

# RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

## SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF ASSISTANT PROFESSOR IN CHEMISTRY FOR COLLEGE EDUCATION DEPARTMENT

### PAPER – I

- 1. Chemical Periodicity:** Periodic Table, Electronic Configuration of Various Group Elements. Periodicity in properties of s, p, d and f - block elements and their trends.
- 2. Chemical Bonding:** Concept of hybridization VBT, LCAO, MOT of homo and heteronuclear diatomic and polyatomic molecules, Coulson diagrams, Valance Shell Election Pair Repulsion Theory, Hydrogen bonding, Fajans Rule and Polairty in Covalent Compunds.
- 3. Transition Metal Chemistry:** Properties with special reference to variable oxidation state, magnetic, colour and complexation behaviour. Metal to Ligand and Ligand to Metal charge transfer spectra, Metal atom clusters, Nomenclature and Isomerism in co-ordination compounds, Ligand field theory, high spin and low spin complexes, CFT, CFSE and Jahn-Teller effect.
- 4. Green Chemistry and Nano Chemistry:** Principles of Green Chemistry and Sustainable Development, Green Reagents and Green Synthesis. Introduction to Nano particles, Nano Science and Nano Technology. Optical and Magnetic properties of Nano material. Characterization of Nano materials by TEM, SEM, SPMT, AFM, X-Ray Diffraction and ASCA.
- 5. Environmental Chemistry:** Air Pollution- Pollution due to  $\text{SO}_x$ ,  $\text{NO}_x$ , Ozone Depletion and Green House Effect, photochemical smog, reaction of hydroxyl radical with  $\text{CH}_4$ ,  $\text{SO}_x$  and  $\text{NO}_x$ .  
Water Pollution: International Standards of drinking water, water quality parameters COD, BOD, TDS, pH etc., Treatment of potable and sewage waste water.  
Soil- Types of soil, soil profile and analysis of physical and chemical parameters.

- 6. Nomenclature of Organic Compounds:** Common and IUPAC nomenclature of Aliphatic, Aromatic, Hetroaromatic, Bicyclo Compounds and Spiranes.
- 7. Isomerism:** Structural Isomerism, Stereoisomerism both geometrical and optical with E/Z and R/S systems respectively. Conformational analysis of alkanes and cyclo alkanes, Asymmetric Synthesis Stereoselective and Stereospecific reactions.
- 8. Basic principles of Organic Chemistry and Reaction Mechanism:** Inductive, Electromeric, Mesomeric, Hyperconjugative and Resonance effects. Reactive Intermediate species i.e. carbocation (classical and non classical), Carbanion, Carbene, free Radicals, Nitrene and Benzyne. Types of reagents- electrophiles and nucleophiles. Basic reaction mechanism- Addition, Substitution, Elimination and Rearrangements.
- 9. Name Reactions and Mechanisms:** Aldol, Benzoin, Cannizzaro's, Perkin's, Stobbe, Dieckman Condensations. Pinacole - Pinacolone, Wagner- Meerwin, Hoffmann, Schmidt, Lossen, Curries, Beckmann, Fries, Baeyer Villiger, Wittig, Reformastky Rearrangements.
- 10. Aromatics Heteroaromatics, annulenes and heteroannulenes:** Basics of Aromaticity and anti- aromaticity. Synthesis and reactions of anthracene, phenanthrene, biphenyl, furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole. UV, IR, NMR and mass spectroscopy of organic compounds.
- 11. (a) Chemical kinetics:** Ionic Reactions, Kinetic salt effect, Steady State Kinetics, Kinetic and Thermodyanic Control of reactions, Dynamic chain, photochemical reaction, acid base and enzyme catalysis, fast reaction: study by stop flow method.  
**(b) Acid-bases and Non-aqueous Solvents:** Basic theories, HSAB concept. Non aqueous solvents: DMSO, THF and Liquid NH<sub>3</sub> their reactions and solvent action.
- 12. Electrochemistry:** Electrochemistry and Ionic Equilibrium, Theory of strong and weak electrolytes pH, Buffer and Buffer action, Electrolysis and electrolytic Cell, Electrochemical cells and reactions, Nernst equation, emf measurement, Calculation of Gibbs free energy and equilibrium constants. Primary and Secondary cells, fuel cell, corrosion and its prevention.

**13. Nuclear and Radio Chemistry:** Nuclear Models, Radioactive decay, mass defect, binding energy, fission and fusion, Isotopes, Isobars, Isodiaphers and application of Isotopes in medicinal Science.

**14. Solution and Colligative Properties:** Types of Solutions Concentration measurement methods. Normality, Molarity, Molality etc. Raoult's law (deviation from ideal behaviour), Nernst law, Henry law, Relative lowering of Vapour Pressure, Elevation in Boiling Point, Depression in Freezing Point, Osmosis and Osmotic Pressure.

**15. Thermodynamics:** First law: relation between  $C_p$  and  $C_v$ , enthalpies of physical and chemical changes, temperature dependence of enthalpies, Joules Law, Joules Thomson coefficient, Second law: entropy, Criteria of Spontaneity Gibbs and Helmholtz functions, evaluation of entropy and Gibbs function, Gibbs-Helmholtz equation, Maxwell relations. Thermodynamics of ideal and non-ideal gases and solutions. Third Law of Thermodynamics.

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**Note: -Pattern of Question Paper**

1. **Objective type paper**
2. **Maximum Marks: 75**
3. **Number of Questions: 150**
4. **Duration of Paper: Three Hours**
5. **All questions carry equal marks.**
6. **Medium of Competitive Exam: Bilingual in English & Hindi**
7. **There will be Negative Marking.**