applications of these processes.	10
8.4.2	Module 2:	
	1.Liquid membranes supported and unsupported liquid membranes, applications and mathematical modeling. 2. Materials and material properties. Polymers and effect of various properties of polymers such as T_g , thermal, chemical and mechanical stability, elastomers and their properties, Inorganic membranes, biological membranes.	07
8.4.3	Module 03	
	1.Characterization of membranes: Characterization of porous membranes, characterization of ionic membranes, characterization of non-ionic membranes. 2. Preparation of synthetic membranes. Preparation of phase inversion membranes. Preparation techniques for immersion precipitation, preparation technique for composite membranes, Influence of various parameters on membrane morphology, preparation of inorganic membranes.	06
8.4.4	Module 04	
	1.Transport processes in membranes driving force, Transport through porous membranes, transport through nonporous membranes, transport in ion-exchange membranes. 2.Polarization phenomenon and fouling concentration polarization, characteristic flux behavior in pressure driven membrane operation, various models, temperature polarization, membrane fouling, methods to reduce fouling.	06
8.4.5	Module 05	
	1.Modules and process design Plate and frame, spiral wound, tubular, capillary, hollow fiber modules and their comparison, system design. 2.Membrane reactors. Application of membrane reactors in biotechnology.	06
8.4.6	Module 06	
	Economics and feasibility of membrane technology. Comparison of membrane technology with other separation techniques, Scope in the future, current and existing industrial applications	06

Term Work:

1. A minimum of 08 Tutorials involving a report based on literature survey and an oral presentation to the class on topic from any one Tutorial during tutorial session is envisaged. In addition numerical problems on various topics as included above.
2. The performance of the students should be evaluated based on report and presentations.
3 Points no 1 and 2 above with an average of a minimum of two tests should accounting for term work.

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TEXT BOOKS:

1. Marcel Mulder, "Basic Principles of Membrane Technology", Kluwer Academic Publishers (1997).

2. E. J. Hoffma, "Membrane Separation Technology", Gulf Prefession Publishing.

3. Nath,"Membrane Separation Processes", Prentice Hall of India

REFERENCE BOOKS:

Membrane Handbook – Editors W. S. Winston Ho, K. K. Sirkar, Van Nostrand Reinhold Publication.

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VIII	
8.4 Elective - III: (iv) Pharmaceutical Technology			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	---	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
8.4.1	Module 1	
	Development of drugs and pharmaceutical industry, organic therapeutic agents uses and economics. Drug metabolism physio chemical principles – radioactivity- pharma kinetics- action of drugs of human bodies.	08
8.4.2	Module 2:	
	Chemical conversion process, Alkylation, carboxylation, condensation and cyclisation, dehydration, esterification, halogenation, oxidation, sulforation, complex chemical conversion, fermentation.	08
8.4.3	Module 03	
	Compressed Tablets, wet granulation, dry granulation, direct compression, tablet presses formulation.	06
8.4.4	Module 04	
	Coating, pills, capsules sustained action dosages forms, parenter solutions, oral liquids, injections, cirtmerts, standards of hygiene's and good manufacturing practice.	06
8.4.5	Module 05	
	Vitamins, cold remedies, laxatives, analgesic, non steroical contraceptives, external antiseptics, antacids and others.	06
8.4.6	Module 06	
	Antibiotics, biologicals, harmones, vitamins, preservations, analytical methods or test for varios drugs and pharmceuticals packing, packing techniques, quality control.	08

Term Work:

1. A minimum of 08 Tutorials involving a report based on literature survey and an oral presentation to the class on topic from any one Tutorial during tutorial session is envisaged. In addition numerical problems on various topics as included above.
2. The performance of the students should be evaluated based on report and presentations.
3 Points no 1 and 2 above with an average of a minimum of two tests should accounting for term work.

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TEXT BOOKS/ REFERENCE BOOKS

1. E.A. Rawlines Bertleys Text books of pharmaceuticals III edition, billieere Tincall, London, 1977.
2. S.H. Yalkorsky and J. Swarbrick, Drugs and Pharmaceutical Science Volume I,II,III,IV,V,VI and VII Marcel Dekar Inc. New York 1975
3. Remingtons Pharmaceutical Sciences, Mark Publishing Co.

