SHIVAJI UNIVERSITY, KOLHAPUR

SYLLABUS

Final Year B.Tech.

in

CHEMICAL ENGINEERING

(To be implemented From JUNE 2020-21 onwards)

Final Year B.Tech (CHEMICAL) – CBCS PATTERN

SEMESTER –VII																								
Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME													
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL			TERM WORK				
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Max	Min	Hours	Max	Min			
1	PCC-CH701	4	4	4	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines	25	10	2	25	10			
2	PCC-CH702	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40		-	-		-	-			
3	PCC-CH703	4	4	4	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10			
4	PCC-CH704	4	4	4	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10			
5	PCE-CH705	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40		-	-	2	25	10			
6	MC-CH706	-	-	-	-	-	-	1	2	2		-	-	-	-		-	-	2	25	10			
7	MC-CH707	-	-	-	-	-	-	1	2	2		-	-	-	-		-	-	2	25	10			
8	SI-CH708	-	-	-	-	-	-	-	-	-		-	-	-	-		-	-	2	25	10			
9	PW-CH709	-	-	-	-	-	-	2	4	4		-	-	-	-		25	10	2	25	10			
	TOTAL	**18**	**18**	**18**	**-**	**-**	**-**	**7**	**14**	**14**				**500**			**100**			**200**				
SEMESTER –VIII																								
1	PCC-CH801	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines	25	10	2	25	10			
2	PCC-CH802	3	3	3	1	1	1	-	-	-		CIE ESE	30 70	100	40		-	-		-	-			
3	PCC-CH803	4	4	4	-	-	-	-	-	-		CIE ESE	30 70	100	40		-	-	2	25	10			
4	PCE-CH804	4	4	4	-	-	-	-	-	-		CIE ESE	30 70	100	40		-	-	2	25	10			
5	PCE-CH805	4	4	4	-	-	-	-	-	-		CIE ESE	30 70	100	40		-	-		-	-			
6	PCC-CH806	1	1	1	-	-	-	1	2	2		-	-	-	-		25	10	2	25	10			
7	PW-CH807	-	-	-	-	-	-	3	6	6		-	-	-	-		75	30	2	75	10			
	TOTAL	**19**	**19**	**19**	**1**	**1**	**1**	**5**	**10**	**10**				**500**			**125**			**175**				
	TOTAL	**37**	**37**	**37**	**1**	**1**	**1**	**12**	**24**	**24**				**1000**			**225**			**375**				

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for Final Year B.Tech Sem VII & VIII : **1600**
• Theory and Practical Lectures : 60 Minutes Each	• Total Credits for Final Year B.Tech Sem VII & VIII : **50**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

Note:

1. **PCC-CH:** Professional Core course –Chemical Engineering are compulsory.
2. **PCE-CH:** Professional Core Elective –Chemical Engineering are compulsory.
3. **SI-CH:** Summer Internship-Chemical Engineering is compulsory.
4. **PW-CH**: Project work- Chemical Engineering is compulsory.
5. **MC-CH:** Mandatory Course- Chemical Engineering is compulsory

COURSE CODE AND DEFINITION

Sr. No.	**Course code**	**Definitions**
1	BSC	BASIC SCIENCE COURSES
2	PCC	PROFESSIONAL CORE COURSES
3	MC	MANDATORY COURSE
4	ESC	ENGINEERING SCIENCE COURSES
5	PCE	PROFESSIONAL CORE ELECTIVES
6	SI	SUMMER INTERNSHIP
7	PW	PROJECT Work
8	MP	MINI PROJECT WORK
9	OEC	OPEN ELECTIVE COURSES
10	HM	Humanities and Management

Semester VII

Sr. No	Code No.	Subject	Semester	Credits
1.	PCC-CH701	Chemical Reaction Engineering -II	**7**	**5**
2.	PCC-CH702	Chemical Process & Synthesis	**7**	**3**
3.	PCC-CH703	Chemical Process Design	**7**	**5**
4.	PCC-CH704	Modeling & Simulation in Chemical Engineering	**7**	5
5.	PCE-CH705	Elective – I	**7**	**3**
6.	MC-CH706	Seminar	**7**	**1**
7.	MC-CH707	Comprehensive Tests	**7**	**1**
8.	SI-CH708	Industrial Training (At the end of VI Semester)	**7**	-----
9.	PW-CH709	Project Work	**7**	**2**
Total				**25**

Semester VIII

Sr. No	Code No.	Subject	Semester	Credits
1.	PCC-CH801	Chemical Process & Green Technology	**8**	**4**
2.	PCC-CH802	Transport Phenomena	**8**	**4**
3.	PCC-CH803	Process Economics and Project Engineering	**8**	**4**
4.	PCE-CH804	Elective – II	**8**	**4**
5.	PCE-CH805	Elective – III	**8**	**4**
6.	PCC-CH806	Advanced Separation Processes	**8**	**2**
7.	PW-CH807	Project Work	**8**	**3**
Total				**25**

Shivaji University, Kolhapur

Final Year B. Tech. in CHEMICAL ENGINEERING

Semester-VII

1. PCC-CH-701. CHEMICAL REACTION ENGINEERING -II

Lectures: 4 hrs per week
Tutorials- Nil
Practical: 2 hrs per week

Credits: 5

Evaluation Scheme:
ESE: 70 marks
CIE – 30 Marks
Term Work: 25 Marks
Practical: 25 Marks

OBJECTIVES:

Course Objectives

1. The course focuses on non-ideal flow and finding of conversion in actual reactors from experiment and different models for finding non ideality in reactors.
2. The course focuses on mixing of fluids, macro fluid concept and Turbulent Mixing with chemical Reaction in Stirred Tanks..
3. The course develops understanding of heterogeneous solid catalyst, isotherms, different industrial terms related to solid catalyst & finding different characteristics of solid catalysts with its recent trends.
4. The course develops understanding & designing of fluid particle reactions with different models for it.
5. The course describes understanding & designing of fluid- fluid reaction and applications of fluid-fluid reactions rate equation to equipment design.
6. The course covers concepts, parameters, mechanisms, applications of catalyst with different catalytic reactors and deactivating catalyst & also describe design. scale up in reactor

Course Outcomes

1. At the end of the course, student will be able to apply knowledge of non-ideal flow and will find conversion in actual reactors from experiment and different models for finding non ideality in reactors.
2. At the end of course, student should be able to express basic concepts of mixing of fluids, macro fluid and Turbulent Mixing with chemical Reaction in Stirred Tanks..
3. At the end of course, student should be able to express working of catalyst & understand industrial terms related to solid catalyst & find different characteristics of solid catalysts with its recent trends.
4. Explain underline principles, understanding & designing of fluid particle reactions

with different models for it.

