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॥ अंतरी पेटवू ज्ञानज्योत ॥

North Maharashtra University, Jalgaon

Syllabus for Forth Year Engineering Degree Course

CHEMICAL

w.e.f. July,2001

C:\ENGINEERING\COVERPAGE.doc\PRAMOD CHAVAN

NORTRH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

B.E. (CHEMICAL ENGG.)

(SEMESTER: I)
(W.E.F. JULY-2001)

SR. No	CODE	SUBJECT	Teaching Scheme (Hrs / Week)		Examination Scheme				
			Lect	Pract	Duration Of paper (Hrs)	Max. Marks TH.	TW.	PR.	OR.
01		Elective *	04	02	03	100	25	--	--
02		Industrial Pollution & Control	04	02	03	100	25	--	25
03		Process Dynamics & Control	04	02	03	100	25	25	--
04		Chemical Reaction Engg—II	04	04	03	100	25	--	25
05		Project	--	02	--	--	50	--	--
06		Seminar	--	02	--	--	--	--	50
		Total	16	14		400	150	25	100
		Grand Total	30				675		

Elective * : A : Fuels And Combustion

B : Polymer Engg.

C : Energy Conservation & Recycling

D . Biochemical Engg.

B.E. (Chemical)

(Semester: II)

(W.E.F. July, 2004)

SR. NO.	CODE	SUBJECT	Teaching Scheme (Hrs/ Week)		Examination Scheme				
			Lect	Pract	Duration Of Paper (Hrs)	Max. Marks TH.	TW.	PR.	OR.
01		Computer Aided Process Equipment Design, Modelling & Simulation	04	04	03	100	25	25	--
02		Process Engg. Economics & costing	04	02	03	100	25	--	--
03		Chemical Plant Design & project Engg.	04	04	03	100	25	--	25
04		Transport Phenomenon	04	02	03	100	25	--	25
05		Technical Visit	--	--	--	--	50	--	--
06		Project	--	04	--	--	50	--	50
		Total	16	16		400	200	25	100
		Grand Total	32				725		

Total of Max. Marks of Semester I & II = 1400.

Elective A : Fuels & Combustion Technology

Teaching Scheme:
Lectures: 4 Hrs/Week
T.W./ Practicals.: 2 Hrs/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

Unit: I : 10 Hrs.

Introduction & classification of fuels. Wood ,wood charcoal & peat.
Origin,composition,characteristics & significance of constituents of coal.
Washing of coal. Storage of coal-oxidation. Carbonizaton of coal.

Unit: II : 10 Hrs.

Pulverised coal /Fuel . Uses of coal. Selection of coal for different uses.
Mineral waters in coal –ash & clinker formation. Properties & testing of coal.
Classification of coal.

Unit: III : 10 Hrs.

Origin, composition, classification & constituents of Petroleum—Indian Crudes.
Processing of crude oil—distillation . Cracking—Thermal & catalytic.
Polymerisation, Alkylation & isomerization . Purification of petroleum products .
Use of alcohols in liquid fuels.

Unit: 4: 10 Hrs.

Natural gas, LPG , Refinery gases. Producer gas & water gas. Blast furnace gas, & coke oven gas.
Coal gas from coal gasification processes. Oil gas from oil gasification process.

Unit:5 : 10 Hrs.

General principles of combustion. Types of combustion processes. Combustion of solid fuels.
Burners for liquid & gaseous fuels combustion. Fluidized bed combustion.
Application of thermal fluids.

T.W./Practicals:. It shall be based on the above syllabus

References:

1. Elements of Fuels , Furnaces & Refractories, O.P. Gupta,Khanna Publishers, Fourth Edn,Delhi.
2. Fuels & Combustion, S.Sarkar,Oriental Longman,1974.
3. Fuels & Combustion, S.P.Sharma & Chander Mohan, Tata McGraw Hill, Delhi, India.

Elective B : Polymer Engineering

Teaching Scheme:
Lectures: 4 Hrs/Week
Hrs/Week

Examination Scheme:
Paper: 100 Marks T.W./ Practicals: 2
T.W.: 25 Marks

Unit: I : 10 Hrs.

