

## 10. CHEMICAL ENGINEERING

### PAPER - I

**1. Fluid Mechanics:** Dimensional analysis, fluid statics, fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids in pipes – Friction factor, Hazen-Poiseuille equation. Turbulent flow, Transportation and metering of fluids. Calculation of pump power for transportation of fluids, flow meters – orifice, Venturi and Rotameters.

**2. Heat Transfer:** Conduction in solids – Steady state and unsteady state. Heat flow in fluids – overall heat transfer coefficient, Log-mean temperature difference, calculation of individual heat transfer coefficient and overall heat transfer coefficient. Fouling factors, Heat transfer to fluids without phase change – Thermal boundary layer, heat transfer by forced convection in laminar flow and in turbulent flow, empirical equations; Heat transfer from condensing vapors. Heat exchange equipment – Double pipe heat exchangers and evaporators.

**3. Mass Transfer:** Molecular diffusion in fluids, mass transfer coefficients, Distillation (binary system), gas absorption, drying and liquid extraction operations.

**4. Reaction Engineering:** Rate of reaction, variables affecting the rate of reaction. Interpretation of kinetic data in batch and flow systems. Theories of reaction rate, classification of reactors, design equations for batch and flow reactors.

**5. Thermodynamics:** First law of thermodynamics – Internal energy, Enthalpy, heat capacity, first law for open systems. Second law of thermodynamics – statement, entropy function, calculations of entropy changes. Free energy functions. Calculation of enthalpy and entropy as function of pressure and temperature, Heat effects. Criteria for equilibrium and their application.

**6. Mechanical Operations:** Size reduction, Properties, Handling and Mixing of particulate solids, Mechanical separations, Screening Filtration, Sedimentation, Conveying and Storage of solids.

### PAPER – II

**1. Process Technology :** Manufacture of following chemical products in process industries – Location and uses – Water, Soda ash, Caustic soda and Chlorine, Ammonia, Fertilizers – Industrial acids, Sulphuric acid, Nitric acid, Phosphoric acid – Industrial gases – Sugar, Pulp and paper, Cement, Electro thermal industries; Calcium carbide, Silicon carbide, Graphite, Coal chemicals, Pigments and Paints.

158

112

**2. Material and Energy Balances:** Basic calculations, Material balances with and without chemical reactions, energy balances, combustion.

**3. Instrumentation and Process Control:** Qualities of measurement, measurement of temperature, pressure and vacuum, liquid level, density and viscosity, composition and analysis. Process control \_ Automatic process control – Elements of a control system – Controllers modes of control and its applications.

**4. Petro Chemicals:** 1. Origin of petroleum. 2. Natural Gas : Composition application as fuel. 3. Petroleum Refining : Refining of crude petroleum, production of gasoline, kerosene, heating oils and residual fuel. Lubricants, asphalts and solvents. 4. History of petrochemical industry and alternative sources. 5. Characteristics of petrochemical manufacture. Techniques involved Naphtha cracking, alkylation, isomerization and polymerization to produce petro-chemicals. 6. Petro-chemicals and their application. 7. Classification of petro-chemicals according to source a) Ethylene derivatives b) Derivatives of higher paraffins c) Propylene derivatives d) Derivatives of C4 hydrocarbons e) Derivatives of higher olefins f) Derivatives of aromatics g) Economic aspects of petro-chemical industry in India.