5. At the end of course, student should be able to understand fluid-fluid reaction, its design and applications of fluid-fluid reactions rate equation to equipment design.

6. Explain underline basic concepts, important parameters, mechanism, applications of catalyst with different catalytic reactors and deactivating catalyst & also described scale up in reactor recent.

SECTION –I

Unit I

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; One Parameter: Dispersion model, Tank in Series model, Introduction to Multi parameter model

Unit II

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 Micro mixing on Conversion Time- Dependent Turbulent Mixing and Chemical Reaction in Stirred Tanks.

Unit III

Heterogeneous processes and Solid catalysts: (7)

Global rate of reaction, Catalysis, Nature of catalytic reactions, adsorption isotherms, Rates of adsorption. Determination of Surface area, Void volume and solid density, Pore volume distribution, Classification of catalysts, Catalyst preparation, Catalyst Poisoning, Catalyst Characterizations, Promoters, accelerators, Support, carrier and inhibitors. Recent trends in heterogeneous catalysis.

SECTION –II

Unit IV

Fluid particle reactions (Non catalytic): (5)

Selection of a models 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.

Unit V

Fluid - fluid reaction (6)

Introduction to heterogeneous fluid - fluid reactions, Rate equation for instantaneous , Fast and slow reaction, Equipments used in fluid- fluid contacting with reaction, Application of fluid -fluid reaction, Rate equation to equipment design, Towers for fast and slow reactions. Industrial absorber design-case study

Unit VI

Solid catalyzed reactions: (6)

Introduction, Rate equation, Film resistance controlling, surface flow controlling , Pore diffusion controlling, Heat effects during reaction, Experimental methods for finding rates, , construction, operation and design of Catalytic reactors like Fixed bed reactor, Fluidized bed reactor, Multiphase reactors : Slurry reactor, Trickle bed reactor. Types of industrial catalytic reactors

Deactivating catalysts (4)

Types of Deactivation, Mechanisms 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.

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 Catalytic liquid reactions
11. Synthesis of Catalyst

Text Book:

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.

Reference books:

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
4. Peter Harriot Marcel Dekker, Inc. New York
5. Chemical Engineering Vol. III Pergamon Press, Oxford, 1989.
6. Introduction to Chemical Reaction Engineering and Kinetics Ronald W. Missen Charles A. Mims Bradley A. Saville
7. John Wiley & Sons, Inc.
8. Chemical Reactor Design Optimization and Scaleup
9. E. Bruce Nauman McGraw Hill, New York - 2001.

Heterogeneous Reactions, Vol. I and II – L. K. Doraiswamy, M. M. Sharma

2. PCC-CH-702. CHEMICAL PROCESSES & SYNTHESIS

Teaching Scheme:	Examination Scheme:
Lectures: 3 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Credits: 3	Term Work: Nil
	Practical: Nil

Course Objective

1. To learn chemical processes and role of chemical engineer in chemical field.
2. To learn manufacturing processes for industrial gases, fuel gases.
3. To learn manufacturing processes of nitrogen, sulphuric acid, chloro alkali,phosphorous, potassium and Hydrochloric industries.
4. To learn manufacturing processes for sugar, fermentation and agri industry.
5. To learn manufacturing processes for glass industries.

Course Outcomes

1. Students will able to explain chemical processes and role of chemical engineer in chemical field and manufacturing processes for industrial gases.
2. Students will able to explain knowledge of glass industries, fuel gases.
3. Students will able to explain knowledge ofsulphuric acid,chloro alkali and electrolytic industries.
4. Students will able to explain knowledge of manufacturing of phosphorous and hydrochloric acid industries.
5. Students will able to explain knowledge of nitrogen and potassium industries.
6. Students will able to explain knowledge of sugar and fermentation industry.

Section I

Unit-1

Chemical Processing and work of chemical engineer (2L)
Industrial Gases: Hydrogen, Oxygen, Nitrogen, Carbon Dioxide, Acetylene (3L)

Unit-2

Glass: Glass raw materials, Manufacturing, Types and Applications. (3L)
Fuels and Fuel gases: Natural gas, Water gas, Producer gas, LPG. (2L)

Unit-3

Chloro – alkali and electrolytic industries: Soda ash, caustic soda, Chlorine,Bleaching powder, Sodium bicarbonate, Aluminum, Sodium, Chlorates and perchlorates.(3L)
Sulfuric Acid- Frasch Process, Manufacturing of sulphuric acid (2L)

Section II

Unit-4

Hydrochloric acid: Hydrochloric acid, Aluminum sulphate and alums.(2L)

Phosphate industries: Elemental phosphorous, Raw materials and process for phosphoric acid, Manufacturing of ammonium phosphate, Baking powder.(3L)

Unit-5

Potassium industries: Potassium, Potassium chloride, Potassium sulfate, Potassium nitrate.(2L)

Nitrogen industries: Synthetic ammonia, Nitric acid, Ammonium nitrate, Urea(3L)

Unit-6

Sugar: manufacturing of raw sugar and refining of sugar.(2L)

Fermentation Industry: Absolute Alcohol, Beer, wines &liquors, vinegar , citric acid and lactic acid .(3L)

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. PCC-CH-703. CHEMICAL PROCESS DESIGN

Lectures: 4 hrs per week
Tutorials- Nil
Practical: 2 hrs per week
Total Credits: 5

Evaluation Scheme:
ESE: 70 marks
CIE – 30 Marks
Term Work: 25 Marks
Practical: 25 Marks

OBJECTIVES:

The aim of this course is to give up-to-date knowledge for designing the process equipment such as heat and mass transfer equipment used in chemical process plants.

After undergoing this course the students will have the knowledge to analyze a problem and finding a process design method for heat and mass transfer equipment used in chemical plants.

OUTCOME:

1. Able to understand various types of process flowsheet and symbols.
2. Able to do process design of heat transfer equipments.
3. Able to do process design of mass transfer equipments.
4. Able to do process design with the help of design software.

SECTION –I

Unit I

The nature and function of process design.

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

Process Planning Scheduling and Flow Sheet Design –Organizational structure, Process design scope, Types of flow sheets, P and I diagrams

Unit II

Counter Flow: Double pipe heat exchanger.

Parallel counter flow: Shell and Tube heat exchangers.

Unit III

Design of condenser

Multiple effect evaporator design

SECTION –II

Unit IV

Design of Binary Distillation Column with sieve trays. (4)

Unit V

Design of packed bed absorption column

Design of Gas-Solid Cyclone Separator.

Unit VI

Application of Computer Software Packages and Use of Computer Programs for Chemical Process Equipment Design (6)

Case studies involving the application of Computer Software Packages such as Aspen /Aspen Plus / ChemCad / Hysis (UniSim) / DWSIM or any other software for Design of Chemical Process Equipment.