Introduction to polymer and their classification. Types of polymerization. Addition Polymerization and Condensation Polymerization & their mechanisms.
Bulk, solution, suspension,& emulsion polymerisation techniques; merits, demerits & applications of these techniques.

Unit: II : 10 Hrs.

Kinetics of polymerisation: Kinetics of free-radical chain ploymerisation via initiation; propagation & termination. Degree of polymerization & chain transfer reactions. Kinetics of catalyzed & uncatalyzed polycondensation reactions. M.Wt. distribution : extent of reaction & degree of polymerization of polycondensation reactions.

Unit: III : 10 Hrs.

Introduction to average moleculer weight & M.Wt. distribution in polymers. Measurements of number Average by cryoscopy; Ebwiometry ; membrane osmometry ; v.p.osmometry & end group analysis. Measurement of wt. Average M.Wt. by light scattering & ultra centrifuge. Measurement of viscoty avg.M. Wt. by viscometry.

Unit: IV : 10 Hrs.

Thermal analysis of polymer by differential Scattering calorimeter; TGA, TMA & HDT. Mechanical Properties like Tensile Strength, Young's Modulus, Hardness, etc.

Unit: V . 10 Hrs.

Properties, Applications & Manufacturing Techniques of polyethylene , PVC, Phenol formaldehyde urea formaldehyde resins, styrene-butadiene rubber (SBR), Nylon 6,6, Cellulose fiber (Reyon Yarn), PET.

T.W./Practicals: above It shall be based on the syllabus.

References:

1 Polymer science : V.R.Gowarikar,N.V.Vishwanathan,j.s.: Wiley Est Publn,Delhi.
2 Polymer Science · B.K.Sharma,Goel Publishing House;Meerut.
3.Text Book of Polymer Science: Fried W.Billmeyar,John Willey & Sons.
4. Dryden's Outlines of Chemical Technology:3rd edn ,M.Gopalarao & M.;East West Press.

Elective C : Energy Conservation & Recycling

Teaching Scheme:
Lectures: 4 Hrs/Week
T.W./ Practicals: 2 Hrs/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

Unit: I : 10 Hrs.

Conventional V's. Nonconventional sources, solar energy, thermodynamic & heat transfer aspects of Solar collection, energy storage, solar distillation, solar drying. Wind energy, wave & tidal energy, ocean thermal energy , geothermal energy.

Unit : II: 10 Hrs.

Energy from biomass, biomass conversion, biogas & biofuels. Energy from biowastes. Nuclear power, nuclear fusion. Hydrogen energy.
Heat recovery systems: recuperator, regenerator, Thermal/ Heat Wheels, Heat pipes & Heat pumps.

Unit: III:10 Hrs.

Waste Heat recovery systems,Direct contact Heat Exchangers,Heat pumps, Rankine power cycle, Incinerators, Waste Heat Boilers, Absorbers, Coolers, Heat pump & HeatTransformers.

Unit: 4 : 10 Hrs.

Efficient steam generation fluidised bed boilers, efficient use of steam traps, condensate collections & return, steam & gas turbine, cogeneration. Heat exchange network synthesis.

Unit: 5 : 10 Hrs.

Process heat recovery, energy conservation in energy intensive chemical process industries: Pulp & paper , cement, sugar, petrochemical & fertilizer industries.
Energy economics: Cost benefit
analysis of heat recovery systems.
Energy Auditing & Management.

T.W./Practicals. It shall be based on the above syllabus.

References:

1 Solar Energy:S.V.Sukhatme, Tata-McGraw Hill, New Delhi.
2. Energy & Technology Hand Book:Douglass C, McGraw Hill.

Elective D :Biochemical Engineering

Teaching Scheme:
Lectures: 4 Hrs/Week
T.W./ Practicals: 2 Hrs/Week

Examination Scheme:
Paper: 100 Marks
T.W.: 25 Marks

Unit: I : 10 Hrs.

Characteristics of biological matrial. Types Of microorganism; general physical properties of cells & chemical composition of cells; structure of cells; requirements for growth of cells & formulation of media ; reproduction cycles in microorganisms; changes in composition of cells with age & with growth rate: effect of substrate limiting growth on the composition of cells.Strain beeding. Maintainance of st. Cultures.

