BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8001	Process Piping Engineering	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit I

Classification of Pipes and Tubes:

IS & BS codes for pipes used in chemical process industries and utilities. Pipes of circular and non-circular cross section-velocity distribution, average velocity and volumetric rate of flow. Flow through curved pipes (Variable cross sections). Pressure drop for flow of Newtonian fluids through pipes. Resistance to flow and pressure drop. Effect of Reynolds and apparent Reynolds number. Recommended design methods.

Unit II

Non-Newtonian Time Independent/Dependent Fluid Flow:

Flow through process pipes, Shear stress, Shear rates behavior, apparent viscosity and its shear dependence, Power law index, Yield stress in fluids. Recommended design methods.

Time dependant behavior, Mechanical analogues, velocity pressure relationships for fluids, line. Recommended design methods.

Unit III

Pipe Line Design and Power Losses in Vertical Flow:

Flow of gas-liquid , liquid –liquid, gas-solid and liquid-solid mixtures in pipes, flow pattern, holdup, pressure gradients and empirical overall correlations, bubble flow pattern, slug flow pattern, annular mist flow pattern Recommended design methods.

Unit IV

Pipe Line Design and Power Losses in Horizontal Flow :

Flow of gas-liquid, liquid –liquid, gas-solid and liquid-solid mixtures in pipes, flow pattern, holdup, pressure gradients and empirical overall correlations, bubble flow pattern, stratified flow pattern, slug flow pattern, annular mist flow pattern, Lockhart Martinelli relations, Flow pattern regimes. Recommended design methods, Case studies.

Unit V

Introduction to software (Casesuse-II, Caepipe), Case studies in real problems from industries

Suggested Readings:

1. Govier, G.W. and Aziz K. - THE FLOW OF COMPLEX MIXTURES IN PIPE- Krieger Publication, Florida, 1982.
2. McKetta .John .J ,Piping Design Hand Book, Marcel Drekker
3. Mohinder L Nayyar, Piping Hand Book, McGraw Hill Book Co.
4. Rip Weaver ,Process Piping Design Vol.1, Gulf Publishing Co.
5. Coulson JM and Richardson *J.F.* - CHEMICAL ENGINEERING - Vol I,VI Edition, Butterworth Heinemann, British Library, Publications, Oxford, 1999.

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8002	Industrial Pollution Abatement	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	2	6	70	22

Unit- I

Introduction:

Legislation, standards for water and air. Effects of air pollutants on human health, vegetation and materials.

Unit - II

Wastewater Treatment:

Characterization of Industrial wastewater, primary, secondary and tertiary treatment, segregation, screening, equalization, coagulation, flocculation, precipitation, flotation, sedimentation, aerobic treatment, anaerobic treatment, absorption, ion exchange, membrane filtration, electro dialysis, sludge dewatering and disposal methods.

Unit - III

Air Pollution Control:

Sources and classification of air pollutants, nature and characteristics of gaseous and particulate pollutants, pollutants from automobiles. Air pollution meteorology, plume and its behavior and atmospheric dispersion,

Unit- IV

Control of Particulate and Gaseous Emissions:

Control of particulate emissions by gravity settling chamber, cyclones, wet scrubbers, bag filters and electrostatic precipitators. Control of gaseous emissions by absorption, adsorption, chemical transformation and combustion.

Unit- V

Solid Waste Management:

Hazardous and non-hazardous waste, methods of treatment and disposal, land filling, leachate treatment and incineration of solid wastes.

Suggested Readings:

1. Metcalf & Eddy, Inc., "Wastewater Engineering: Treatment and Reuse", 4th ed., Tata McGrawHill, New Delhi, 2003.
2. Modi, P. N., "Sewage Treatment and Disposal and Waste Water Engineering," Vol. II, Standard Book House, Delhi , 2001.
3. Peavy, H. S., Rowe, D. R. Tchobanoglous, G. "Environmental Engineering" ; McGraw Hill, 1995.
4. De Nevers, N., "Air Pollution Control Engineering", 2nd ed., McGraw-Hill, 2000.
5. Bhatia, S.C., "Environmental Pollution and Control in Chemical Process Industries," Khanna Publishers, Delhi, 2001.
6. Mahajan, S. P., "Pollution Control in Process Industries," Tata McGraw-Hill, New Delhi, 1998.