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

Text Book:
Reference books:

1. D.Q. Kem, "Process Heat Transfer", Tata McGraw Hill Company, New York, 1997.
2. E.E. Ludwig, "Applied Process Design for Chemical and Petrochemical Plants", Vol.I,II,III, Gulf Publication, 3rd edition London, 1994.
3. G.D.Ulrich, "A Guide to Chemical Engineering Process Design and Engineering", John Wiley and Sons, New York, 1984.
4. M.S. Peters & K.D. Timmerhaus, "Plant Design and Economics for Chemical Engineers", 5th edition, McGraw Hill International Book Co., 2003.
5. McCabe W.L. and Smith J.C. 'Unit operations of Chemical Engg.' 7th ed.McGraw Hill Book Co., International ed. 2005.
6. R. E. Treybal, "Mass Transfer Operations", 3rd Edition, McGraw Hill Company, Singapore, 1980.
7. R.H. Perry & Don W. Gress, "Perry's Chemical Engg.", Hand-book , 7th Edition McGraw Hill Company, New York, 1997.
8. S.D. Dawande, "Process Design of Equipment", Dennet Publication, Vol. I and II, 5th Edition 2005.
9. Process Modeling and Simulation, R.W. Gaikwad and Dr. Dhirendra, Third Edition, Bennet and Co., 2010.
10. Process Simulation and Control using Aspen, A.K. Jana, Prentice Hall of India

TERM WORK:

1. Detailed drawing of the following
a. Equipment symbols
b. Instrument symbols and stream designations
c. P and I diagrams
d. Process Flow Diagram
2. Minimum three case study on any design software

4. PCC-CH-704. MODELING AND SIMULATION IN CHEMICALENGINEERING

Teaching Scheme	Examination Scheme
Lectures: 4 hours/week	ESE: 70 Marks
Practical: 2 hrs/batch/week	CIE: 30 Marks
Total Credits: 5	Term Work: 25 Marks
	Practical: 25 Marks

Course Objectives

1. This course explores the basic concepts of modeling and fundamental equations for systems in chemical process industries
2. To study the basic equations required for modeling the chemical systems
3. The basic objective is to develop system and to visualize the effect of various Processes inputs on system performance and state variables
4. The basic objective is to develop the model equation for mass transfer operations
5. The basic objective is to develop the model equation for plug flow reactor
6. To develop the basics of simulation software used in chemical engineering

Course Outcomes

1. Student should be able to explain the basics of modeling and physical and chemical laws for the given system
2. Student should be able to execute model equations for the given chemical system
3. Students will be able to execute mathematical model of system
4. Student will learn to execute model equations for the mass transfer operations
5. Student should be able to execute model equations for the plug flow reactor
6. Students will be able to operate simulation software used in chemical engineering

Section I

Unit-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)**

Unit-2

Formulation of dynamic models: Mass balance equation - Balancing procedure, Casestudies: 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)**

Unit-3

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

Section II

Unit-4

Mass transfer models: such as liquid-liquid extraction, distillation, multicomponentseparation, multicomponent steam distillation, absorber- stage wise absorption, steady state gas absorption with heat effects, evaporator**,** Heat Transfer Models (Heat exchanger, Evaporator, etc). **(7L)**

Unit-5

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

Unit-6

Simulation of chemical engineering: Process simulation, Scope of processsimulation, 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)**

Practical's:

1. Mathematical modeling and simulation of gravity flowtank.
2. Mathematical modeling and simulation of CSTR.
3. Mathematical modeling and simulation of multicomponent distillationcolumn.
4. Mathematical modeling and simulation of liquid – liquid extractioncolumn.
5. Mathematical modeling and simulation of heatexchanger.
6. Mathematical modeling and simulation of lumped parameter model of columnTray.
7. Mathematical modeling and simulation of complex batchreactor.

Note- Minimum 2 or 3 Practical's should be completed using any Open source software.

Text books:

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

Reference books:

1. W. L. Luyben, ―Process Modeling, Simulation and Control for Chemical Engineering, McGraw Hill Book co., 1973.

5. PCE-CH-705: Elective – I

1. Optimization Techniques In Chemical Engineering

Teaching Scheme	Examination Scheme
Lectures: 3 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 3	Term Work: 25 Marks
	Practical: Nil

Course Objectives (CO):

1. Introduces the basic concepts in optimization and how to obtain a mathematical representation of the optimization problem.
2. The basic theoretical principles in optimization, formulate the optimization problem, and choose appropriate method/solver for solution of the optimization problem.
3. The course includes both linear and nonlinear programming problems
4. A set of software tools for solution of optimization problems are also discussed
5. An emphasis on problems arising in Chemical Engineering applications

Unit 1:

Introduction, Scope, Function of single variables, Methods of optimum point search and Constrained optima, Equality constraints, Inequality constraints (6L)

Unit 2:

Multivariable functions. Direct search methods, First order, second order methods

Unit 3:

Application to flashing of multicomponent mixture, Equilibrium composition of products of chemical reactions, Heat conduction etc. applications there to batch distillation column, Ammonia synthesis etc.

Unit 4:

Linear programming, Non – linear programming, Geometric programming, Mathematical Tool – Solver in Excel

Unit 5:

Applications to extraction and solvent recovery systems, Condenser design, Complex chemical Equilibria

Unit 6:

Dynamic programming and its applications, Pumping Stations Distribution, variation methods and its applications.

Text Books

1. Optimization of Chemical Processes – T.F. Edgar and Hemmelblue, McGraw Hill Book Company.
2. Optimization – Theory and its Applications, S. R. Rao.

Reference Books:

1. C.L. Smith, R. N. Pike, P. W. Muralli, Formulation and Optimization of Mathematical Model, International Textbook Co., Perrylvania – 1970.

Useful Websites:

Moocs/ Swayam/NPTEL Courses on Optimization in Chemical Engineering

2. PETROLEUM REFINERY ENGINEERING

Teaching Scheme	Examination Scheme
Lectures: 3 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 3	Term Work: 25 Marks
	Practical: Nil

Course Objective

The students completing this course are expected to understand and learn

1. What is crude oil, what are various petroleum resources?
2. Origin of petroleum, exploration techniques and drilling techniques in details.
3. Composition, classification, distillation & separation techniques including pre-treatment.
4. Properties & specification of petroleum products and overall separation processes.
5. Various conversion processes, Treatment methods and post production operations of Petroleum refineries.
6. Recent trends, advancement in Petroleum refineries.