Unit: II: 10 Hrs.

Kinetics of enzyme catalyzed reactions: Enzymes & their uses, Immobilized enzymes & applications. Enzyme substrate complex & enzyme action. Simple enzyme kinetics with one & two substrates. Michaelis Menten kinetics & equation of parameters in it. Kinetics of reversible reaction. Substrate activation & inhibition. Multiple substrates reacting on a single enzyme. Effect of Temp & pH on enzyme activity . Kinetics of immobilized enzyme system.
Material balances in biocesses : Applications of material balances to bioprocesses, material balance with recycle, by-pass & purge streams.
Stoichiometry of growth & product formation.
Energy balances in bioprocesses : Heat of reaction for processes with biomass production. Thermodynamics of microbial growth.

Unit:III: 10 Hrs.

Microbial Kinetics : Balanced growth kinetics, Monod Growth Kinetics, Environmental Effects on Growth Kinetics, Trancient Growth Kinetics, Unstructured Batch Growth Model, Growth of filamentous organisms, Structured Kinetics Model, Product formation kinetics : Unstructured model, chemically structured kinetics model, Product formation kinetics by filamentous organisms.

Reactor configurations : Enzyme reactors, batch growth of microorganisms, continuous culture microorganisms, stirred tank reaction with recycle of biomass, continuous stirred tank fermentors in series, plug flow fermentors, fed batch fermentors, CSTR cell reactors with recycle and wall growth, multiphase reactors such as packed bed reactors, bubble column reactors, fluidized bed reactors and trickle bed reactors.

Unit: IV: 10 Hrs.

Sterilization : Importance of Sterilization, Batch Sterilization of liquids, continuous sterilization of liquids, filter sterilization of liquids, sterilization of air, thermal death kinetics of cells and sports.

Aeration & Agitation : Mass transfer and microbial respiration, bubble aeration and mechanical agitation, corelation between oxigen transfer coefficient and operating variables, effect of factors such as temperature, organic substrates, surface active agents, mycelium and types of sparger on the values of oxigen transfer coefficient. Scale up.

Unit: V: 10 Hrs.

Recovery of fermentation products, principle of mechanical separation; hindered settling in gravitation and centrifugal fields, filtration, pretreatment of cells to alleviated filtration resistance; Disruption of cells. mechanical methods, ultrasonic vibrations, grinding and mechanical shaping, shearing by pressure, induction by lysis (physical methods, lytic agents) dessication, increasing the fragility of cells. Extraction preliminary fractionation procedures (removal of nucleic acids precipitation), high resolution techniques (ultra filtration, chromatography, counter current distribution methods and other means).

Instrumentation & control : Introduction, methods of measuring process variables; temperature measurement and control, flow measurement and control, pressure measurement and control, foam sensing and control, weight of fermentor and estimation of microbial biomass, dissolved oxigen measurement and control, inlet and exit gas analysis, pH measurement and control, online analysis

of other chemical factors and computer applications in fermentation technology, bioprocess economics & automization with digital computerized fermentation technology.

T.W. /Practicals : It shall be based on the above syllabus.

References:

1. Biochemical Engg; Shuichi Aiba, Arthur E. H. & Nancy F.M., University of Tokyo Press.
2. Biochemical Engg. Fundamentals; James E.Bailey & David f. Ollis, McGraw Hill Publication.
3. Principles of Fermentation Technology; P.F.Stanbury, A. Whitaker & S.J.Hall, Aditya Books(p) Ltd; New Delhi.
4. Bioprocess Engg; D.Noran.

INDUSTRIAL POLLUTION AND CONTROL :

Teaching Scheme
Lectures : 4 hrs/week
T.W./Practicals . 2 hrs/week

Examination Scheme
Paper : 100 marks
TW : 25 marks
OR : 25 marks

UNIT - I : 10 hrs.

1.1 Introduction : Types of Pollution
1.2 Introduction : Pollution control aspects
1.3 Environmental Legislation
1.4 Water (Prevention and Control of Pollution) Act, 1974.
1.5 Air (Prevention and Control of Pollution) Act, 1981.
1.6 Industrial Waste Water Analysis.
1 7 Industrial Gaseous Effluent Analysis.
1.8 General Instruments for Gaseous Pollutants.