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8041	Optimization of Chemical Processes	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit- I

Formulation and Optimization:

Formulation of the objective function. Unconstrained single variable optimization: Newton, Quasi- Newton methods, polynomial approximation methods.

Unit-II

Unconstrained Optimization:

Unconstrained multivariable optimization: Direct search method, conjugate search method, steepest descent method, conjugate gradient method, Newton's method.

Unit-III

Linear Programming:

Linear Programming: Formulation of LP problem, graphical solution of LP problem, simplex method, duality in Linear Programming, two-phase method.

Unit-IV

Non linear Programming:

Non linear programming with constraints: Necessary and sufficiency conditions for a local extremum, Quadratic programming, successive quadratic programming, Generalized reduced gradient (GRG) method.

Unit-V

Applications:

Applications of optimization in Chemical Engineering.

Suggested Readings:

1. Edgar, T.F., Himmelblau, D. M., Lasdon, L. S., "Optimization of Chemical Process", 2nd ed. McGraw- Hill, 2001.
2. Rao, S. S., "Optimisation Techniques", Wiley Eastern, New Delhi, 1985.
3. Gupta, S. K., "Numerical Methods for Engineers", New Age, 1995.
4. Beveridge, G. S. and Schechter, R. S., "Optimization Theory and Practice", McGraw- Hill, New York,1970.
5. Rekllaitis, G.V., Ravindran, A. and Ragsdell, K. M., "Engineering Optimization- Methods and Applications", John Wiley, New York, 1983.

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8042	Process Safety & Hazard Management	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit- I
Introduction:
Origin of process hazards, Laws Codes, Standards, Case Histories, Properties of Chemicals, and Health hazards of industrial substances.

Unit - II
Toxicology:
Toxic materials and their properties, effect of dose and exposure time, relationship and predictive models for response, Threshold value and its definitions, material safety data sheets, industrial hygiene evaluation.

Unit – III
Fire & Explosion:
Fire and explosion hazards, causes of fire and preventive methods. Flammability characteristics of chemical, fire and explosion hazard, rating of process plant. Propagation of fire and effect of environmental factors, ventilation, dispersion, purifying and sprinkling, safety and relief valves.

Unit- IV
Energy Hazards:
Electrical hazards, noise hazard, radiation hazard in process operations, hazards communication to employees, plant management and maintenance to reduce energy hazards.
Risk Analysis: Component and plant reliability, event probability and failure, plant reliability, risk analysis,

Unit- V
Analysis and Assessment:
HAZOP AND HAZAN, event and consequence analysis (vapour cloud modelling) Designing for safety, measurement and calculation of risk analysis.
Hazard Assessment: Failure distribution, failure data analysis, modeling for safety, safety training, emergency planning ad disaster management, case studies.

Suggested Readings:

1. Crawl D.A. and Louvar J.A., Chemical process safety fundamentals with applications," Prentice Hall of India, New Delhi.
2. Wentz, C.A., "Safety health and environmental protection," McGraw Hill, 2001.
3. Smith, B.D., "Design of equilibrium state process," McGraw Hill I.
4. Van Winkle, "Distillation," McGraw Hill.

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8043	Pharmaceutical Technology	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	0	4	70	22

Unit I

Unit Operation in Pharmaceutical Industries:

Heat transfer, evaporation, distillation, drying, mixing, size reduction, crystallization, filtration, size separation, conveying, humidification, air conditioning and refrigeration.

Unit II

Production, Formulation and Quality control:

Formulation, development of sterile dosage forms. Production facilities, environmental control and personnel in the production of sterile dosage form, compounding, processing, filtration, sealing, sterilization, packing and labeling of sterile dosage forms. Quality control tests like sterility, pyrogen, clarify, safety and leakage testing.

Unit III

Tablets and Capsules:

Types of tablets. Manufacturing of tablets by wet granulation, dry granulation and direct compression. Tablet processing problems and defects, tablet standardization: hard- ness, friability, weights variation, disintegration, dissolution and content uniformity tests.

