

## POST GRADUATE DEGREE STANDARD

### PAPER -I

#### UNIT 1.1

##### PROCESS CALCULATION AND THERMODYNAMICS

Properties of gases, liquid, and gases, Ideal and real gas, Properties and mixture and solutions, Laws of conservation and mass and energy; use of tie components; recycle, bypass and purge calculations; Thermochemistry. First and second law of thermodynamics and their applications; equation of state and thermodynamic properties of real system; phase equilibria; fugacity; excess properties and correlations of activity coefficients; chemical reaction equilibria.

#### UNIT 1.2

##### FLUID MECHANICS AND MECHANICAL OPERATIONS

Fluid statics, Newtonian and non-newtonian fluids, Macroscopic energy balance, Bernouli equation and its applications, Dimensional analysis, continuity equation, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds, elementary boundary layer theory (laminar and turbulent flow) Thickness of boundary layer (definition and formulae). Size reduction and size separation; free and hindered settling; centrifuges and cyclones; thickening and classification, filtration; mixing and agitation; conveying of solids.

#### UNIT 1.3

##### MASS TRANSFER AND HEAT TRANSFER

Fick's law, mass transfer coefficients, film, penetration and surface renewal theories, momentum, heat and mass transfer, stagewise and continuous contacting and stage efficiencies; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, crystallization, drying, humidification, dehumidification and adsorption. Conduction, convection, and radiation, heat transfer coefficients, steady and unsteady hear conduction, boiling, condensation and evaporation; type of heat exchangers and evapators and their design.

#### UNIT 1.4

##### CHEMICAL REACTION ENGINEERING

Theories of reaction rates; kinetics of homogenous reactions, interpretation of kinetic data, single and multiple reaction in ideal reactors, non-ideal reactors; non-isothermal reactors, kinetics of heterogenous catalytic reactions; diffusional effects in catalysis.

#### UNIT 1.5

##### PROCESS CONTROL AND INSTRUMENTAL METHODS OF ANALYSIS

Measurement of process variables; dynamics of simple systems such as CSTR's, heat exchanges etc; transfer functions and response of simple systems, process reaction curve, controller modes (P,PI and PID); control valves; analysis of closed loop systems including stability, frequency response (including Bode Plots) and controller tuning Spectroscopic analysis; Absorption spectroscopy, emission spectroscopy, mass spectroscopy, x-ray diffraction, colour measurement by spectrometers, details of NMR. Gas analysis by thermal conductivity Moisture (humidity analysis) pH measurements, Chromatography - G.L.C; H.P.L.C.

#### UNIT 1.6

##### CHEMICAL PROCESSES

Study of the following processes:-

1 Nitration:- Nitration agents, kinetics and mechanism of aromatic nitration. Thermodynamics of nitration, Equipments for nitration, mixed acids for nitration and typical industrial nitration process e.g. preparation of nitrobenzene, nitronaphthalene, Chloronitronaphthalene and nitro acetanilide.

2 Sulphonation and Sulfation:- Sulphonation and sulfating agents: Kinetics, mechanism and thermodynamics, Industrial equipment and techniques, Technical preparation of sulphonates and sulphate, such as aliphatic sulphonates, sulphonation of laury alcohol, dimethyl ether, etc.

3 Hydrogenation:- Catalytic Hydrogenation, Kinetics and thermodynamics of hydrogenation reaction. Apparatus and material of construction, hydrogenation of fatty oils, synthesis of methanol, Hydroforming of naphtha, Hydrogenation of heavy oils.

4 Halogenation:- Thermodynamics and kinetics of halogenation, Photohalogenation, Equipment and design for halogenation Technical preparation of halogen compounds e.g. allyl chloride, DDT; BHC; Chlorobenzene, dichlorodifluoromethane, vinyl chloride etc.

5 Oxidation: Liquid and vapour phase oxidation, Kinetics and thermodynamics, apparatus for oxidation, Technical oxidation of isoeugenol acetaldehyde, chloroethane, isopropyl benzene, naphthalene, benzene, ethyl benzene and naphthalene sulfonic acid.

#### UNIT 1.7 FERMENTATION

Industrial alcohols, raw materials, making of industrial alcohols, Absolute alcohol. Beer: Raw material; manufacture of beer. Wine, Butyl alcohol.