Course Outcomes

1. Students will get aware about basic information about crude, resources and overall scenario of refineries in India as well across the world.
2. Students will be able to understand about origin, exploration techniques, Drilling Rigs and Drilling techniques in detailed manner.
3. Students will be able to understand composition, Classification of crude oil and able to understand various distillation processes & separation methods.
4. Students will be able to understand properties and specification of petroleum products and Overall separation processes.
5. Students will be able to understand various steps in conversion processes, treatments and post operations in refinery.
6. Students will be able to quite aware about recent trends, capacities of petroleum refineries.

Section - I

Unit-1

Introduction to petroleum refineries: (4 Hrs.)
Resources of petroleum
Origin and exploration techniques:
Origin of petroleum, methods of exploration, drilling rigs, drilling techniques, production methods of crude oil, etc.

Unit-2

Natural Gas: Introduction, Processing, Properties, Uses, gas Hydrates, Shell gas, Purification. (3 Hrs.)

Pre-refining operations: (3 Hrs.)
Composition of crude, classification of crude, types of distillation methods – ASTM, TBP, pretreatment of crude, Different arrangement of Distillation column, Multi component of atmospheric distillation, vacuum distillation, transportation of crude.

Unit-3
Properties and specifications of petroleum products: (5 Hrs.)

Properties and specifications of fuel gas, LPG, gasoline, naphtha, jet fuel, kerosene, diesel, lubricating oils, greases, waxes, coke, etc.
Separation processes: Solvent extraction processes, solvent de-waxing. (3 Hrs.)

Section II

Unit-4
Conversion process: (5 Hrs.)
Thermal cracking, visbreaking, coking, catalytic cracking, thermal reforming, catalytic reforming, hydrocracking, hydro processing, alkylation, Isomerization and polymerization.
Treatment methods:
Sweetening process, hydrodesulphurization, smoke point improvement.

Unit-5

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

Unit-6 **(4 Hrs)**

Recent trends in petroleum refineries:
Recent trends in petroleum in terms of Distillation, Packing materials, Catalyst, Non conventional fuels, Necessity of Bio-fuels, Trans-esertification process, 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.‖, McGra 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
7. Dr.Ram Prasad Petroleum Refinery Engineering
8. B.K.Bhaskara Rao Modern Petroleum Refining Processes

3. BIO-TECHNOLOGY

Teaching Scheme	Examination Scheme
Lectures: 3 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 3	Term Work: 25 Marks
	Practical: Nil

Section I

Unit-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)

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)

Unit-2

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.

Unit-3

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)

Section II

Unit-4

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)

Unit-5

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)

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

Unit-6

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)

The business of Biotechnology and its scope

Informal sectors and small entrepreneurs, some biotechnology industries/companies in India. (2)

Introduction to intellectual property protection in biotechnology (1)

References:

1. A. H. Scragg, —Biotechnology for Engineers ||, Ellis Harwood Ltd.
2. Prescott, Harley & Klein —Microbiology 6 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 Ratledgeet. 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. TrehanKeshav, —Bio-technology ||, Wiley Eastern Ltd, New Delhi,1991.

4. INTRODUCTION TO CRYOGENIC ENGINEERING

Teaching Scheme	Examination Scheme
Lectures: 3 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 3	Term Work: 25 Marks
	Practical: Nil

Section I

Unit-1
Application areas of cryogenics, Methods of producing cryogenic temperatures and energy / exergy considerations

Unit-2
Gas liquefaction processes, Commercial liquefiers and cryogenic refrigerators, cryogenic recovery and purification of industrial gases.

Unit-3
Thermophysical properties at cryogenic temperatures & Process design considerations for cryogenic separations

Section II

Unit-4
Storage and transportation of cryogenic fluids

Unit-5
Cryogenic insulations and vacuum technology, Measurement techniques and instrumentation

Unit-6
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. PHARMACEUTICAL TECHNOLOGY – I

Teaching Scheme	Examination Scheme
Lectures: 3 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 3	Term Work: 25 Marks
	Practical: Nil

Section I

Unit-1

Discussion of monographs such as limit test, LOD, ash value, Saponification value, ester acid value, determination of volatile oils etc.

Unit-2

Inorganic chemicals of Pharmaceutical importance with respect to their manufactures and uses, assay methods, Chemotherapeutic agents, Antiinfectives other than antibiotics, Antifungal, antimycobacterials-Antiprotozoal

Unit-3

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.

Section II

Unit-4

Photochemistry: 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.

Unit-5

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

Unit-6

Synthesis of vitamins and peptide

Books:

1. Pharmaceutical Dosage Forms And Drug Delivery Systems, Ansel, Philadelphia, Fea and Febiger, 1985
2. Introduction to Pharmaceutical DosageForms 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

6. MC-CH-706. SEMINAR

Teaching Scheme:	Examination Scheme:
Lectures: Nil	ESE: Nil
Practical: 2 hrs/batch/week	CIE: Nil
Credits: 1	Term Work: 25 Marks
	Practical: Nil

Students will be required to prepare two review reports (of seminars) on interested topics one in general topic and other related to Chemical Engg. and should deliver two seminars (30 minutes) which will be followed by discussion and submit the both reports in the form of a standard typed format to the staff member/guide

Student should submit title of seminar of both general and Chem. Engg. topic with min 10 references in the first week general topic and second week Chem. Engg. topic of the semester. The topic is to be selected from outside the purview of prescribed text books preferably from magazines for general topic and Chem. Engg. topic should be from peer reviewed journals

The prepared report should contain some major points-

1. Introduction: Maximum 2 pages
2. Exhaustive Review of literature (including figures): 10-12 pages (50% weightage)
3. Critical Analysis of literature: students should make analysis of literature available: 4-5 pages.Q. Are papers technically correct? Are assumptions reasonable etc.
4. Comments on the analysis : based on method used in literature/ suggestion

Evaluation based on above points as-

1. Students will be required to make both topics oral presentations of the seminar report min 20 PPT slides of each.
2. Students should deliver the seminar in front of students and internal judge committee evaluates the performance.
3. Asking and answering questions during the seminars.
4. Seminar reports (two- one general and one Chem. Engg.)
5. Student's attendance of batch is mandatory for both the presentations.

The staff member/members shall guide the students in :

1. Selecting the two seminar topics. (one general and one related to Chem. Engg)
2. Information retrieval (literature survey)

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

b) Searching for the information i.e. referring to chemical abstracts for Chem. Engg. topic

3. Preparing both the seminar reports based on his / her work with references used.
4. Delivering the seminar both general and related to Chem. Engg.

7. MC-CH-707. COMPREHENSIVE TEST

Teaching Scheme	Examination Scheme
Lectures: Nil	ESE: Nil
Practical: 2 hrs/batch/week	CIE: Nil
Total Credits: 1	Term Work: 25 Marks
	Practical: Nil

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:

Mathematics: -

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

Mechanical Operation: -

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

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

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.