Capsules: Hard gelatin capsule, capsule size, formulation and preparation of filled hard gelatin capsules, soft gelatin capsule, soft gel - manufacturing procedures. Quality control of capsule.

Unit IV

Cosmetics and Toiletries:

Introduction, factors to be considered in the formulation of facial cosmetics, dentifrice's, deodorant, antiperspirants, shampoos, hairdressing and hair removers.

Unit V

Pharmaceutical Packing:

Packing components, types of packing containers and closures, materials used for and their pharmaceutical specification, method of evaluation, stability aspects of packaging materials.

Suggested Readings:

1. Leon Lachman, H.A. Lieberman, J.L.K. - THE THEORY AND PRACTICE OF INDUSTRIAL PHARMACY - Verghese Publishing House, Hind Rajasthan Building Dadar, Mumbai,400014.
2. Ganderton - UNIT PROCESS IN PHARMACY.
3. D. Hershey, Ed. - CHEMICAL ENGINEERING IN MEDICINE AND BODOGY - Plenum Press, New York.
4. CHEMICAL ENGINEERING IN MEDICINE - Chern. Engg. Progrer Syrnp Series No. c 66, Vol 62.

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8051	Novel Separation Techniques	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	2	6	70	22

Unit I

Introduction:

Introduction to separation process in chemical and Biochemical Industries, Categorization of separation processes, equilibrium and rate governed processes. Introduction to various new separation techniques e.g. Membrane separation, Ion-exchange foam separation, supercritical extraction, liquid membrane permeation, PSA & Freeze drying.

Unit II

Membrane Separation: Introduction

Membrane based Separation Techniques, Historical background, physical and chemical properties of membranes, Techniques of membrane preparation, membrane characterization, various types of membranes and modules.

Unit III

Membrane Operation and Design:

Osmosis and osmotic pressure. Working principle, operation and design of Reverse osmosis, Ultra filtration, Micro filtration, Electro dialysis and Pervaporation. Gaseous separation by membranes.

Unit IV

Ion Exchange:

Ion Exchange History, basic principle and mechanism of separation, Ion exchange resins, regeneration and exchange capacity. Exchange equilibrium, affinity, selectivity and kinetics of ion exchange. Design of ion exchange systems and their uses in removal of ionic impurities from effluents.

Unit V

New Techniques in Separation:

Introduction to foam separation, micellar separation, supercritical fluid extraction, liquid membrane permeation and chromatographic separation, Reactive separation and Hybrid separation.

Suggested Readings:

1. King, C.J., "Separation Processes", Tata McGraw-Hill.
2. Sourirajan, S. and Matsura, T., "Reverse Osmosis and Ultrafiltration - Process Principles," NR Publications, Ottawa, 1985.
3. Porter, M. C., "Handbook of Industrial Membrane Technology," Noyes Publication, New Jersey, 1990.
4. Henry, J. D. and Li, N. N., "New Separation Techniques", AICHE Today Series, AICHE (1975).
5. Hatton, T. A., Scamehorn, J. F. and Harvell, J. H., "Surfactant Based Separation Processes", Vol. 23, Surfactant Science Series, Marcel Dekker Inc., New York 1989.
6. McHugh, M. A. and Krukonis, V. J., 'Supercritical Fluid Extraction", Butterworths, Boston, 1985.

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8052	Petrochemical Technology	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	2	6	70	22

Unit – I

Introduction:

Importance size and scope of petro-chemical industry, principle of raw materials, precursors, intermediate and finished products viz. Chemicals from C1 to C4 compounds.

Unit –II

Feed Stocks:

Raw material for organic chemicals – coal, biomass, petroleum and natural gas, evolution of crude oil, petrochemical feed stocks – natural gas LPG, naphtha, kerosene, crude pyrolysis gasoline.

Unit –III

Separation and Reforming :

Separation of O- Xylenes, m- Xylenes and p-Xylenes methane and synthesis gas derivatives, steams reforming and partial oxidation formaldehyde, methanol chlorinated methane.

