Course Contents

Course	Title	Code	Credits-4C			Theory Papers
DC 15	Process Equipment Design I	CM 601	L	T	P	Max.Marks-100
			3	1	-	Min.Marks-35
						Duration-3hrs.

Note 1: One question must be asked from each unit of twenty five marks each.
Note 2: Design data book approved by Chemical Dept Head and Exam Spdt may be permitted; (a copy of that must be preserved in Exam Center for at least a year)

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, tor-spherical, ellipsoidal, and conical closures, compensations of openings.
High pressure Vessels: Stress analysis of thick walled cylindrical shell, Design of monobloc and multiplayer 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.

References:

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 Co.

Course Contents

Category	Title	Code	Credit-6C			Theory Paper
DC 16	Organic Process Technology	CM602	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35
						Duration-3hrs.

Unit I Soaps and detergents: Pulp and paper, pulping process, chemical recovery, stock preparation and paper making,

Unit II Agro based alcohol industries, production of cane sugar, molasses, formation of alcohol, alcohol derivatives like acetic acid, acetic anhydride, vinyl acetate and ethylene glycol.

Unit III Intermediates for petrochemical from petroleum based stocks, phenol, methanol, ethylene, propylene, aromatic benzene, toluene, xylene, acrylo-nitrite, styrene and butadiene.

Unit IV Dyes and Dye intermediates, insecticides and pesticides, nitration and nitrating agents.

Unit V Man-made fibers; rayon, polyester, polyamides, acrylics, cellulose and acetate,

References:

1. Gupta VB & Kathari VK; Manufacturing Fibre Technology; Chapman Hall, Newyork I Edition
2. Kathari V.K.; Progress In Textile, Sciences Technology, Vol I & II; IAFL Publications, S-351 Greater Kailash part I New Delhi – 48 I Ed.
3. Austin, G.T; Shreeves Chemical Progress Industries; . Mc. Graw Hill New York
4. Dryden C.E; Outlines Of Chemical Technology; Affilicted. East West press, New Delhi, 1997

List of Experiment (Pl. expand it):

1. To determine BOD and COD of given water sample.
2. Preparation of acetic acid from ethyl alcohol
3. To find out the sucrose content in aqueous solution by polarimeter.
4. To evaluate the viscosity of molasses.
5. To determine percentage of formaldehyde in the formalene.
6. To determine iodine value of the given oil sample.
7. To determine the acetic acid, ethanol concentration in aqueous solutions.
8. To prepare azodye and finding the yield.
9. Prepare a standard phenol solution and estimate the % of phenol in the given unknown sample of phenol
10. To prepare urea formaldehyde resin and report % conversion.

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

Course Contents

Category	Title	Code	Credit-6C			Theory Paper
DC 17	Mass Transfer II	CM603	L	T	P	Max.Marks-100
			3	1	3	Min.Marks-35
						Duration-3hrs.

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: Equilibrium mechanism theory of drying, drying rate curve. Batch and continuous drying for tray driers, Drum dryers, spray and tunnel dryers.

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.

References:

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

List of Experiment (Pl. expand it):

To determine to diffusion coefficient of liquid vapour in air by Stefan's tube.
To study the rate dissolution of a rotating cylinder and then to calculate the mass transfer coefficient.
To investigate the mass transfer characteristic of a wetted surface column unit.
To investigate the characteristics of cooling tower.
To study the drying characteristics of a wet granular material using natural and forced circulation in tray dryer.
To prepare the drying rate curve for fluidized bed dryer.
To study the characteristics of spray dryer.
To study the characteristics of drum and Tunnel dryer.
Studies on solid-liquid extraction column.
To find out the crystal yields with and without seeds.
To draw the tie lines and plot equilibrium curve for given ternary system.
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.

Course Contents

Category	Title	Code	Credit-6C			Theory Paper
DC 18	Chemical Process Control	CM604	L	T	P	Max.Marks-100
			3	1	2	Min.Marks-35
						Duration-3hrs.

