BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6001	Process Equipment Design	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	2	6	70	22

Unit I

Heat Exchangers:

Scale up criteria and scale up of process equipment. Process design calculations for heat exchanges equipment shell and tube heat exchangers general description, heat transfer coefficients and pressure drop by Kern's & Bells methods rating on existing unit.

Unit II

Evaporators :

Design of a new system having one or more units in series: single effect evaporation, multiple effect evaporator with boiling point elevation.

Unit III

Distillation and Absorption Column:

Process design calculations for mass exchange equipment plate and packed column for distillation and absorption including column diameter and height.

Unit IV

Auxiliary Equipment:

Detailed process and mechanical design, Flash drum, Kettle reboiler, condenser, cooling tower, rotary drier.

List of Experiments:

Each student should design a complete chemical process plant with mechanical design details of at least three major equipments.

Suggested Readings:

1. Perry, Robert H. Green Don W 7th ed- PERRY'S CHEMICAL ENGG. HANDBOOK – McGraw Hill New Delhi.
2. E.E. Ludwig – APPLIED PROCESS DESIGN IN CHEMICAL PETROCHEMICAL PLANTS – Gulf Publishing Co. 1964 Vol. – 2
3. B. D. Smith – DESING OF EQUILIBRIUM STAGES.
4. Coulson J. M. Richardson J.F. – CHEMICAL ENGG. VOL – 6 ed. Pergaman Process.

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6002	Chemical Reaction Engineering - II	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit-I

Heterogeneous Processes:

Heterogeneous processes: Catalysis and adsorption; Classification of catalysts, Preparation of catalysts, Promoters and Inhibitors, General mechanism of catalytic reactions surface area and pore size distribution Rate equation of fluid solid catalytic reactions, Hougen - Watson & Poinule law models, Procurement and analysis of kinetic data, kinetics of catalyst deactivation.

Unit –II

Processes and their Effects on Heterogeneous :

External transport processes and their effects on heterogeneous reactions yield and selectivity Reaction and diffusion in porous catalysts, Isothermal and non-isothermal effectiveness factors, Effect inter phase transport on yield, selectivity & poisoning, Global reaction rate.

Unit -III

Reactors:

Design of catalytic reactors, Isothermal & adiabatic fixed bed reactor staged adiabatic reactors, Non-isothermal, non-adiabatic fixed bed reactors, Fluidized bed reactors, Slurry reactors, Trickle bed reactors.

Unit-IV

Non-Catalytic Reactions:

Models for fluid - solid non-catalytic reactions, controlling mechanisms, Diffusion through gas film controls. Diffusion through ash layer controls, Chemical reaction controls, fluidized bed reactors with and without elutriation.

Unit – V

Miscellaneous Reaction:

Gas-liquid reactions and liquid-liquid reaction, Rate equation based on film theory, Reaction design for instantaneous reactions and slow reactions, Aerobic Fermentation, Application to Design Tools for Fast Reactions.

Suggested Readings:

1. J.M. Smiili-CHEMICAL ENGG. KINETICS -3rd Mc. Graw Hill
2. K.G.Denbig & K.G. Turner -CHEMICAL THEORY - AN INTRODUCTION TO RE- ACTORS- 2nd Ed. United Press & ELBS 1972
3. G. Cooper & G.V.J. Jefferys CHEMICAL KINETICS AND REACTOR ENGG. Prentice Hall 1972.
4. O. Levenspiel -CHEMICAL REACTION ENGG.- 2nd Ed. Wiley Eastern, Singapore.
5. Hougen, Watson & Ragatz, CHEMICAL PROCESS PRINCIPLES PART 3 (Kinetics & Catalysis) 2nd ed.
6. Fogler, H.S. : ELEMENTS OF CHEMICAL REACTION ENGG. 2nd ed. Prentice Hall of India Pvt. Ltd. New Delhi - 1997.

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6003	Mass Transfer - II	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	3	7	70	22

Unit I

Adsorption: Adsorption theories, types of adsorbent; activated carbon, silica and molecular sieves. Batch and column, adsorption; Break through curves, Liquid percolation and gas adsorption, BDST models for adsorption, calculation.

Unit II

Humidification and Dehumidification: Humidification: General Theory, psychometric chart, fundamental concepts in humidification & dehumidification, wet bulb temperature, adiabatic saturation temperature, measurement of humidification calculation of humidification operation, cooling towers and related equipments.

Unit III

Drying: Drying Theory Equilibrium mechanism, drying rate curve, Estimation of Drying time, drying rate curve, Classification of Driers, drying Characteristics Batch and continuous drying for tray driers, Drum dryers, spray and tunnel dryers. Through circulation driers design, Description and application of Drier Analysis of continuous driers.