Process Calculations: -

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

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.

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.

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.

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

References: -

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

8. SI-CH-708. INDUSTRIAL TRAINING

Teaching Scheme	Examination Scheme
Lectures: Nil	ESE: Nil
Practical: Nil	CIE: Nil
Total Credits: Nil	Term Work: 25 Marks
	Practical: Nil

In-Plant Training Evaluation:

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

Major products of the company
Plant description

General plant layout
Processes for Major Products (no confidential proprietary information may be included)
Chemistry of processes studied (in case of chemical manufacture) based on Journal papers, Patents, Books, etc.
Safety and Health (Material Safety Data Sheets, Safety Policy)
Environmental Protection (measures used and general description of the processes and facilities used)
Standards and compliance thereof (ISO 9000, ISO 14000, OHSAS 18000, etc.)
Three Major Equipment – description with sketch (no detailed drawing to be given: just a sketch with major dimensions, nozzle location and dimensions thereof)
Heat Exchangers: total number and types, Pumps and Compressors: total number and types,
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. PW-CH-709. PROJECT WORK

Teaching Scheme:	Examination Scheme:
Lectures: Nil	ESE: Nil
Practical: 4 hrs/batch/week	CIE: Nil
Credits: 2	Term Work: 25 Marks
	Practical: 25 Marks

Objectives:

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

Outcome :

1)Final Year Projects represent the culmination of study towards the Bachelor of Engineering degree. Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis, and a public demonstration of work undertaken.

2) Personal competences of students are reinforced most during the FYP process, including the preparation, elaboration, presentation and defense stage.

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. 20

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 21 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		

ASSESMENT METHODS (Project Progress)

	Marks					
	First Review			Second Review		
Examination Panel	Presentation	Project Proposal	Total	Presentation	Draft Final Report	Total
Total	15	10	25	15	10	25

Note – For final Marks , average marks of two reviews must be consider

Semester-VIII

1. PCC-CH-801. CHEMICAL PROCESSES AND GREEN TECHNOLOGY

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 Hrs./ batch
Credits: 4

Examination Scheme :
ESE: 70 Marks
CIE: 30 Marks
Term Work: 25 Marks
Practical: 25 Marks

Course Objective

1. To learn manufacturing processes for food and explosive industries.
2. To learn manufacturing processes of paper and plastic industries.
3. To learn manufacturing processes for pharmaceutical and dyes industries.
4. To learn principles of Green chemistry and engineering.
5. To learn the various ecological treats and various Green chemistry challenges.
6. To understand the various green fuel technologies and sustainable development.

Course Outcomes

1. Students will be able to understand and develop manufacturing processes for food and explosive industries.
2. Students will be able to understand and develop manufacturing processes of paper & plastic industries.
3. Students will be able to understand and develop manufacturing processes for pharmaceuticals and dyes industries.
4. Students will be able to understand and apply the principles of green chemistry and technology.
5. Students will be able to understand the various ecological treats and various green chemistry challenges.
6. Students will be able to understand the various green fuel technologies and sustainable development.

Section – I

Unit-1

Explosives: Types of explosives, explosive characteristic, Industrial explosives , propellants, missiles. (2 Hr.)

Food industries: Types of food processing, preservation methods, Food byproducts. (3 Hr.)

Unit-2

Pulp and paper industries: Manufacturing of pulp, Manufacturing of paper. (3 Hr.)

Plastic industries: Raw materials, General polymerization processes, Manufacturing processes. (3 Hr.)

Unit-3

Pharmaceutical industries: Classification of pharmaceutical products. Manufacture of antibiotics, Isolates from animals. (3 Hr.)

Dyes and Pigments: Types of dyes, manufacturing of dyes, Manufacturing of pigments. (2 Hr.)

Section - II

Unit-4

Green Chemistry: An Overview, Energy Scenario in the world

Introduction, underlying philosophy and focus, twelve principles of green chemistry. (3 Hr.)

Unit-5

Ecological Threats & Green Chemistry

The Greenhouse Effect, Climate Change, Ozone Layer Depletion, Global Warming, Kyoto protocol and Carbon credits, photochemical smog, Old Technology vis-à-vis Green Technology with Suitable examples to understand comparative advantage of Green Technology over Old one, Renewable resources , Process intensification. (6 Hr.)

Unit-6

Green Chemistry & Nonconventional Fuels

Green chemistry in batteries, Fuel cell and electric vehicles, Solar energy and hydrogen production, biodiesel, bio-hydrogen (4 Hr.)

Green Chemistry & Sustainable development

Esterification and transesterification processes, Transesterification under supercritical conditions

Optimization: catalyst concentration, methanol to oil ratio, reaction temperature, reaction time

Best practices in Green Chemistry for sustainable development with suitable examples(4 Hr.)

Practicals:

1. Preparation of azo dye
2. Preparation of soap
3. Preparation of phenol formaldehyde
4. Preparation of yellow pigments
5. Preparation of blue pigments
6. Preparation of nitrobenzene.
7. Preparation of Biodiesel

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. PCC-CH-802. TRANSPORT PHENOMENA

Teaching Scheme:
Lectures: 3 hours/week
Tutorial: 1 hours/week
Credits: 4

Examination Scheme :
ESE: 70 Marks
CIE: 30 Marks
Term Work: Nil
Practical: Nil

Course Objectives:

1. Students will be able to get depth knowledge of momentum, energy and mass transport.
2. Applications of fundamental subjects learned, towards chemical engineering problems.
3. Ability to analyze industry oriented problems.

Course Outcomes:

1. Understanding of transport processes.
2. Student will able to establish and simplify appropriate conservation statements for momentum, energy and mass transfer processes.
3. Ability to do momentum, energy and mass transfer analysis.
4. To apply conservation principles, along with appropriate boundary conditions for any chemical engineering problem.

Section I

Unit-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.
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.

Unit-2

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.
Velocity distributions:(2 Hrs.)
Time-Dependent Flow of Newtonian Fluids Unsteady viscous flow, flow near a wall suddenly set in motion.

Unit-3

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.
Macroscopic balances for isothermal systems: (3 Hrs.)
The Macroscopic mass balance, the macroscopic mechanical energy balances, estimation of friction loss.
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

Unit-4

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.
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 and through packed beds, Heat transfer coefficient for free convection, Heat transfer coefficient for condensation of pure vapors.

Unit-5

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. 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.

Unit-6

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.

