Advanced Elective-I

UG	Department: **Chemical Engineering**
Course Code: **CH404**	Course Name: **Advanced Separation Processes**
Credit: **3**	L-T-P: **3-0-0**
Version: **1**	Approved on:
Prerequisite Course: **Nil**	

Introduction

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.

Membrane based Separation Technique (MBSTs)

Historical background, physical and chemical properties of membranes, Techniques of membrane preparation, membrane characterization, various types of membranes and modules. Osmosis and osmotic pressure. Working principle, operation and design of Reverse osmosis, Ultrafiltration, Microfiltration , Electrodialysis and Pervaporation. Gaseous separation by membrances.

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.

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

Books

1. King, C.J., "*Separation Processes*", Tata McGraw-Hill.

2. Sourirajan, S. and Matsura, T., "*Reverse Osmosis and Ultra-filtration - Process Principles*," NRC 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.

UG Department: **Chemical Engineering**
Course Code: **CH406** Course Name: **Polymer Process Modelling**
Credit: **3** L-T-P: **3-0-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Classification of Polymer Processing Operations. Simple Model Flows for analyzing processing operations with examples. Extrusion and extruders. Calendering, Roller and Blade Coating, Film Blowing. Fiber spinning injection moulding, blow moulding, thermoforming, rotational moulding. Compression and transfer moulding. Reaction injection moulding. Compounding and mixing. Twin screw extruder. Banbury and other mixing equipments in polymer processing.

Books

1. Middleman, S., "Fundamentals of Polymer Processing," McGraw-Hill Book Company, NY, 1977.
2. Morrison, F.A., "Understanding Rheology," Oxford University Press, 2001.
3. Tadmor, Z. and Gogos C.G., "Principles of Polymer Processing," Wiley-Interscience, New York, 1979.

UG Department: **Chemical Engineering**
Course Code: **CH408** Course Name: **Process Safety and Hazards**
Credit: **3** L-T-P: **3-0-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Origin of process hazards, Laws Codes, Standards, Case Histories, Properties of Chemicals, Health hazards of industrial substances.
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.

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.

Other 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, 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.

Books

1. Crawl D.A. and Louvar J.A., “Chemical Process Safety Fundamentals with Applications,” Prentice Hall, 1990
2. Wentz, C.A., “Safety Health and Environmental Protection,” McGraw Hill, 2001.
3. Lees, F. P., "Loss Prevention in Process Industries", Vol.1 and 2, 2nd ed., Butterworth, 1996

UG Department: **Chemical Engineering**
Course Code: **CH410** Course Name: **Process Piping and Design**
Credit: **3** L-T-P: **3-0-0**
Version: **1** Approved on:
Prerequisite Course: **Nil**

Classification of pipes and tubes, IS and BS codes for pipes used in chemical process industries and utilities.
Pipes for Newtonian and non-Newtonian fluids, sudden expansion and contraction effects, Pipe surface roughness effects, Pipe bends, Shearing characteristics.

Pressure drop for flow of Newtonian and non-Newtonian fluids through pipes, Resistance to flow and pressure drop. Effect of Reynolds and apparent Reynolds number.

Pipes of circular and non-circular cross section velocity distribution average velocityand volumetric rate of flow. Flow through curved pipes (Variable cross sections). Effects of pipe fittings on pressure losses.

Non-Newtonian fluid flow through process pipes, Shear stress, Shear rates behaviour, apparent viscosity and its shear dependence, Power law index, Yield Stress in fluids, Time dependant behaviour, Thixotropic and rheopetic behaviour, mechanical analogues, velocity pressure relationships for fluids, line.

Pipe line design and power losses in compressible fluid flow, Multiphase flow, gas-liquid, solid-fluid, flows in vertical and horizontal pipelines, Lockhart-Martinelli relations, Flow pattern regimes.

Books

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering," Vol. I and VI, Butterworth Heinemann, 1999.
2. Govier, G.W. and Aziz K., "The Flow of Complex Mixtures in Pipe," Krieger Publication, Florida, 1982.
3. Green D.W. and Malony, "Perry's, Chemical Engineers Handbook,"7th ed., McGraw Hill, New York 1997.