UNIT - II : 10 hrs.

2.1 Removal of BOD
2.1.1 Introduction to removal of BOD
2.1.2 Biological oxidation units : Activated Sludge Process; Trickling/Biological Filters; Waste Stabilization Ponds.
2.1.3 Anacrobic Treatment
2.1.4 Numerical Examples based on removal of BOD

2.2 Removal of Chromium
2.2.1 Introduction to removal of chromium
2.2.2 Control methods.
2.2.3 Reduction precipitation
2.2.4 Ion Exchange
2.2.5 Reverse osmosis
2.2.6 Lime coagulation and adsorption

UNIT - III . 10 hrs.

3.1 Removal of Mercury
3.1.1 Introduction of removal of mercury
3.1.2 Measurement of mercury
3.1.3 Ventron mercury - removal process.
3.2 Removal of ammonia/urea
3.2 1 Introduction to removal of Ammonia/Urea
3 2 2 Methods for removal of nitrogen
3.2.3 Physico-chemical processes
3.2.4 Biological methods.

UNIT - IV : 10 hrs.

4.1 Treatment of Phenolic Effluents
4.1.1 Introduction to Treatment of Phenolic Effluents
4.1.2 Sources of Phenols.
4.1.3 Treatment/Removal Methods : Steam Gas Stripping, Adsorption/ Ion-Exchange; Extraction of Phenols using Phenosolvan; Biological Methods of Treatment.
4.2 Removal of particulate matter
4.2.1 Introduction to removal of particulate matter
4.2.2 Gravity settling chamber, solid traps, cyclone separators, fibre filters, fabric filter, liquid scrubbers and ESP.
4.2.3 Numerical Examples based on settling chamber, cyclone separators, fibre filter, liquid scrubber and ESP.

UNIT - V : 10 hrs.

5.0 Pollution control in process industries.
5.1 Introduction to pollution control
5.2 Pollution control aspects of fertilizer industry
5.2.1 Introduction to Pollution control in fertilizer industry
5.2.2 Removal of carbon in ammonia plant effluents by scrubbing with liquids using vacuum filtration.
5.2.3 Removal of oil in ammonia plant Effluents.
5.2.4 Removal of hydrogen sulphide in Ammonia Plant Effluents.
5.3 Pollution control in petroleum and petrochemical units.
5.3.1 Introduction
5.3.2 Refinery liquid based treatment methods : Oxidation pond treatment, disposal of sludges.
5.3.3 Treatment of liquid effluents from petrochemical industries
5.3.4 Removal of hydrogen sulphide gas from sour gas by stripping
5.3.5 Removal of ammonia from gases.
5.4 Alcohol industry : Treatment method by recovery of potash from distillery spent-wash.

T.W./Practicals : It shall be based on the above syllabus.

REFERENCES :

1] Pollution control in process industries : S. P. Mahajan, Tata McGraw-Hill Pub., New Delhi.
2] Waste Water Treatment : M. N. Rao & A.K.Datta, IBH Pub., New Delhi.

PROCESS DYNAMICS & CONTROL

Teaching Scheme
Lectures : 4 hrs/week
T.W./ Practicals : 2 hrs/week

Examination Scheme
Paper : 100 marks
TW : 25 marks
PR : 25 marks

UNIT - I : 10 hrs.
Characteristics of Chemical Process Control, Mathematical Modelling of Chemical Processes, State Variables and State Equations for a chemical processes.

The Input-Output Model, Linearization of non-linear systems, Solution of Linear Differential equation using Laplace Transform.

First orders system and their transfer functions.

UNIT - II : 10 hrs.
Dynamic behaviour of first order system, Pure capacitive process, first-order system with variable time constant and gain. Response of first-order system in series : Interacting and Non-interacting.

Second-order system and their transfer functions

UNIT - III : 10 hrs.

Dynamic behaviour of second-order system : Underdamped and overdamped and critically damped systems, transportation lag.