Unit – IV

C4- and C5- Cuts:

Treatment and upgrading of C4 and C5 cuts: Up gradation of C4 & C5 streams from crackers, MTBE aromatic production, Catalytic reforming aromatic conversion process, separation of aromatic, production of olefins from steam cracking of naphtha and natural gas.

Unit –V

Specific Intermediates:

Ethylene, propylene and butadiene and their derivatives product profiles of ethylene butadiene ethylene oxides, ethylene glycol propylene oxide, glycol and isopropyl alcohol. BTX Derivatives Nitrobenzene aniline, phthalic anhydride, caproiactum terephthalic acid, DMT, Maleic anhydride.

Suggested Readings

1. Charneal, A and Lafyte, G.L. –PETROCHEMICAL PROCESS- part- I & II, 2nd ed,Rue Ginux (1986)
2. Little, D.M. – CATAYTIC REFORMING – Pen Well Publishing House (1985).
3. Wisemen P.- PETROCHEMICALS – John Willey (1986)

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8053	Food Technology	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	3	1	2	6	70	22

Unit I

Introduction:

Introduction to food processing technology including calculations of processing parameters, unit operations involved with thermal technologies and non thermal technologies (Pulsed Electric fields)

Types of Food Processing: canning, freezing, Pasteurization and sterilization, fermentation, irradiation, packaging.

Unit II

Mathematical concepts:

Algebra, interpolation of data in tables, Graphs and curve fitting, calculus, problem solving on gases and vapors, mass balances, energy balances, fluid mechanics and heat transfer.

Physical properties of food and food processing system: Units and dimensions: Density and specific gravity, fluids viscosity, rheology and texture, surface, properties, thermodynamics of food, heat changes, diffusion and mass transfer

Unit III

Food Dehydration:

Factory organization, Preparation of plant, dryers and their classification, dehydration of potato products dehydration of vegetables, dehydration of fruits, spray dried products, dehydration of meat, soup, selection and storage of dehydrated products, quality control and economics of dehydration.

Unit IV

Separation Processes:

An overview, supercritical fluid extraction, Pressure activated membrane processes, Ultra-filtration, Ion exchange & innovative separation methods, Fractionation in fat, and solid separation processes.

Unit V

Quality Optimization and Assessment:

Quality optimization and minimal processing of foods, methodologies to optimize thermal processing conditions, process assessment of high pressure processing of fluid, high pressure treatment of fruit, meat and cheese product, equipments, quality and safety aspects of novel minimal processing technologies.

Suggested Readings:

1. Richardson, P., "Thermal Technologies in Food Processing," April 2001
2. Fellows, R.P., "FOOD PROCESSING TECHNOLOGIES, PRINCIPLES AND PRACTICES," 2nd ed.
3. Hartel, R.W. Howell,T.A, and Hyslop, D.B., "MATHEMATICS FOR FOOD ENGINEERING," University of Wisconsin USA.
4. Lewis, M.J., "PHYSICAL PROPERTIES OF FOOD AND FOOD PROCESSING SYSTEMS"
5. M.Gransmits, Gunness Peat group & APV, "PRACTICAL DEHYDRATION," 2nd ed. *Syllabus-page 82 of 147*
6. Randison, A.S.G. and Lewis M.J., "SEPARATION PROCESSES IN THE FOOD AND BIO TECHNOLOGY INDUSTRIES".
7. F.A.R. Oliveria, J.C. Olivenia, "PROCESSING FOODS QUALITY OPTIMIZATION AND PROCESS ASSESSMENT".

BE VIII SEMESTER CHEMICAL ENGG.							
COURSE CONTENTS (UEC SCHEME)							
CM-8005	Project Part-II	**L**	**T**	**P**	**C**	**Max. Marks**	**Min. Marks**
Duration	3 Hours	0	0	8	8	120	37

- All Experimental Projects should contain: Project Part–I and Completion including Experimentation, Results, Discussion and Conclusion

- All Plant Design Projects should contain: Project Part –I and Completion of equipment design, cost estimation safety, instrumentation, environmental considerations and conclusion