

Tamil Nadu Public Service Commission
Syllabus
Chemistry and Chemical Technology
(PG Degree Standard)

Code: 530

Unit I: Solid State Chemistry (20 Questions)

Crystal systems – Designation of crystal faces. Lattice structure and unit cell, law of rational indices – Bragg's Law and X-ray diffraction by crystals – Determination of crystal structure by Bragg's Method – Structure of NaCl, Wurzite, TiO_2 and Spinel - Crystal defects: Stoichiometric and non-Stoichiometric defect – line and plain defects - Schottky and Frenkel defects – Electrical Properties – Insulators and semiconductors – Band theory of solids – Superconductors – Nanomaterials preparations and properties

Unit II: Electrochemistry (20 Questions)

Types of Reversible electrodes - Nernst equation – Calculations of thermodynamic quantities of cell reactions – Overpotential and hydrogen over voltage – Determination of pK_a of acids by potentiometric methods – Kohlrausch's law – Ostwald's dilution law – Debye – Huckel Onsager equation for strong electrolytes -Primary and secondary fuel cells – Corrosion and prevention – Dry cells and storage batteries.

Unit III: Instrumentation Method of Analysis and Spectroscopy (20 Questions)

Adsorption, partition chromatography - Gas chromatography (GC) – High Pressure Liquid Chromatography (HPLC) - Solvent extraction and ion exchange methods- Atomic absorption spectroscopy, Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Colorimetry (DSC) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS).

Rotational spectra of diatomic molecules - Isotopic substitution and rotational constants – Vibrations spectra of linear symmetric. Linear asymmetric and bent triatomic molecules – Electronics spectra – selection rules – Nuclear magnetic resonance – Chemical shifts – Spin-Spin coupling – Electron spin resonance and mass spectroscopy for structural elucidation of organic compounds.

Unit IV: Nuclear Chemistry (20 Questions)

Nuclear reactions - nuclear cross section - Q-Values, coulombic barrier, threshold energy and excitation function – different types of nuclear reaction transmutation, stripping and pick-up reactions-isotope distribution - neutron activation analysis. - radioactive equilibria –Carbon dating – counting techniques.

Projectile capture and particle emission, spallation, nuclear fission, nuclear fusion – proportional counter, Geiger-Muller counter, scintillation counter and Cherenkov counter – linear accelerator, cyclotron and synchrotron.

Unit V: Metallurgy (20 Questions)

Occurrence, extraction and various methods of concentration of ore, types of furnaces used in metallurgy Important alloys of Pb, Sn, Ti, V, Cr, Fe, Zn, Al, Fe, Au, Ag and Cu with special reference to steel and alloy steels.

Polymers: Different types of Polymerizations – Synthesis and application of polyethylene, Teflon, Polystyrene, Polyester, and Poly Vinyl Chloride (PVC)

Analysis of Soil:- Moisture, pH, Total nitrogen, phosphorus, silica, lime, magnesia, Manganese Sulphur and alkali salts.

Unit VI: Chemical Process Calculations, Thermodynamics and Mechanical Operations (20 Questions)

Properties of solids, liquids and gases, Material and Energy balances, Material balance involving recycle, by - pass and purge streams.

Thermodynamic functions - Chemical and Phase Equilibrium - Laws of Thermodynamics - Ideal and non - ideal gases and solutions, fugacity, partial molal properties.

Laws of size reduction, Gravity settling, hindered settling, sedimentation, centrifuges, cyclones. thickeners, filtration, mixing and agitation, conveying of solids.

Unit VII: Fluid Mechanics and Heat Transfer (20 Questions)

Newtonian and non - Newtonian fluids, compressible and non - compressible fluids, flow through pipeline systems, packed and fluidized beds, Continuity and conservation equations. Bernoulli equation and its applications, Dimensional analysis, flow meters, pumps and compressors.

Fourier's law of heat conduction, convection and radiation, Heat transfer with phase change, heat exchangers, Heat transfer in extended surfaces, heat transfer coefficient for flow through pipes. Radiative heat transfer – Black body radiation, Emissivity, Stefan - Boltzman law, Planck's law.

Unit VIII: Reaction Engineering, Mass Transfer, Computational Chemical Engineering (20 Questions)

Rate equation, elementary and non - elementary reactions, theories of reaction rate and Predictions, Design equation for constant and variable volume batch reactors.

Homogeneous reactor systems, the residence time distribution, basic models for non - ideal flow; conversion in non - ideal reactors.

Diffusion, Theories of mass transfer, Analogy, inter - phase mass transfer, Distillation, absorption, liquid - liquid extraction, leaching, Crystallization, Adsorption, Drying, Humidification and De - humidification.

Laplace transformation, application to solve ODEs. open loop and closed loop systems, principles of pneumatic and electronic controllers, Instrumentation: Sensors for Pressure, Flow, Temperature, Control valves, Micro processor – based control.

Unit IX: Chemical Process Industries (20 Questions)

Manufacture of Soda ash, Chlorine and Caustic soda, Bleaching powder, Sodium sulfide, Sodium Silicates; Sodium peroxide. Manufacture of phosphoric acid, nitric acid, Sulfuric acid and Hydrochloric acid.

Manufacture of Industrial alcohols. Extraction and refining of oils, fats and waxes.

Surfactant: Classification, Biodegradation and applications. Manufacture and applications of soap and detergents.

Classification of crude oils, composition of petroleum and petroleum products (liquid and gas); Refining of crude oil, Catalytic cracking, thermal cracking; reforming. Extraction of Aromatics.

Classification and manufacture of Insecticides and pesticides, Raw material for fertilizers: Synthesis of ammonia, Ammonium nitrate, Ammonium Phosphates; Urea, Super phosphates, Mixed fertilizers, organic fertilizers.

Manufacture of pulp and paper, Cellulose, Hemi cellulose, lignin and associated materials.

Manufacturing processes of plastics, Natural rubber, synthetic rubber, rubber fabrication, latex compound, rubber derivatives, Hormones and Vitamins

Unit X: Explosives, Cement and Biological Compounds (20 Questions)

Types, Characteristics & Uses of explosive, Industrial Explosives, coking of coal, manufacture of graphite, carbon.

White wares: Structural Clay products, Refractories, Specialized Ceramic products, manufacture of specialty glasses.

Portland cement: Raw materials and Manufacture, Setting and Hardening of cement, Manufacture and use of Lime and Gypsum.

Classification and structure of carbohydrates, Physical and chemical properties of sugar, starch, other polysaccharide, lipids chemistry of fatty acids, Amino acids, Peptides and Proteins.

Plant pigments, vegetable proteins, Physical and chemical properties of milk proteins, chemistry of milk products.

Dated: 25.03.2025