Dynamic behaviour of higher order systems

Introduction to feedback control, controllers and final control elements.

Control action block diagram of chemical reactant control systems.

UNIT - IV : 10 hrs.

Dynamic behaviour of feedback control processes : P, PD, PI, PID.

Design of feedback controller : performance criteria, selection of type of controller. Tuning of feedback controller.

Stability analysis by Routh criteria and Root - Locus analysis.

UNIT - V : 10 hrs.

Frequency response analysis of linear processes : Bode's diagram, Nyquist plots.

Design of feedback control system using frequency response technique : Bode's stability criteria, gain and phase margin.

Ziegler - Nichols tuning technique.

Nyquist stability criteria, advanced control strategies : Cascade control, feed forward control, ratio control, selective control, split range control, adaptive and inferential control.

Introduction to analogue, digital computers and DCS.

TW/Practicals : It shall be based on the above syllabus.

REFERENCES :

1] Chemical Process Control : An Introduction to Theory & Practice, George Stephanopoulous, Prentice Hall of India.

2] Process System Analysis and Control : Dr. D.R.Coughnour, McGraw-Hill

3] Process Control : Peter Harriot, Tata McGaw-Hill

4] Principles of Process Control : D. Patranabis

CHEMICAL REACTION ENGINEERING - II

Teaching Scheme
Lectures : 4 hrs/week
T.W./ Practicals : 4 hrs/week

Examination Scheme
Paper : 100 marks
TW : 25 marks
OR : 25 marks

UNIT - I : 10 hrs.

Introduction, Rate Equation for Heterogeneous Systems.

Contacting Pattern in Two-Phase System, Introduction to Fluid Particle Reaction, Unreacted Core Model for Spherical Particle of Unchanging Size, Rate of Reaction for Shrinking Spherical Particles, Determination of Rate Controlling Step, Mathematics of Progressive Conversion Model Reactors for Fluid-Particle non-catalytic reactions.

UNIT - II : 10 hrs.

Introduction to Fluid-Fluid System (without catalyst), Rate Equation for Instantaneous, Fast, Intermediate and Slow Reaction, Slurry Reaction Kinetics, Rate Equation for Infinitely Slow Reaction, Film Conversion Parameter, Reactors for Gas-liquid reactions and their comparative evaluations on the basis of holdups.

Gas-liquid reactions Modelling on the basis of Simultaneous Absorption Reaction Model.

Aerobic Fermentation, Tower for Fast and Slow Reaction, Mixer Settler and Semi Batch Contacting Pattern.

Reactive Distillation and Exhactive Reaction.

UNIT - III : 10 hrs.

Introduction, Classification, Characteristics, Preparation and Deactivation of Catalyst. Promoters and Inhibitors, Determination of Surface Area and Pore Volume of Catalyst. Adsorption Process and its Classification, Types of Adsorption Isotherm.

UNIT - IV : 10 hrs.

Introduction to Solid Catalyzed Reactor. Rate Equation for Adsorption, Desorption and Surface Reactor. Deffusion and Reaction in Spherical Catalyst Pellets. Internal Effectiveness Factor. Overall Effectiveness Factor. Estimation of Deffusion and Reaction Limited Regimes. Mass Transfer and Reaction in a Packed Bed. The determination of Limiting Situation from Reaction Data. Chemical Vapour Deposition Reactors.

UNIT - V : 10 hrs.

Introduction to Heterogeneous Catalytic Reactors.

Design, Mechanical Construction and Applications of :

Moving Bed Reactors, Fluidized Bed Reactors, Slurry Bed Reactors, Trickle Bed Reactors.

Isothermal and Adiabatic Fixed Bed Reactors.

TW/Practicals : It shall be based on the above syllabus.

REFERENCES :

1] "Chemical Reactions and Reactor Design"
Ed : Hiroo Tominaga & Masakazu Tamaki
Wiley & Maruzene Publicatinos (1997)

2] "The Engineering of Chemical Reactions"
Lanny D. Schmidt, Oxford University Press (1998)

3] "Chemical Reactor Theory - A Review"
Ed. Lapidus L. and Amundson N.R. Prentice Hall Publication (1977)

4] "Principles of Chemical Kinetics"
J. E. House W. C. B. Publishers (1995)

5] "Chemical Reactor Analysis and Design"
Froment and Bischoff, Wiley Publications, New York (1979)

6] "Elements of Chemical Reaction Engineering",
H. Scott Fogler,Prentice Hall of India,2nd edn (1997)

7] "Chemical Engg. Kinetics",Smith J.M:3rd edn;New York,McGraw Hill (1981).

