

RECRUITMENT FOR THE POST OF JUNIOR TECHNICIAN (CHEMISTRY)

Syllabus for 2 Levels of selection process

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**Level-1 Test: Syllabus for Computer-based Multiple Choice (MCQ) Test:**

**1. General Aptitude:** English comprehension, vocabulary, grammar; verbal and nonverbal reasoning; quantitative reasoning; general science

**2. Solids, liquids, and gases Classification of solids based on different binding forces:**

Molecular, ionic, covalent and metallic solids. Crystal system – unit cell and voids. Surface tension effect of temperature on surface tension; Viscosity -effect of temperature, effect of pressure; Solutions -concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions; Colligative properties-relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure. Raoult's law-binary liquid mixtures, ideal solutions, deviations from ideal behaviour, vapour pressure, composition and vapour pressure, temperature curves and azeotropic distillation.

Kinetic theory of molecular gases; transport properties – viscosity, thermal conductivity, diffusion, Maxwell's distribution of molecular velocities

**3. Thermochemistry, chemical kinetics, and electrochemistry**

Thermodynamics: Bond Energy, Bond dissociation energy, calculation from thermochemical data variation of heat of reaction with temperature Kirchoff's equation.

Chemical kinetics: Definition of order and molecularity -methods to determine the rate of reactions -derivation of rate constants for I, II, III and Zero order reactions -derivation for time for half change -methods to determine the order of reactions -effect of temperature on the rate of reactions -Arrhenius equation and concept of energy of activation.

Electrochemistry: Redox reactions and their standard electrode potential; Relation between Gibbs energy and emf of the cell; Galvanic cells -standard cell-emf and its measurement; Specific and molar conductivity -variation of conductivity with concentration; Electrorefining of copper and molten aluminium production by smelting.

**4. Organic chemistry**

Concepts and Characteristic reactions< Hybridisation of carbon;  $\sigma$  and  $\pi$ -bonds; Shapes of simple organic molecules; Structural and geometrical isomerism; Optical isomerism of compounds containing up to two asymmetric centres; IUPAC nomenclature of simple organic compounds (simple hydrocarbons, mono-functional and bi-functional compounds); Conformations of ethane and butane (Newman projections); Resonance and hyperconjugation; Keto-enol tautomerism; Hydrogen bonds: definition and their effects on physical properties of alcohols and carboxylic acids; Inductive and resonance effects on acidity and basicity of organic acids and bases; Polarity and inductive effects in alkyl halides; Reactive intermediates (carbocations, carbanions and free radicals) – formation, structure and stability; Aliphatic nucleophilic substitution reactions – SN1 and SN2; Elimination reactions – E1 and E2 mechanisms; Electrophilic addition reactions of alkenes with X<sub>2</sub>, HX, HOX and H<sub>2</sub>O (X = halogen); Addition reactions of alkynes; Aromaticity, Electrophilic substitution reactions Effect of *o*-, *m*- and *p*-directing groups in monosubstituted benzenes; simple functional group interconversions pertaining to alkenes, alkynes, carbonyl compounds, haloalkanes and arenes, hydroxyl compounds, amines.

## 5. Laboratory techniques

Separation techniques -chromotography, distillation, extraction; Purification techniques – crystallization, recrystallization, sublimation; Quantitative estimation – acid/base, iodo/iodimetry, potentiometric and conductometric titrations, and gravimetry; Qualitative analysis -detection of nitrogen, sulphur, halogen in organic compounds; determination of anions and cations.

## 6. Polymers and biomolecules

Free radical, cationic, anionic, addition and condensation polymerization, polymers: natural rubber, nylon, teflon and PVC; Amino acids, peptides, proteins (primary, secondary, tertiary and quaternary structures); DNA and RNA; Carbohydrates (glucose, fructose, sucrose and starch).

## 7. Chemistry of s-and p-block elements

Alkali and alkaline earth metals –electronic configuration, structure, study of oxides, hydrides, halides, hydroxides, carbonates and sulfates; Electronic configuration, structure, oxidation states, oxides and oxoacids of N, P, S and halogens, their preparation and properties.

## 8. d-block elements

Electronic configuration, oxidation states; coordination compounds – ligands, coordination number, colour, magnetic properties and shape. Crystal field stabilization theory.

## 9. Mathematics for chemists

Linear equations; polynomials; logarithmic and exponential relations; calculus (Functions of single variable, limit, continuity and differentiability); first order differential equations; probability and statistics (Definitions of probability and sampling theorems, conditional probability, mean, median, mode and standard deviation, random variables, Poisson, Normal and Binomial distributions, Linear regression analysis)

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Results of Level-1 test will be published in the Institute recruitment portal <https://recruit.iitm.ac.in>

Email intimation will be sent to the short-listed candidates for Level-2 test.

**Level-2 test will be scheduled tentatively during third week of August 2023.**

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## Level – 2 Test: Syllabus for Trade Test

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