DEPARTMENT OF INDUSTRIAL CHEMISTRY
FACULTY OF SCIENCE
Syllabus for Ph.D Admissions Test 2026-27 onwards

SECTION-B

1. Applications in organic synthesis: Functional groups interconversion (Retrosynthesis approach), Connection and disconnection approach, Protection-deprotection of functional groups; named reactions: Prins reaction, Sharpless epoxidation, Suzuki reaction, Stork enamine reaction, Stille coupling reaction, Mcmurry reaction, Aldol reaction, Bayer-Villiger oxidation; Rearrangements: Beckmann, Favorskii, Fries, Hofmman, Wagner-Meerwin; Reagents: N,N Dicyclohexyl carbodiimide (DCC), trimethylsilyl iodie, Gilman's reagent, lithium diisopropylamide (LDA), osmium tetroxide, 1,3-dithiane, lithium dimethylcuprate etc. ; organic reactive intermediates: generation, stability and reactivity of carbocations, carboanions, free radicals, carbenes, benzynes, nitrenes; Stereochemistry: Chirality of organic molecules with or without chiral centres and determination of their absolute and relative configurations (R-S and E-Z nomenclature), Erythro and Threo isomers, Configurational and conformational isomers, Stereochemistry of allenes, ansa compounds, biaryls; Group theory: symmetry operations, symmetry elements, point groups and their applications.

2. Spectroscopy and analytical techniques: Structure determination of organic compounds by IR, UV-Vis, ^{1}H and ^{13}C NMR; Instrumentation and working principle of AAS, ICP-AES, HPLC, GC-MS; titrimetry, gravimetry, chromatography (Paper Chromatography, TLC), Flame photometry.

3. Corrosion: Different chemical corrosion and their mechanisms, factors influencing corrosion and their control, corrosion rate expressions and allowances, corrosion reactions and free energy change, corrosion control by cathodic and anodic protection, organic coating, electro and electroless plating
Catalysis: activation energy concepts of catalysis, green catalysis, nanocatalysis, phase transfer catalysis, metalloenzymes (carbonic anhydrase, xanthine oxidase, vitamin B_{12} and B_{12} coenzyme); Surface characterization of catalysts: XPS, Auger spectroscopy; metal catalyst in industries: Fisher tropsch reaction, Ziegler-natta polymerization.

4. Polymer Chemistry: Molar masses, kinetics of polymerization, molecular weight and molecular weight distribution: average molecular weight, number-average and weight-average molecular weights, sedimentation and viscosity average, molecular weights, practical significance of molecular weight and molecular weight distribution, size of polymer molecules, determination, of molecular weight (viscosity, osmometry, light scattering).
Polymer properties: Glassy state and glass transition temperature, factors influencing Tg and Tm, Importance of Tg, amorphous state, viscoelasticity and five regions of

viscoelastic behavior of polymers, rubber elasticity, mechanical properties of polymers, polymer degradation Thermal, oxidative, photo-degradation), polymer stabilization.

5. Chemical Reaction Engineering: Rate of reaction, elementary and non-elementary reactions, molecularity and order of reaction, mechanism of reaction, temperature dependency from thermodynamics, Arrhenius and collision theories, Integral and differential methods for analyzing kinetic data, Interpretation of constant volume batch reactor data for zero, first, second and third order reactions, half-life period, auto catalytic reaction, interpretation of variable volume batch reactor data for zero, first and second order reactions, enzyme catalyzed reactions. Industrial reactors, space time and space velocity. Design of single ideal reactor-batch, CSTR. Multiple reactions: Independent, parallel and series reactions, instantaneous and overall fractional yield;
Heat Transfer: steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers. Mass transfer: Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories, design and operation of equipment for distillation, leaching, liquid-liquid extraction, drying, and adsorption.

6. Pollution and its control: Air, water and soil pollution, Classification, control and remediation. Solid waste management: treatment and disposal of hazardous and non-hazardous solid waste, E-waste treatment. Composting, Carbon Sequestration, Bioenergy and biofuels, Anaerobic digestion for methane production. Environmental Impact Assessment (EIA): Criteria for the selection of EIA methodology; Impact identification, measurement, interpretation & evaluation.

7. Industrially Important Chemicals: Manufacturing processes of acetic acid, acrolein, acetaldehyde, aniline, benzoic acid, citric acid, glycerol, oxalic acid, phthalic and maleic anhydride, phenol; Cosmetics and dyes: different manufacturing techniques for shampoos, talcum powders, lipsticks, hair dyes.

8. Interdisciplinary topics: Chemistry in nanoscience and technology, Photo and green chemistry, Environmental Chemistry, Separation technology.