8] "Kinetics of Heterogeneous Catalytic Reactors" , Bardert,M.&G.Djega Mariadassav Prinsetom University press (19984).

9] "Heterogeneous Catalysis",White M.G;New Jerry, Prentice Hall,(1990).

10] "Chemical Reaction Engg.",O,Levenspiel,3rd edn,John Wiley & Sons,New York (1999).

PROJECT

The project topic shall consist of either some investigation work or design problem or experimental set-up of some development work or prototype equipment or dissertation related to the field of Chemical Engineering.

Project shall be taken in the beginning of the seventh term in consultation with concerned guide & must be completed in eighth term. The project proposal must be submitted in the beginning of the seventh term by every student or a group of students (not more than five students in a group).

The progress of the project shall be evaluated by a committee of internal teachers which shall include concerned guide also and shall award the term work marks. The oral examination of the project shall be conducted by concerned guide and external examiner jointly.

During seventh term, students are expected to complete at least literature survey of the concerned project or as per the instructions of the guide. a copy of the same shall be submitted to the concerned guide.

The total marks in the seventh and eighth term for the project shall be as follows.

Seventh Term	T.W.	50 marks (2 hrs/week)
Eighth Term	T.W.	50 marks (4 hrs/week)
Eight Term	Oral Exam.	50 marks

SEMINAR

Teaching Scheme	Examination Scheme
Practicals . 2 hrs/week	OR : 50 marks

During seventh term, every student individually will study a topic assigned to him and submit a report in a typed form and shall deliver a short lecture/seminar on the topic at the time of seminar oral examination. The topic assigned will be related to the field of Chemical Engineering.

The oral examination shall be conducted by a committee of teachers internally which shall include the concerned guide also and shall award the oral marks (during the seventh term or at the end of the seventh term).

COMPUTER AIDED DESIGN OF PROCESS EQUIPMENT, MODELLING AND SIMULATION

Teaching Scheme	Examination Scheme
Lectures : 4 hrs/week	Paper : 100 marks
T.W./ Practicals : 4 hrs/week	T.W. : 25 marks
	PR : 25 marks

UNIT - I : 10 hrs.

Computer Aided Design :

1.1 Shell and Tube heat exchanger.
1.2 Reactor.

UNIT - II : 10 hrs.

Computer Aided Design :

2.1 Single effect evaporator.
2.2 Distillation column.

UNIT - III : 10 hrs.

Computer Aided Design :

3.1 Absorption Column.
3.2 Rotary Dryer.

UNIT - IV : 10 hrs.

4.1 Introduction to lumped parameter model.

4.2 Comparison of model with real situation.

4.3 Modelling of an Activated Sludge process as a continuous operation by recycling biological sludge.

4.4 Modelling difficulties in a CSTR.

4.5 Modelling of constant holdup three CSTRs in series.

4.6 Modelling of batch reactor with first order consecutive reactions take place as time proceeds for study of optimal batch time.

4.7 Modelling for maximizing the yield of the intermediate (desirable) product.

4.8 Modelling for evaluation of the adiabatic equilibrium temperature.

4.9 Modelling for catalyst decay in a CSTR.

4.10 Modelling for evaluation of conversion with catalyst decay in batch reactor.

UNIT - V : 10 hrs.

5.1 Introduction to the Chemical Engineering Simulation.

5.2 Simulation languages.

5.3 When to use Simulation ?

5.4 Steps of Simulation Process.

5.5 Chemical Engineering applications of simulations techniques.

5.6 Advantages and limitations of simulation techniques.

5.7 Simulation of ammonia production system.

5.8 Simulation of catalyst temperature by Newton-Raphson method.

5.9 Simulation of CSTR by Eulers method.

5.10 Simulation of CSTR with second order irreversible exothermic reaction using Runga-Kutta metho

T.W./Practicals : It shall be based on the above syllabus.
REFERENCES :

1] Process Modelling, Simulation and Control for Chemical Engineers;
W. L. Luyben, 1988, McGraw Hill

2] Computer Aided Design of Chemical Process Equipment :
B. C. Bhattacharya & C. M. Narayanan, Ist Edition, 1992, NCBA, Calcutta.