Unit IV

Leaching and Crystallization: Leaching: solid liquid equilibrium, Equipment, principles of leaching, concurrent and counter current systems and calculation of number of stage required. Crystallization: Factors governing nucleation and crystal growth rates, controlled – growth of crystals, super saturation curve, principle and design of batch and continuous type equipment.

Unit V

Liquid –Liquid Extraction: Liquid equilibrium & Ponchon – Savarit method, Mc-Cabe- Thiele method, packed & spray column, conjugate curve and tie line data, plait point, ternary liquid – liquid extraction, operation and design of extraction towers analytical & graphical solution of single and multistage operation in extraction, Co-current, counter current and parallel current system.

List of Experiment

1. To determine to diffusion coefficient of liquid vapour in air by Stefan's tube.
2. To study the rate dissolution of a rotating cylinder and then to calculate the mass transfer coefficient.
3. To investigate the mass transfer characteristic of a wetted surface column unit.
4. To investigate the characteristics of cooling tower.
5. To study the drying characteristics of a wet granular material using natural and forced circulation in tray dryer.
6. To prepare the drying rate curve for fluidized bed dryer.
7. To study the characteristics of spray dryer.
8. To study the characteristics of drum and Tunnel dryer.
9. Studies on solid-liquid extraction column.
10. To find out the crystal yields with and without seeds.
11. To draw the tie lines and plot equilibrium curve for given ternary system.
12. Liquid- Liquid extraction in a packed column for co-current and counter current flow of binary systems.

Note: Each student should perform at least eight experiments from the above list.

Suggested Readings:

1. Mc-Cabe, W.L. Smith J.M. – UNIT OPERATION IN CHEMICAL ENGG. – 5th edition Tata McGraw Hill – Hogakusha, Tokyo, New Delhi.
2. Coulson J.M. Richardson J.F. - CHEMICAL ENGG. – Vol – 2 Edition-2, Butserworth Heinmann, Oxford, New Delhi.
3. Treybal R.E. – MASS TRANSFER OPERATION – 3rd edition, Mc. Graw Hill Book Co. New York.

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6004	Chemical Process Control	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	2	6	70	22

Unit I

Control Elements: Construction and characteristics of final control elements such as Proportional, Integral, PD, PID controllers, pneumatic control valve, principles and construction of pneumatic and electronic controllers.

Unit II

First Order System: Laplace Transform, Linear open loop system, First order system and their transient response, Dynamic response of a pure capacitive process, Transportation lag, Dynamic response of a first order lag system.

Unit III

Second Order System: Second order system and their transient response. Interacting and non-interacting system, Linear closed loop system, block diagram of closed loop transfer function, controllers, Transient response of closed loop system.

Unit IV

Stability Concept: Stability concept, stability criterion, relative stability, Routh-Hurwitz stability criterion, Root locus technique, Feedback controllers tuning

Unit V

Frequency Response: Introduction to frequency response, Bode diagram, Bode stability criterion, gain and phase margins, Ziegler Nichols controller setting. Nyquist's stability criterion.

List of Experiments:

1. To study the characteristics of control valves (linear, quick opening, etc)
2. To study the dynamics of liquid level systems of non-interacting and interacting types.
3. To study the response of mercury in glass thermometer with and without a thermowell.
4. To study the characteristics of an electronic PID controller.
5. To study the characteristics of a current to pneumatic converter.
6. To study the effectiveness of computer control of a distillation column.
7. To study the effectiveness of a computer control of a heat exchanger.
8. To study to effectiveness of a computer control of a chemical reactor
9. To study to dynamics of a pressure tanks.
10. To calibrate an air purged liquid level indicator.

Note: Each student should perform at least eight experiments out of the above list.

Suggested Readings:

1. Coughnower & Koppel – PROCESS SYSTEM ANALYSIS AND CONTROL- McGraw Hill, New York.
2. D. P. Eckman – AUTOMATICS PROCESS CONTROL – McGraw Hill, New York.
3. Peter Harriot – PROCESS CONTROL – McGraw Hill, New York.
4. J. J. Nagrath & M. Gopal – CONTROL SYSTEM ENGINEERING.

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6011	Mechanical Design of Process Equipment	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit I

Mechanics of Materials:

Stress- Strain relationships of elastic materials subjected to tensile, compressive and shear forces, Elastic and plastic deformation, General design considerations; Design of shell, bottom plates, self supported, and column supported roofs, wind girder, nozzles and other accessories.

Unit II

Unfired Pressure Vessel:

Pressure vessel codes, classification of pressure vessels, Design of cylindrical and spherical shells under internal and external pressures; Selection and design of flat plate, tore-spherical, ellipsoidal, and conical closures, compensations of openings. High pressure Vessels: Stress analysis of thick walled cylindrical shell, Design of monobloc and multilayer vessels.