Reference Books:

1. C.O. Bennett, J.E. Mayers, ―Momentum, Heat & Mass transfer , 3 Edn.,McGraw Hill, Chemical Engineering Series,1985.
2. Alan S. Foust, Leonard A. Wenzel, Curtisw Clump, Louis Maus,L Bryce Andersen
3. Principles of Unit Operations‖,2ndedn.,McGraw Hill, 1985.
   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.PCC-CH-803. PROCESS ECONOMICS AND PROJECT ENGINEERING

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
Practical:Nil	CIE: 30 Marks
Total Credits: 4	Term Work: 25 Marks
	Practical:Nil

Course Objectives:-

1. The students completing this course are expected to understand concept of process design &development, general design considerations in industries.
2. The students completing this course are expected to understand concept of cost accounting, estimation & BEP analysis used in industries.
3. The students are to learn types of interest, taxes, insurances, annuity, depreciation, profitability, alternative investment, replacement and optimum design.
4. The students completing this course are expected to understand process development and commercialization in industries.
5. The students completing this course are expected to understand selection of contractor with its scope, licensing & its types with concept of plant start-up.
6. At the end of course students should understand concepts project conception and project engineering, PERT, CPM.

Course Outcomes:-

1. Student should be able to apply knowledge of process design & development, general design consideration in industries.
2. Student should be able to apply the concept of cost accounting, estimation & BEP analysis in industries.
3. Student should be able to apply knowledge of types of interest, taxes, insurances, profitability, alternative investment, replacement and optimum design in industries.
4. Student should be able to apply knowledge of process development and commercialization.
5. Student should be able to apply knowledge of selection of contractor with its scope & types with concept of plant start-up.
6. Students should be ableto apply knowledge of project conception and project engineering, PERT, CPM in industries.

Section – I

Unit-1

Introduction, General design considerations like plant location layout, HAZOP,FTA, SIL, QRA, Process Design Development.

Unit-2

Cost and Asset accounting, Different ratio in accounting, Analysis of Cost estimation and break even analysis.

Unit-3

Interest, Time value of Money, Taxes and Insurance Profitability, Depreciation, Alternative investments and replacements, Optimum design and Design strategy.

Section – II

Unit-4

Process development and commercialization:Introduction, Exploratory research and its types, development for final process design,

Process Licensing:Licensing principles, License agreement, and Agreement implementation.

.**Unit-5**

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

Plant Startup :Introduction, Organization of startup, Budget for startup, Information centre, Planning and schedules, Log sheets and calculations, Plant startup, Operating the plant, Battery limits, Offsite facilities. Procurement and Construction.

Unit-6

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.

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

Textbooks:

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", Reinhold.
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 Delhi2005.
8. Chemical Project Economics, Mahajani V. V. and Mokashi S M.

References:

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

4. PCE-CH-804. ELECTIVE – II

1. PETROCHEMICAL TECHNOLOGY

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
	CIE: 30 Marks
Total Credits: 4	Term Work: 25 Marks
	Practical:Nil

Course Objective

The students completing this course are expected to understand and learn

1. What are petrochemicals, petrochemical Industries

2.Cost consideration. , indigenous technology, natural gas & petroleum, classification of petrochemicals

3 Raw Materials like Organic chemicals, coal, biomass petroleum, Chemicals from Methanol & Synthesis gas..

4. Chemicals from Ethane, Ethylene & Acetylene, Propane & Propylene:, Butanes & Pentanes.

5. Chemicals from aromatics, Polymers, elastomers, synthetic fibers, PVC, Nylon & Polyesters

6. Recent trends, advancement in Petroleum refineries, Integrated Petrochemical complex, Energy crises.

Course Outcomes

1. Students will get aware about basic information about petrochemicals,industry venture.

2. Students will be able to understand about raw materials

3. Students will be able to understand about product produced

4. Students will be able to understand process,conditions,variables,controlling parameters

5. Students will be able to understand specialized product like polymers,

6. Students will be able to quite aware about recent trends,energy efficient process.

Section I

Unit-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.

Unit-2:

Raw Materials: (4 Hrs.)

Organic chemicals, coal, biomass petroleum, etc.

Chemicals from Methanol & Synthesis gas: (4 Hrs.)
Steam reforming, Oxo-Products, Methanol, Formaldehyde, Carbon-di-sulphide, Hydrogen cyanide.

Unit-3:

Chemicals from Ethane, Ethylene & Acetylene: (4 Hrs.)
Synthetic Ethanol, Acetaldehyde, Acetic acid, Vinyl acetate, Ethylene oxide, Ethylene glycols, Acrylonitrile, Chemicals from Propane & Propylene: (4 Hrs.)
Isopropanol, Acetone, Glycerol, Propylene oxide, Propylene Glycols, Isoprene, Cumene.

Section II

Unit-4:

Chemicals from Butanes & Pentanes: (4 Hrs.)
Butadiene, Butone epoxides &Butanol amines, Butyl acetate, Methyl-Ethyl Ketone, MTBE, TAME.Chemicals from aromatics: (5Hrs.)
BHC, Nitrobenzene, Do-decyl benzene, Benzoic acid, Nitrotolune, Pthalic anhydride, Isopthalic acid, TPA & DMT, Maleic anhydride, Adipic acid, Hexamethylenediamine, Aniline, Caprolactum.

Unit-5:

Polymers: (4 Hrs.)
Polymers, elastomers, synthetic fibers, PVC, Nylon & Polyesters.

Unit-6:

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 thelatest technologies.

Text Books:

1. B.K. Bhasker Rao, ―A Text on Petrochemicals‖2nd
Edition, Khanna publishers, 1996.
2. SukumarMaiti, ―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. PCE-CH-804. ELECTIVE – II

2. DISTILLATION

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
	CIE: 30 Marks
Total Credits: 4	Term Work: 25 Marks
	Practical:Nil

OBJECTIVES:

1. Make students aware about basic principles of vapor liquid equilibrium.
2. To impart knowledge of basic principles of differential and steam distillation.
3. Explain methods of design of distillation column.
4. Make students familiar with techniques to design multicomponent distillation column.
5. Explain azeotropes, azeotropic calculations and azeotropic distillation.
6. Give introduction of packed bed distillation and its design.

OUTCOME:

After successful completion of this course students will

1. Understand basic principles of vapor liquid equilibrium.
2. Understand principles of differential and steam distillation
3. Design of distillation column by using appropriate method.
4. Use multi component distillation technique for separation of mixture of chemicals.
5. Apply azeotrope separation techniques for separation azeotrope in Chemical Process Industry.
6. Develop better product and process to mitigate the problem of distillation unit in Chemical Industry.

SECTION –I

Unit I (4Hrs)

Thermodynamics of equilibrium vapour liquid equilibria of ideal and non ideal solutions- Binary and Multi component systems.