NOTE : Students can utilize Fortran-77 and/or C and/or C++ programming/Simulation Language(s) for the above syllabus.

PROCESS ENGINEERING ECONOMICS & COSTING

Teaching Scheme

Lectures : 4 hrs/week
T.W./Practicals : 2 hrs/week

Examination Scheme

Paper : 100 marks
TW : 25 marks

UNIT - I : 10 hrs.

Scales of Production, Selection of Plant Capacity, Plant Location. Availability of Raw Material, Energy Gestation period. Expansion and diversification and obsolescence scope for standardization in design and production. Economics of Research and Development. Indian Chemical Industry, Current State and Trends.

UNIT - II : 10 hrs.

Cost Estimation : Factors affecting investment and production cost. Capital investment, fixed investment and working capital. Estimating equipment cost by 6/10 factor rule. Methods of estimating capital investment. Different cost involved in total product cost. Computer automization in costing.

UNIT - III : 10 hrs.

Interest and investment cost, simple and compound interest, nominal and affective rates of interest, continuous interest, ordinary annuity, perpetuities and capital costs. Taxes and Insurances : Types of Taxes and Tax Returns. Types of Insurance and Legal Responsibility.

UNIT - IV : 10 hrs.

Depreciation : Types of depreciation, service life, salvage value, present value and methods of determining depreciation, single unit and group depreciation. Causes of Obsolescence and Inadequacy.

UNIT - V : 10 hrs.

Profitability, alternative investments and replacements, mathematical methods of profitability evaluation, Cash flow diagram. Break even analysis, Balance Sheet, pricing issue method and income statement.

T.W./Practicals : It shall be based on the above syllabus.

REFENRENCES :

1] Plant Design and Economics for Chemical Engineers :
Peter M.S., Timmerhaus K.D., McGraw Hill.

2] Chemical Process Economics :
Happel & Jordon D.G.

3] The Chemical Economy
Reaben B.G. Burstall, M.L. Longman.

4] Plant Design for Chemical Engineers
Vilbrandt F. C. & C. E. Dryden, McGraw Hill.

CHEMICAL PLANT DESIGN AND PROJECT ENGINEERING

Teaching Scheme

Lectures : 4 hrs/week
T.W./Practicals : 4 hrs/week

Examination Scheme

Paper : 100 marks
T.W. : 25 marks
OR. : 25 marks

UNIT - I : 10 hrs.

Introduction to Chemical Engineering Plant Design and Project Engineering.

The role of Chemical Engineer in Chemical Plant Design. Chemical Engineering Design, need for Plant Design, Process Design.

Development of the project : Evaluation of a process, process research, research evaluation, process development, preliminary engineering studies, pilot plant, semicommiercial plant, commercial plant and commercial plant design factors.

Technical factors, economic factors, safety considerations, legal phases, sources of information.

UNIT - II : 10 hrs.

Process Design : Choice of Process continuous vs. Batch processing.

Process Equipment and Materials : Selection of Materials, Plan for Selection of Materials. Selection of Process Equipments, Equipment selection procedures, standard vs. special equipment.

Scale up method, types of flow sheet, development of process flow sheet from process information.

UNIT - III : 10 hrs.

Plant Layout : Introduction planning-layout, factors in planning-layout, methods of layout planning, unit area concept, two dimensional layouts, scale models, priciples of plant layouts, safety, utilities servicing, materials handling equipments, railroads and road, etc. Plant layout for Benzene hexachloride process.

Locating the Chemical Plant : Introduction, summary of factors in plant location. Economics of plant location, plant location factors, raw material supply, market and transportation, power and fuel supply, water supply, temperature, plant measures for conservation of water, legal restriction, federal water pollution act, climate, labour, community and site characteristics and waste disposal.

