

## CHEMICAL ENGINEERING (OIL TECHNOLOGY)

### I. CHEMICAL ENGINEERING:

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.
7. **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.
8. **Material and Energy Balances** : Basic calculations, Material balances with and without chemical reactions, energy balances, combustion.
9. **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.

## II. ELECTIVE/SPECIALIZATION : OIL TECHNOLOGY

### 1. Chemistry of Oils, Fats and Fatty Acids :

**i. Glycerides :** Structure and composition of oils & fats, definition, distinction between oils and fats, simple and mixed triglycerides, mono, and di-glycerides. Theories of even and random distributions of fatty acids in glyceride molecules.

**ii. Fatty Acids :** Saturated fatty acids, unsaturated fatty acids (acids with one, two, three and more double bonds) – Fatty acids of unusual structure : Hydroxy and di-hydroxy acids, acetylenic acids, epoxy acids and Keto acids – Artificially produced Fatty acids.

**iii. Non Glyceride Components of Oils & Fats :** Phosphatides – sterols, carotenoid pigments – tocopherol and other anti oxidants, flavour reversion, fat soluble vitamins A, D, E and K.

**iv. Chemical Reactions of Fats and Fatty Acids :** Hydrolysis, saponification and interesterification, saponification with alkali, hydrogenation of Carboxyl group, formation of nitrogen derivatives, formation of acid chlorides, dehydration hydrogenation and halogenation reaction in the fatty acid chain, sulfation and sulfonation, pyrolysis, atmospheric oxidation (Rancidity its occurrence, prevention and its evaluation) reaction of the hydroxyl group, polymerization and isomerisation.

### 2. Technology and Production of Oils & Fats :

**i)** Present status of oils & oil seeds in India.

**ii)** Post harvest technology : Storage and pretreatment of oil seeds.

a) Sources and classification of oils and fats.

b) Glyceride composition and important characteristics of the following oils:

3. Coconut, cotton seed, peanut, palm, sunflower, sesame, softlower, rice bran, rapeseed and mustard seed, linseed, soyabean, tung, castor oil lard and tallow.

4. Minor Oils : Neem Oil and Safflower.

a) Mechanical expression of oils,

b) Solvent extraction of oilseed and oil bearing material,

c) Fat splitting (Twitchall & Autoclave methods).

a) Refining and Bleaching : Degumming, alkali refining (batch refining), Miscella refining, refining losses – Bleaching by absorption – continuous bleaching.

b) Hydrogenation : Mechanism – selectivity as applied to the reaction and catalysis, Hydrogenation in practice (Batch & continuous) preparation of Raney Nickel catalyst.

c) Soap manufacture : Raw materials required, selection of raw materials – full boiled process.

d) Nutritional functions of fats.

e) Testing and important analysis of oils and fats in determining the quality and quantity of oils / fats and oilseed; such as moisture, oil content, F.F.A., protein content, color of the raw / refined oil.

## CHEMICAL ENGINEERING (POLYMERS AND PLASTICS)

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### II. ELECTIVE/SPECIALIZATION : POLYMERS AND PLASTICS

Introduction – Definition of Polymers, Classification of polymers, Functionality, Polymerization mechanisms – Chain polymerization (Free radical, anionic, cationic and coordination polymerization – Ziegler Natta catalyst), step polymerization (polycondensation, poly addition reactions).

Molecular weights of polymers and their determination methods – Number average molecular weight, Weight average molecular, Weight and viscosity average molecular

weight. Methods of determination – Cryoscopy, Ebulliometry, Light scattering and Viscometric methods.

Polymerization processes : Bulk polymerization, Solution polymerization, Suspension polymerization and Emulsion polymerization.

Fabrication processes : Injection moulding, Extrusion, Blow extrusion and extrusion blow molding.

Manufacturing Methods of a few common Polymers : LDPE, HDPE, Polystyrene, Polyvinyl chloride, Phenolic resins.

Status of Indian Plastics – Industry with respect to production, location of industries, demand etc.

## **CHEMICAL ENGINEERING (PETRO-CHEMICALS)**

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## **II. ELECTIVE/SPECIALIZATION : 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 C<sub>4</sub> hydrocarbons
  - e) Derivatives of higher olefins
  - f) Derivatives of aromatics
  - g) Economic aspects of petro-chemical industry in India.