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VIII	
8.4 Elective - III: (v) Nano-Technology			
Periods Per Week (60 Min)	Lectures	04	
	Practical's	----	
	Tutorials	---	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical Examination	-----	-----
	Oral Examination	-----	-----
	Term Work	----	25
	Total	---	125

Sr. No.	Detailed Syllabus	Hours
8.4.1	Module 1	
	Fundamentals of Science behind Nanotechnology – 4 Hours • Electron , Atom & Ions , Molecules, Metals • Biosystems • Molecular Recognisation • Electrical Conduction & Ohm's Law • Quantum Mechanics and Quantum Ideas • Optics	04
8.4.2	Module 2:	
	Fullerenes – 6 hours • Combustion Flame Synthesis • Crystal Formation • Sintering • Organic Synthesis Method • Super Critical Oligomerization • Solar Process • Electric Arc Process	06
8.4.3	Module 03	
	Carbon NanoTubes (CNT) – 6 Hours	06

	• Synthesis of CNT
	  • Electric Arc Discharge Process
	  • Laser Ablation Process
	  • CVD
	  • HIPCO Process
	  • Surface Mediated growth of Vertically Aligned Tubes
	• Physical Properties of CNTs
	• Morphology of CNT	

8.4.4	Module 04	
	Nanostructuring Methods – 8 Hours • Vacuum Synthesis • Gas Evaporation Tech • Condensed Phase Synthesis • Sol Gel Processing • Polymer Thin Film • Atomic Lithography • Electro deposition • Plasma Compaction **Characterization of Nanostructures – 4 Hours** • Transmission Electron Microscope • Scanning Electron Microscope • Microwave Spectroscopy • Raman Microscopy • X ray Diffraction	12
8.4.5	Module 05	
	Calculations in Nanotechnology – 5 Hours • Particle Size Distribution • Particle Size & Measurement Methods • Fluid Particle Dynamics • Particle Collection Mechanisms • Particle Collection Efficiency	05
8.4.6	Module 06	
	NanoBiology- 4 Hours	08

	• Interaction between Biomolecules & Nanoparticle Surface • Influence of Electrostatic Interactions in the binding of Proteins with Nanoparticles • The Electronic effects of bimolecule - Nanoparticle Interaction • Different Types of Inorganic materials used for the synthesis of Hybrid Nano-bio assemblies • Application **Catalysis- 4 Hours** • Nature of Catalysis • Surface area of NanoParticles • Porous Materials • Pillared Clay • Colloids	

Term Work:

1. A minimum of 08 Tutorials involving a report based on literature survey and an oral presentation to the class on topic from any one Tutorial during tutorial session is envisaged. In addition numerical problems on various topics as included above.
2. The performance of the students should be evaluated based on report and presentations.
3 Points no 1 and 2 above with an average of a minimum of two tests should accounting for term work.

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Text Books

1. Nanostructuring Operations in NanoScale Science and Engineering-Kal Ranganathan Sharma, McGraw-Hill Companies,
2. Nanotechnology: Basic Calculations for Engineers and Scientists – Louis Theodore, A John Willy & Sons

3. Nanotechnology: A Gentle Introduction to the Next Big Idea-By Mark Ratner, Daniel Ratner
4. Nano-The Essentials, Understanding Nanoscience and Nanotechnology, T.Pradeep-
5. Introduction to NanoTechnology- Charles P. Poole, Jr. and Frank J. Owens, John Wiley & Sons,2003

Reference Books

1. Nanotechnology: Basic and Emerging technologies – Michael Wilson ,Chapman & Hall/CRC-Rs,3311.93
2. Principal of NanoTechnology-Molecular Based Study of Condensed Matter in Small Systems –G .Ali Mansoori
3. NanoTechnology Assessment and Prospective -Schmid et al.,Springer

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering	Semester: VIII		
8.5 Seminar			
Periods Per Week (60 Min)	Lectures	--	
	Practical's	--	
	Tutorials	02	
		Hours	Marks
Evaluation System	Theory Examination	--	--
	Practical Examination	-----	--
	Oral Examination	-----	--
	Term Work	----	25
	Total	---	25

Detailed Syllabus:

1. Each one of the students will be assigned a Seminar Topic in the current and frontier areas of Chemical Engineering Research or Practice. The student has to conduct a detailed study/survey of the material available on the assigned topic and prepare a report, running to 30 to 40 pages. The student will make an oral presentation for a period of about 20 Minutes, followed by a brief question and answer session. The Seminar (Presentation and Report) will be evaluated by the panel of Two Internal Examiners for a total of 10 marks.