UNIT - IV : 10 hrs.

Site Preparations and Structures : Introduction, Site Preparation, Surface Evaluation, Foundations, Size and Shape of Foundations, Machinery and Equipment Foundations, Supports, Outdoor Plants, Selection of Building types, Building design principles, Flooring, Walls, Roof, Safety and higher protection, Air Conditioning, Heating and Ventilation. Cost Consideratinos for Plant Sites and Structures.

New Development in Management Techniques (PERT & CPM).

Project feasibility report.

UNIT - V : 10 hrs.

Process Auxiliaries : Introduction, Piping, Explanation of CODES, Selection of Piping, Pipe strength and wall thickness, Nominal Pipe Size (NPS), Criteria for Selection of Materials, Pipe sizing by ID, Choosing the final pipe size, Process steam piping, piping layout, piping insulation, methods of providing flexibility for piping.

T.W./Practicals : It shall consist of minimum 5 (five) half imperial size drawing sheets based on the above syllabus.

REFERENCES :

1] Chemical Engineering Plant Design
F. C. Vilbrandt and C.E. Dryden
McGraw Hill, New Delhi.

2] Plant Design and Economics for Chemical Engineers :
Peter M. S. and K.D. Timmerhaus, McGraw Hill.

3] Project Engineering with CPM and PERT :
Modes J. and Philips, Rheinhold.

4] Plant Design : Rase.

5] Perry's Chemical Engineer's Handbook.

TRANSPORT PHENOMENON

Teaching Scheme

Lectures : 4 hrs/week
TW/Practicals : 2 hrs/week

Examination Scheme

Paper : 100 marks (3 hrs.)
OR : 25 marks

UNIT - I : 10 hrs.

1.1 Introduction.
1.1.1 Transport Phenomenon and Unit Operations.
1.1.2 Equilibrium and Rate Processes.
1.1.3 Fundamental Variables and Units.
1.1.4 The role of Intermolecular forces.
1.1.5 Simple balance : Material and Energy.

1.2 Molecular Transport Mechanism :
1.2.1 The Analogy.
1.2.1.1 The Case for Heat Transfer
1.2.1.2 The Case for Mass Transfer
1.2.1.3 The Case for Momentum Transfer
1.2.1.4 The Analogous Forms
1.2.2 Heat, Mass & Momentum Diffusivites
1.2.2.1 Thermal conductivity
1.2.2.2 Diffusion Coefficient
1.2.2.3 Viscoty

UNIT–II: 10 Hrs.
2.1 Viscoty & Mechanism of Momentum Transport.
2.2 Velocity Distribution in Laminar Flow.

UNIT–III: 10 Hrs.
3.1 Thermal Conductivity & The Mechanism Of Energy Transport.
3.2 Temperature Distribution In Solids & In Laminar Flow.

UNIT–IV: 10 Hrs.
4.1 Diffusivity And Mechanism of Mass Transport.
4.2 Concentration Distribution In Solids & In Laminar Flow.

UNIT–V: 10 Hrs.
5.1 The Equation of Change for Isother System.
5.2 The equation of Change for Non-Isothermal System.

T.W./Practicals: It shall be based on the above syllabus.

References:

1. Transport Phenomenon: R.B.Bird;W.E.Stewart;E.N.Lightfoot;John Wiley & Sons;1994;Singapore.
2. Transport Phenomens: A Unified Approach:R.S.Brodsky & H.C.Hershey;McGraw Hill International Edn.
3. Momentum,Heat,And Mass Transfer;C.O.Bennett& J.E.Myers;McGraw Hill,1982.
4. Fundamentals of Momentum,Heat ,And Mass Transfer,3rd edn, James.R.Welty; .Charles.E.Wicks, & Robert.E.Wilson.

Technical Visit

Examination Scheme:
T.W : 50 marks

During seventh & eighth term, every student shall visit minimum three industries or organization pertaining to the Chemical Engineering arranged by college & accompanied by departmental teachers as per AICTE & University norms. The report of technical visit shall be submitted by every student at the end of eight term which shall be evaluated by the concerned teachers through through internal Viva-Voce.