#### UNIT 1.8 WATER AND WASTE WATER TREATMENT

Source of water, Impurities in water, Requirement of water by different industries, treatment of water for industrial and domestic purpose, boiler feed water treatment, reuse of water, water conservation. Classification of waste waters, Methods of treatment, Sludge treatment and disposal, treatment of effluent water from textiles, rayon, pulp, dairy, distillery. Petroleum refinery, electro-plating tanning, coal mining and radioactive waste.

#### UNIT 1.9 INDUSTRIAL AND FUEL GASES

Manufacture, alternative, method of manufacture and application of Carbon dioxide, Hydrogen, Oxygen and Nitrogen; Rare gases of the atmosphere; Helium; Acetylene; sulfur dioxide; Carbon monoxide; and Nitrous oxides. Occurrences, composition and uses of Natural gas Purification of Natural gas; Coke-oven gas; Producer gas; Water gas; Synthesis gas; Substitute Natural gas; and Liquefied petroleum gases.

#### UNIT 1.10 ACIDS, ALKALIS AND SALTS

A Raw Materials for phosphoric acid and their occurrence; Manufacture of phosphoric acids and their applications.

B Raw material for nitric acids and their occurrence; Manufacture of Nitric acid.

C Mining, manufacture and applications of sulfur; Sulfuric acid. Purification and recovery of used sulfuric acid. Concentration of sulfuric acid.

D Hydrochloric acid. Raw material and manufacture of Soda ash, Sodium bicarbonate, Chlorine and Caustic soda, Bleaching powder, Calcium Hypochlorite; Sodium Hypochlorite; Unit operations and chemical conversions involved therein. Sodium chloride or common salt, sodium sulfate, sodium bisulfate, or Niter cake, Sodium Bisulfite ; Sodium Sulfite, Sodium Hydrosulfite; Sodium sulfide, Sodium Hydro

Sulfide, Sodium Thiosulfate; Sodium Nitrite; Sodium Silicates; Sodium peroxide, Sodium perborate; Sodium amide; Sodium cyanide and Ferricyanide.

## PAPER -II

### UNIT 2.1

#### SURFACE COATINGS

Convertible and non-convertible coatings; Chemical nature of coatings and their properties; Raw materials for surface coatings; Constituents of paints; Varnishes; Lacquers and printing inks. Inorganic and Organic pigments and their specific purposes, Printing Inks.

### UNIT 2.2

#### OILS, FATS, WAXES, SOAPS AND DETERGENTS

Occurrences of oils, fats and waxes. Their classification, chemical composition, Extraction and refining oils and fats. Manufacture of edible oil and fat products like: vanaspati, margarine, shortening etc. Technology of fat splitting.

Surfactant: Concept of surface activity, structure of surfactant molecule; Hydrophilic-lipophilic balance; Mechanism of detergency. Classification of surfactants; Biodegradation of surfactant; application of surfactants.

Soap: Raw material for soap; classification and selection of raw materials; Manufacture of soap.

Detergents: Classification of raw materials, plant and process employed in manufacture of detergents; Applications.

Glycerine: Manufacture of glycerine from natural sources, sweet waters, spent lye, synthetic glycerine; Properties, analysis and utilization of glycerine.

### UNIT 2.3

#### COSMETICS, ESSENTIAL OILS, FRAGRANCES AND FLAVOURS

Cosmetics: Classification and manufacture of cosmetic preparations such as Shampoo, shaving creams, hair conditioners, cold cream, vanishing cream, nail polishes, lipsticks, face powders, and toothpastes.

Essential oils: Classification and chemical constituents of essential oils, methods of extraction of essential oils; Natural and synthetic perfumery materials for industrial uses; Composition of perfumes, Natural fruit concentrates.

Flavor-Essence Formulations.

### UNIT 2.4

#### AGROCHEMICALS AND FERTILIZERS

Classification and manufacture of Insecticides and pesticides, Sulfur and sulfur compounds, Plant derivatives, Pyrethrins, Nicotine, Rotenone, Attractants and repellents, Fumigants, Nematicides, Acaricides, Rodenticides, Fungicides, Industrial Biocides, Plant growth regulators, Herbicides. Raw material for fertilizers; Synthesis of ammonia, Ammonium nitrate, ammonium sulfate, Ammonium Phosphates; Urea, Superphosphates, Mixed fertilizers.

### UNIT 2.5

#### PULP AND PAPER

Raw material for pulp, manufacture of pulp and paper. Hydrolysis of wood, Wood extractives and conversion products. Occurrences, distribution and morphology of Cellulose; Hemicellulose, lignin and associated materials in plant. composition of cell walls. Physical and Chemical properties of cellulose; Chain structure of cellulose; reaction of cellulose with water, aqueous alkali, organic bases, ammonia and salt solutions, etc. Oxidation of cellulose, chemical, thermal and biological cellulose. Derivatives of cellulose; Technology of Cellulose esters and others and their application.