Unit II (5Hrs)

Correlation and prediction of VLE data (Brief outlines only). Principles of differential distillation and steam distillation. Equilibrium Flash vaporization, Hydrocarbon water mixtures

Unit III (6Hrs)

Binary distillation Determination of minimum and total reflux calculations for the number of equilibrium stages- Analytical and graphical methods-problems with open steam side streams. Distillation Column sequencing.

SECTION –II

Unit IV **(6Hrs)**

Degree of freedom for multicomponent mixture, Multiple feeds-batch columns multicomponent distillation: Preliminary calculations - selection of key components- Fenske, Underwood and Gilliland Technique, Rigorous calculations - Methods of Sorel. Lewis- Matheson, Thiele-Geddes and Short cut methods.

Unit V **(4Hrs)**

Introduction to azeotrope, types of azeotropes, Azeotropic and extractive Distillation. Separation of azeotrope selection of solvents and entrainers, column design by pseudo ternary and pseudo binary methods, Solvent recovery.

Unit VI **(5Hrs)**

Design of distillation equipment, plate and packed columns, introduction to open source simulation software e.g DWSIM, Practice simulation by using examples.

Text Book:

1. Distillation‖Van Winkle.
2. Distillation Design‖J. H. Kister

3 Chemical Engineering Coulson &Richardson Vol-2 **Reference books:**

1 Design of Equilibrium Stages‖ B. D. Smit
2 Separation Process Principles C.J.Geankoplis

4. PCE-CH-804. ELECTIVE – II

3. BIO-CHEMICAL ENGINEERING

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
	CIE: 30 Marks
Total Credits: 4	Term Work: 25 Marks
	Practical:Nil

Section I

Unit-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.

Unit-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.

Unit-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.

Section II

Unit-4

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

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.

Unit-5

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.

Unit-6

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.

Introduction of advanced topics such as,

Bioprocess simulation, Molecular modeling for protein synthesis and drug design, Protein engineering, manufacturing process for typical pharmaceutical products.

Reference Books:

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. BungayH.R.,Belfort G., ―Advanced Bio-Chemical Engineering‖,John Willey And Sons,New York, 1987.

4. PCE-CH-804. ELECTIVE – II

4. COMPUTER AIDED DESIGN

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
	CIE: 30 Marks
Total Credits: 4	Term Work: 25 Marks
	Practical:Nil

Section I

Unit-1

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

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

Unit-2

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.

Unit-3

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

Section II

Unit-4

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

Unit-5

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.

Unit-6

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.

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.

4. PCE-CH-804. ELECTIVE – II

5. MEMBRANE SEPARATION PROCESS AND DESIGN

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
	CIE: 30 Marks
Total Credits: 4	Term Work: 25 Marks
	Practical:Nil

Section I

Unit-1

Introduction: Introduction to membrane processes, History, Definition of membrane, importance, processes.

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.

Unit-2

Liquid membranes, Supported and unsupported liquid membranes, Applications and mathematical modeling.

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.

Unit-3

Characterization of membranes: Characterization of porous membranes, Characterization of ionic membranes, Characterization of non – ionic membranes. 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.

Section II

Unit-4

Transport processes in membranes, Driving force, Transport through porous membranes, Transport through non porous membranes, Transport in ion-exchange membranes.

Polarization phenomena and fouling concentration polarization, Characteristic flux behavior in pressure driven membrane operation, Various models, Temperature polarization, Membrane fouling, Methods to reduce fouling.

Unit-5

Modules and process design plate and frame, Spiral wound, Tubular, Capillary, Hollow fiber modules and their comparison, System design. Membrane reactors, Applications of membrane reactors in biotechnology

Unit-4

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.

5. PCE-CH-805. ELECTIVE – III

1. ENERGY CONSERVATION AND RECOVERY

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 4	Term Work: Nil
	Practical: Nil

Course Objective

1. To study the importance of energy and Indian energy scenario.
2. To study the energy available for industrial use and role of energy conservation.
3. To study in detail energy management and policy.
4. To know basic principles of energy conservation, equipments used for heat recover & energy audit.
5. To know basic of cogeneration & energy audit.
6. To know the effect of climate change in India, how to do the energy conservation in sugar Industry? & energy conservation act 2001.

Course Outcomes

1. Students will come to know the importance of energy in production & employment & what is energy scenario in India?
2. Students will be able to understand how to forecast industrial energy supply, demand? and what is role of energy conservation in industry?
3. Course will develop the knowledge of doing comprehensive energy conservation planning.
4. Students will be able to explain basic principles, equations of calculating waste heat, selection of equipments for heat recover & how to conduct energy audit.
5. Students will be able to explain cogeneration concept & how to conduct energy audit.
6. Students will be able to understand the effect of climate change on energy in India, saving of energy in sugar industry and energy conservation act 2001.

Section I

Unit-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)

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)

Unit-2

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)**

Unit-3

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**. (5L)**

Section II

Unit-4

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)**

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

Unit-5

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

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)**

Unit-6

Impact of climate change in India (3L)
Energy conservation in Sugar Industry (3L)
Energy conservation act 2001. (3L)

Text books:

1. Devid Hu. S, ―Handbook of Energy Conservation, McGraw Hill Publication.
2. Rao, Diwalkar P.L., ―Energy Conservation Handbook, Utility Publication, Hydrabad.
3. The Bulletion on Energy Efficiency and Management by IRADA, MITCON, MEDHA etc.
4. Amit Tagi, ―A Handbook Energy Audit, Tata McGraw Hill publication, 2000
5. A Practical Guide to Energy Conservation, PCRA Publication, 2010.

Reference books:

1. D. Mohan Singh, Col. S. K. Murthy (Retd.) and etc., ―Energy Conservation in Industries□, Module I and II, AICTE, CEP, Code 358.
2. D. A. Reay, ―Heat Recovery Systems, E and F. N. Spon ltd., 11, New Fetter Lane, London, 1979.

5. PCE-CH-805. ELECTIVE – III

2. POLYMER REACTION ENGINEERING

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 4	Term Work: Nil
	Practical: Nil

Section I

Unit-1

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

Unit-2

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

Unit-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

Section II

Unit-4

Copolymerization: Introduction, Classification of copolymers, Basic principles ofcopolymers, 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.

Unit-5

Introduction to Smith- Ewart's emulsion polymerization kinetics, Experimentaltechniques 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.

Unit-6

Reactors for polymerization: Batch, PFR, CSTR with residence time, averagemolecular 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. PCE-CH-805. ELECTIVE – III

3. PHARMACEUTICAL TECHNOLOGY-II

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 4	Term Work: Nil
	Practical: Nil

Section I

Unit-1

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.

Unit-2

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.

Unit-3

One topic of current interest, Effluent treatment Raw materials for Pharmaceutical Industry,.