Unit I 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 Process instrumentation diagrams and symbols, process instrumentation for process equipments such as Distillation column Absorption column, Heat Exchanger, Reactors, Evaporators, fluid storage vessels.

Unit III 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 IV 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 V Stability concept, Routh stability criterion, relative stability, Hurwitz stability criterion, Nyquist's stability criterion. Root locus technique, introduction to frequency response, Bode diagram, Bode stability criterion, gain and phase margins, Ziegler Nichols controller setting.

References:

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.

List of Experiment (Pl. expand it):

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.

Course Contents

Category	Title	Code	Credit-6C			Theory Paper
DC 19	Chemical Reaction Engineering I	CM 605	L	T	P	Max.Marks-100
			3	1	3	Min.Marks-35
						Duration-3hrs.

Unit I Classification of reactions, Definition of reaction rate, Variables affecting the rate, concept of reaction equillibria, order of reaction and its determination, theoretical study of reaction rates, collision and activated complex theory, Mechanism of reaction series, Parallel and consecutive reaction, autocatalytic reactions, chain reaction, polymerization reaction.

Unit II Interpretation of kinetic data, Integral and differential method of analysis, variable volume reactions, total pressure method of kinetic analysis

Unit III Classification of Reactors: Concept of ideality, Development of design equations for batch, semi batch, tubular and stirred tank reactor, Design of Isothermal and non-isothermal batch, CSTR, PFR, reactors. Combination of reactors, Reactors with recycle, yield and selectivity in multiple reactions.

Unit IV Multiple Reactions in Batch, continuous stirred tank and Plug flow reactors uniqueness of steady state in continuous stirred tank reactor, optimum temperature progression, thermal characteristics of reactors.

Unit V Non ideal reaction, RTD dispersion model, Tank and series model, recycle model, segregated flow in mixed models, evaluation of RTD characteristics.

References:

1. Smith J.M; Chemical Engineering Kinetics; Mc Graw Hill.
2. Denbigh & Turner K.G; Chemical Reaction Theory An Introduction; United Press.
3. Copper & Jeffery's GVJ; Chemical Kinetics And Reactor Engineering; Prentice Hall
4. Levenspiel O; Chemical Reaction Engg; Willey Eastern, Singapore.
5. Houghen Watson & Ragatz; Chemical Process Principles Part Iii; Asian Pub-House Mumbai
6. Fogler H.S; Elements Of Chemical Reaction Engineering; PHI

List of Experiment (Pl. expand it):

1. To determine velocity rate constant of the hydrolysis of ethyl acetate by sodium hydroxide.
2. To study the rate constant of hydrolysis of an ester-catalyzed by acid.
3. Determine the rate constant and order of reaction between Potassium per sulphate and Potassium iodide.
4. To study temperature dependency of rate constant, evaluation of activation energy and verification of Arrhenius law.
5. To study a consecutive reaction system(hydraulic model)
6. To study a parallel reaction system (hydraulic model)
7. To study a homogeneous reaction in a semi-batch reactor under isothermal conditions.
8. Study of non catalytic homogeneous saponification reaction in CSTR.
9. To study a non-catalytic homogeneous reaction in a plug flow reactor.
10. To study the residence time distribution behavior of a back mix reactor.
11. To study the RTD behavior of a tubular reactor.
12. To study the RTD behavior of a packed bed reactor.
13. To study the behavior of a continuous flow reactor system-three reactor in series.
14. To study the kinetics of thermal decomposition of calcium carbonate.
15. To study a homogeneous catalytic reaction in a batch reactor under adiabatic conditions.
16. Study of non catalytic saponification reaction in a tubular flow reactor.

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

Course Contents

Category	Title	Code	Credit-4C			Theory Paper
DC 20	Chemical Process Plant Simulation-II	CM 606	L	T	P	Max.Marks-100
			3	1	0	Min.Marks-35
						Duration-3hrs.

Chemical Process Plant Simulation-II

1. Introduction to Polymath software Understanding its function & working
2. CHEM CAD Understanding its functions & working