

Syllabus for UPSC Indian Forest Services Examination

Chemistry Paper II

The Scope of the Syllabus for optional subject papers for the examination is Broadly of the Honours Degree level i.e. A level Higher than the Bachelors Degree and lower than the Masters Degree. In the case of Engineering subjects, the level corresponds to the Bachelors Degree.

There will be no practical examination in any of the subjects.

Optional Subjects

Total number of questions in the question papers of optional subjects will be eight. All questions will carry equal marks. Each paper will be divided into two parts, viz. Part A and Part B, each part containing four questions. Out of eight questions, five questions are to be attempted. One question in each part will be compulsory. Candidates will be required to answer three more questions out of the remaining six questions, taking at least one question from each Part. In this way, at least two questions will be attempted from each Part i.e. one compulsory question plus one more.

Paper II

1. **Delocalised covalent bonding** : Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, kekulene, fulvenes, sydnones.

2(a) **Reaction mechanisms** : General methods (both kinetic and non-kinetic) of study of mechanism or organic reactions illustrated by examples—use of isotopes, cross-over experiment, intermediate trapping, stereochemistry; energy diagrams of simple organic reactions—transition states and intermediates; energy of activation; thermodynamic control and kinetic control of reactions.

(b) **Reactive intermediates** : Generation, geometry, stability and reactions of carbonium and carbanium ions, carbanions, free radicals, carbenes, benzyne and nitrenes.

(c) **Substitution reactions** : SN_1 , SN_2 , SN_i , SN_1' , SN_2' , SN_i' and SRN_1 mechanisms; neighbouring group participation; electrophilic and nucleophilic reactions of aromatic compound including simple heterocyclic compounds—pyrrole, thiophene, indole.

(d) **Elimination reactions** : E_1 , E_2 and E_{1cb} mechanisms; orientation in E_2 reactions—Saytzeff and Hoffmann; pyrolytic *syn* elimination—acetate pyrolysis, Chugaev and Cope eliminations.

(e) **Addition reactions** : Electrophilic addition to $C=C$ and $C=C$; nucleophilic addition to $C=O$, $C=N$, conjugated olefins and carbonyls.

(f) **Rearrangements** : Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer–Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner–Meerwein rearrangements.

3. **Pericyclic reactions** : Classification and examples; Woodward-Hoffmann rules—electrocyclic reactions, cycloaddition reactions [2+2 and 4+2] and sigmatropic shifts [1, 3; 3, 3 and 1, 5] FMO approach.

4. **Chemistry and mechanism of reactions** : Aldol condensation (including directed aldol condensation), Claisen condensation, Dieckmann, Perkin, Knoevenagel, Wittig, Clemmensen, Wolff-Kishner, Cannizzaro and von Richter reactions; Stobbe, benzoin and acyloin condensations; Fischer indole synthesis, Skraup synthesis, Bischler-Napieralski, Sandmeyer, Reimer-Tiemann and Reformatsky reactions.

5. **Polymeric Systems**

(a) **Physical chemistry of polymers** : Polymer solutions and their thermodynamic properties; number and weight average molecular weights of polymers. Determination of molecular weights by sedimentation, light scattering, osmotic pressure, viscosity, end group analysis methods.

(b) **Preparation and properties of polymers** : Organic polymers—polyethylene, polystyrene, polyvinyl chloride, Teflon, nylon, terylene, synthetic and natural rubber. Inorganic polymers—phosphonitrilic halides, borazines, silicones and silicates.

(c) **Biopolymers** : Basic bonding in proteins, DNA and RNA.

6. **Synthetic uses of reagents** : OsO₄, HIO₄, CrO₃, Pb(OAc)₄, SeO₂, NBS, B₂H₆, Na-Liquid NH₃, LiAlH₄, NaBH₄ n-BuLi, MCPBA.

7. **Photochemistry** : Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish-Type I and Type II reactions.

8. **Principles of spectroscopy and applications in structure elucidation**

(a) **Rotational spectra**—diatomic molecules; isotopic substitution and rotational constants.

(b) **Vibrational spectra**—diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.

(c) **Electronic spectra** : Singlet and triplet states. N→* and →* transitions; application to conjugated double bonds and conjugated carbonyls—Woodward-Fieser rules.

(d) **Nuclear magnetic resonance** : Isochronous and anisochronous protons; chemical shift and coupling constants; Application of ¹H NMR to simple organic molecules.

(e) **Mass spectra** : Parent peak, base peak, daughter peak, metastable peak, fragmentation of simple organic molecules;— cleavage, McLafferty rearrangement.

(f) **Electron spin resonance** : Inorganic complexes and free radicals.