Unit-4

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.

Unit-5

Introduction to Novel drug Delivery Systems: Transdermal, Transmucosal, Ophthalmic,

Colloidal: Liposome‘s, nanoparticles, emulsion systems etc Introduction to Radio pharmaceuticals,

Unit-6

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

Text Book of Pharmaceutical Analysis, Kenneth A., Connors, A

5. PCE-CH-805. ELECTIVE – III

4. MULTIPHASE REACTOR DESIGN

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 4	Term Work: Nil
	Practical: Nil

Section I

Unit-1

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

Review of reaction kinetics and reactor design

Unit-2

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

Unit-3

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

Section II

Unit-4

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

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

Unit-5

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

Unit-6

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. PCE-CH-805. ELECTIVE – III

5. MASS TRANSFER WITH CHEMICAL REACTON

Teaching Scheme:	Examination Scheme:
Lectures: 4 hours/week	ESE: 70 Marks
Practical: Nil	CIE: 30 Marks
Total Credits: 4	Term Work: Nil
	Practical: Nil

Section – I

Unit-1

Theory of simultaneous mass transfer and chemical reaction, Film theory, Penetration and surface renewal theory

Unit-2

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

Unit-3

Instantaneous reaction regime, Physico - chemical data, Prediction and estimation of diffusivity and solubility of gases in pure liquids and solutions.

Section – II

Unit-4

Model experiments on absorption and extraction with chemical reaction, Use of wetted wall column, Laminar jet, Disc column multiple sphere absorber, Stirred cell

Unit-5

Application of theory for studying the kinetics of heterogeneous reaction and determination of mass transfer coefficient and interfacial areas by chemical method

Unit-6

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. PCC-CH-806. ADVANCED SEPARATION PROCESSES

Teaching Scheme:
Lectures: 1 hours/week
Practical: 2 hours/week
Total Credits: 2

Examination Scheme:
ESE: Nil
CIE: Nil
Term Work: 25 marks
Practical: 25 marks

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

List of Practical's:

Ultrafiltration of some dilute solutions.
Reverse osmosis of saline solution.
Microfiltration of raw material.
Electrodialysis.
Pressure swing Adsorption.
Electrostatic precipitator.
Gas Chromatography.
Supported liquid membranes.
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
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. SouriRajan S. "Reverse Osmosis" Logos Press Ltd..

PW-CH-807. PROJECT WORK

Teaching Scheme:
Lectures: Nil
Practical: 6hrs/week
Total Credits: 3

Examination Scheme:
ESE: Nil
CIE: NIL
Term Work: 75 Marks
Practical: 75 Marks

OBJECTIVES

1: An ability to apply one's knowledge of mathematics, science, and engineering.
2: An ability to design and conduct experiments, as well as to analyze and interpret data.
3: An ability to design a system, component, or process to meet the needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
4: An ability to function on multidisciplinary teams.
5: An ability to identify, formulate, and solve engineering problems.
6: An understanding of professional and ethical responsibilities.
7: An ability to communicate effectively.
8: A broad education in order to understand the impact of engineering solutions in a global, economic, environmental and societal context.
9: A recognition of the need for, and an ability to engage in, life-long learning.
10: Knowledge of contemporary issues.
11: An ability to use the techniques, skills and modern engineering tools that are necessary for engineering
practice.

B. E PROJECT OUTCOME

1)Final Year Projects represent the culmination of study towards the Bachelor of Engineering degree. Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis, and a public demonstration of work undertaken.

2) Personal competences of students are reinforced most during the FYP process, including the preparation, elaboration, presentation and defence stage.

Project Guidelines

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.
- o List of Tables
- oSample CalculationoData Tables, etc.

Each group should consist of maximum 3 students. For term-work (Internal) 75 marks, the assessment should be by conducting frequent ,PPT ,seminars during the year & an oral exam at the end of the year conducted by all thefacultymembers 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 least 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.

IMPLEMENTATION PROCEDURE FOR CONDUCTING FINAL YEAR PROJECT

The main objective of the Final Year Project is to learn and experience the process of conducting a good research project. The following points serve as a guideline of activities that take place in the process.

Problem Statement

A problem statement is a concise statement of the problems which initiate/spark the research questions or design ideas. Some of the points that could be highlighted are:

a. What is the issue that we want to address (problem or question)?

b. Why need to address the issues?
c. How the project can solve the issues?
d. Who get benefits from the project?

Objective sets a clear goal of what we want to accomplish by doing the research work. It SHOULD NOT INCLUDE the objective of doing the Final Year Project (e.g. to learn how to manage a project etc.). Student should only state the technical objective of the project (e.g. to evaluate the performance of the design, to test a hypotheses, to study the relationship between variable x and variable y etc.). Use measurable action verbs when defining an objective (e.g. define, design, identify, describe, analyze, evaluate etc).

Scope

Scope sets a clear boundary (time, geography, environment, function etc.) of our work to provide a common understanding of the project among stakeholders (in FYP the stakeholders are students, lecturer, panels etc.). Scope makes our project achievable and realistic by defining the limits and constrains of the study.

Literature review

A literature review discussed published information in a particular subject area. The purpose of a literature review is to summarize and synthesize the ideas of others. When we write a literature review, it usually consists of 3 main sections:

a. Introduction section that describe the topic of the review.
b. Body section which contains the discussion of sources.
c. Conclusions from the discussion of sources and recommendations (if any). The main point in the conclusion of the literature review would be the clarification and emphasis of the gaps (unexplored/unsolved problem in the field) and the contribution of the student's project.

The discussion of the sources could be arranged chronologically, thematically or methodologically or in combination of any of them. In the discussion, students should:

a. Be clear of the items that need to be discussed. It can be a variable or a technique or different design decisions.

b. Make comparisons and give technical comments. Summary of the comparison could be tabulated or shown in graphs to clarify the differences.
c. For engineering design, discuss on the tradeoff of a particular design decision

ASSESMENT METHODS (Project Progress)

	Marks					
	First Review			Second Review		
Examination Panel	Presentation	Project Proposal	Total	Presentation	Draft Final Report	Total
Total	35	40	75	35	40	75

Note – For final Marks , average marks of two reviews must be consider

The presentation slideshow should cover the following:
a. Introduction and overview of the project. This may include project objectives and scopes.
b. Methodology.
c. Result and discussion.
d. Conclusion and recommendation.
e. List of References.
During the presentation, students are evaluated in various aspects of knowledge. These may include communication skill, presentation contents, ability to answer any question, readiness of facing critic and comment, as well as ability to interact with audience.
The project demonstration (if any) takes place right after the presentation on the same day of presentation schedule. However, the panel may arrange suitable time for demonstration.