#### UNIT 2.6

##### PHARMACEUTICALS Classification:

Alkylations, Carboxylation and Acetylation; Condensation and Cyclization; Dehydration; Halogenation; Oxidation; Sulfonation; Amination; Complex Chemical Conversions; Radioisotopes in Medicine; Fermentation and Life processing for antibiotics, Biologicals, Hormones and Vitamins, Biologicals, Steroids Hormones; Vitamins; Isolates from Plants and Animals.

#### UNIT 2.7

##### PETROLEUM PROCESSING

Origin, Occurrence, exploration of crude petroleum; Classification of crude oils, Hydrocarbon composition of petroleum and petroleum products (liquid and gas); Refining of crude oil, Products of refining. Catalytic cracking, thermal cracking; reforming/ platforming. Chemical conversions, Manufacture of various organic chemicals.

#### UNIT 2.8

##### POLYMERS, PLASTICS AND RUBBERS:

Types of polymers, Thermoplastics and thermosettings, Linear, branched, cross linked polymers and copolymers. Polymerisation Types and Methods; Distinctive features of addition and condensation polymerisation. Degradation of polymers through thermal, mechanical, chemical and other agencies. Raw materials for polymers and resins. Chemistry of Natural resins and polymers such as lac, rosin, cellulose, rubber, proteins, fossil resins, etc. Preparation and applications of phenolics, amino resins, polyesters, polyamides, epoxides, polyureathanes, vinyls and others. Raw materials, manufacturing processes and applications of plastics. Composites: Raw materials, Comparison of different materials with composite; advantages and disadvantages Natural rubber, synthetic rubber, rubber compounding, rubber fabrication; latex compound, rubber derivatives.

#### UNIT 2.9

##### NUCLEAR INDUSTRIES, EXPLOSIVES, PROPELLENT

Nuclear reactions: uranium and Thorium fission; Uranium as an energy source; Nuclear fuels, Processing of nuclear materials. Types of explosive, Explosive characteristics; Industrial Explosives; Miscellaneous Industrial Explosive; Uses.

#### UNIT 2.10

##### COAL CHEMICALS AND INDUSTRIAL CARBON

The destructive distillation of coal; Coking of coal; Distillation of coal tar; methods of distillation; coal to Chemicals.

Methods of manufacture and applications of : Lampblack; carbon black; activated carbon; Natural graphite; Manufactured graphite and carbon; Industrial diamonds.

#### UNIT 2.11

##### CERAMIC AND GLASS

Basic Raw Materials; Chemical conversions, Including, Including Basic Ceramic Chemistry; Whitewares: Structural Clay products; Refractories; Specialized Ceramic products: Vitreous Enamel; Kiln, Composition of glass, raw materials for glass, method of manufacture and speciality glasses.

#### UNIT 2.12

##### CEMENT AND LIME

Portland Cement: Types of Portland cements; Raw materials for cements; Setting and Hardening of cement; Manufacturing processes of Portland cements; Occurences, Manufacture and use of Lime and Gypsum.

#### UNIT 2.13

##### FOOD AND FOOD BY-PRODUCTS:

Food Chemistry, Nature and origin of life, Basic additives of animals and plants and their relations. Water

and Ice: Importance of water in food, Structure of water and ice, Concept of bound and free water and their implications. Nomenclature, Classification and structure of carbohydrates, Physical and chemical properties of sugars, starch, pectic substances, gum and other polysaccharide, Functional properties of carbohydrates in foods. Definition and classification of lipids, chemistry of fatty acids and glycerides. Functional properties of lipids in foods. Importance of Proteins, Nomenclature, classification, structure and chemistry of amino acids, peptides and proteins, Source and distribution of proteins, Isolation, identification and purity of proteins. Denaturation, functional properties of proteins in foods. Plant cells and tissues, their structure, functions and physiology, chemical composition of edible plant tissues, Texture of fruits and vegetables, Plant pigments, Effects of cooking on texture and composition of fruits and vegetables Animal proteins, Structure and chemical composition of muscles. Composition of milk, Physical and chemical properties of milk proteins and effects of processing on these, chemistry of milk products like cheese, cream, butter, ghee, etc. Sensory perception of tests and flavours. Browning reactions, Nutritive and non-nutritive sweeteners, Food dispersions and their implications of foods.