Unit III

Tall Vertical & Horizontal Vessels:

Pressure, dead weight, wind, earthquake and eccentric loads and induced stresses; combined stresses, Shell design of skirt supported vessels. Vessel supports; Design of skirt, lug, and saddle supports.

Unit IV

Bolted Flanges:

Types of Flanges, and selection, Gaskets, Design of non- standard flanges, specifications of standard flanges. Fabrication of Equipment; major fabrication steps; welding, non-destructive tests of welded joints, inspection and testing, vessel lining, materials used in fabrication of some selected chemical industries.

Suggested Readings:

1. Brownell, N.E and Young, H.E; Process Equipment Design; John Wiley
2. Bhattacharya, B.C; Introduction Of Chemical Equipment Design; CBS Publishers, Delhi.
3. Perry RH; Hand book of Chemical Engrs; Mc Graw Hill Pub
4. I.S.: 2825-1969 – Code For Unfired Pressure Vessels.
5. I.S. 803-1962, Code For Practice For Design, Fabrication And Erection Of Vertical And Mild Steel Cylindrical Welded Oil Storage Tanks.
6. Joshi, M.V.; Process Equipment Design.
7. Ludwig EE; Applied Process Design In Chemical And Petrochemical Plants; Gulf publishing

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6012	Polymer Technology	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit - I

Polymerization Chemistry:

Chain, step and miscellaneous polymerization reactions and polymerization technique. Polymerization kinetics: Free radical, cationic and anionic polymerization, polycondensation and polymerization.

Unit-II

Polymerization Processes:

Bulk solution, emulsion and suspension polymerization, thermoplastic composites, fiber reinforcement fillers, surface treatment reinforced thermo set composites resins, fillers, additives.

Unit-III

Polymer Reactions:

Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions, reactions of various specific groups, cyclyzation and cross linking reactions, reactions leading to graft and block copolymer

Unit - IV

Manufacture of Polymers:

Manufacturing processes of important polymer Plastics - polyethylene, polypropylene polyvinyl chloride & copolymer, polystyrene. phenol - formaldehyde, epoxides, urethane, teflon, elastomers, robbers, polymeric oils - silicon fibers - cellulosic (Rayon) , polyamides (6:6 Nylon), Polyesters (Dacron). Acrylic olefin.

Unit - V

Composite Materials:

Ceramic and other fiber reinforced plastics, Polymer degradation - Thermal, Mechanical, Ultrasonic, Photo, High energy radiation, Ecology and environmental aspects of polymer industries. Rheological Sciences Equations, Unicoelastic models - Maxwell.

Suggested Readings:

1. Rodringuez - PRINCIPLES OF POLYMER SYSTEMS - McGraw Hill (1970).
2. Billmayer Jr. Fred W. - TEXTBOOK OF POLYMER SCIENCE - Wiley Tappon (1965).
3. David J. Williams - POLYMER SCIENCE & ENGINEERING - Prentice Hall (1971)
4. Mc. Keley, J.H. - POLYMER PROCESSING - John Wiley (1962).

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6013	Nano Technology	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit - I

Supramolecular Chemistry:

Definition and examples of the main intermolecular forces used in supramolecular chemistry. Self-assembly processes in organic systems. Main supramolecular structures.

Unit - II

Physical Chemistry of Nanomaterials:

Students will be exposed to the very basics of nanomaterials; A series of nanomaterials that exhibit unique properties will be introduced.

Unit - III

Synthesis of Nonmaterial:

Methods of Synthesis of Nonmaterial. Equipment and processes needed to fabricate nano devices and structures such as bio-chips, power devices, and opto-electronic structures. Bottom-up (building from molecular level) and top-down (breakdown of microcrystalline materials) approaches.

Unit - VI

Biological Nanotechnology:

Biologically-Inspired Nanotechnology Basic biological concepts and principles that may lead to the development of technologies for nano engineering systems. Coverage will be given to how life has evolved sophisticatedly; molecular nano scale engineered devices, and discuss how these nano scale biotechnologies are far more elaborate in their functions than most products made by humans.

Unit - V

Nano Instrumentation:

Instrumentation for nano scale Characterization. Instrumentation required for characterization of properties on the nano meter scale. The measurable properties and resolution limits of each technique, with an emphasis on measurements in the nano meter range.

Suggested Readings:

1. Supramolecular Chemistry by Jean-Marie Lehn,
2. Supramolecular Chemistry by Jonathan Steed & Jerry Atwood
3. Intermolecular and Surface Forces by Jacob Israelachvili.

BE VI SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-6006	Chemical Process Plant Simulation-II	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	0	0	4	4	60	20

COURSE CONTENTS

Operations on following Software's

- ChemCad Part –II
- Pro-simulator Part –II