2. The Project Guide will guide the Seminar and the student will make monthly progress reports to the guide, which will be considered for term work grading of 15 marks.

B.E. CHEMICAL (SEM-VIII)

Class: BE. Chemical Engineering		Semester: VIII	
8.6 Project-B			
Periods Per Week (60 Min)	Lectures	--	
	Practical's	04	
	Tutorials	--	
		Hours	Marks
Evaluation System	Theory Examination	--	--
	Practical Examination	-----	--
	Oral Examination	-----	50
	Term Work	----	50
	Total	---	100

Detailed Syllabus:

1. The topic and team for the project will be continued from semester VII. In case of more than one student being in the team, the topic will be subdivided in such a way that each of the student will have at least one distinct sub task for which that team member will be solely responsible and on the performance of which he will be graded.

2. Each student group will prepare a detailed, typed project report containing a maximum of 100 pages A4 size, inclusive of index, abstract, illustrations, charts, P and ID and other diagrams, flow sheets, photographs, etc. The report will contain a brief summary of the earlier report submitted at the end of semester VII.

3. A) In case of a project involving the design of a process system leading to a product, the

report will include:

- Material and Energy balances
- Detailed process design and HAZOP of one major equipment per student/ process
- P and ID/ Flow diagram
- Cost and feasibility Analysis

B) In case of project involving experimentation, the report will list all the experimental data, analysis of data, conclusions drawn and discussion on how the conclusions are supported by the experimental data and its analysis.

Some discussion on the utility of the work done for design of a full-scale plant/ possibility of scale up should be presented.

C) In case of a project consisting of developing a process system leading to a service, the project report will enunciate the objective, details of specifications/ recommendations, adequacy of the proposed system, methods to check the adequacy performance, comparison vis-à-vis existing systems should be discussed.

Term Work:

1. The student will make monthly progress reports to the guide, which will be considered for term work grading. An oral presentation to peers and a panel of senior faculty towards the end of the term is a must. The oral presentation shall carry 40 % of the marks allocated for term work.
2. The project orals will be conducted as per rules, by an internal examiner and external examiner from industry or academia, and would be based on the final project report.

COURSE: CHEMICAL ENGINEERING

YEAR: B.E. SEMESTER :VII (Old)

Sr.No.	**Subject** **Old (R 2001)**	**Equivalent Subject** **New Revised Syllabus (R 2007)**
1	Chemical Processes-II	Chemical Processes-II (Sem VII)
2	Process Engineering	Process Engineering (Sem VII)
3	Instrumentation & Process Control	Instrumentation & Process Control (Sem VII)
4	Chemical Reaction Engineering	Chemical Reaction Engineering(Sem VIII)
5	Entrepreneurship & Management	No Equivalence, so same subject to be appeared i.e. Entrepreneurship & Management of R – 2001
6	Project – A	Project – A (Sem VII)
7	**Elective – II**	
	i. Biochemical Engineering	Bio-Technology (Sem VII)
	ii. Polymer Engineering	Polymer Engineering (Sem VII)
	iii. Food Process Engineering	Food Process Engineering (Sem

		VII)
	iv. Petrochemical & Refining Technology	Petrochemical & Refining Technology(Sem VII)

COURSE: CHEMICAL ENGINEERING

YEAR: B.E. SEMESTER :VIII (Old)

Sr.No.	**Subject** **Old (R 2001)**	**Equivalent Subject** **New Revised Syllabus (R 2007)**
1	Environmental Engineering	Environmental Engineering (Sem VIII)
2	Project Engg & Management	Project Engineering & Entrepreneurship Management (Sem VII)
3	Industrial Safety	Industrial Safety (Sem VIII)
4	Process Simulation & Design	Modeling & Simulation in Chemical Engineering (Sem VIII)
5	Elective-III	
	i. Multiphase Reactor Design	No Equivalence, so same subject to be appeared i.e. Multiphase Reactor Design R – 2001
	ii. Energy System Design	Energy System Design (Sem VIII)
	iii. Adsorptive Process Design	No Equivalence, so same subject to be appeared i.e. Adsorptive Process Design

		of R – 2001
	iv. Membrane Process Design	Membrane Process Design (Sem VIII)
6	Project – B	Project-B