RANI DURGAVATI UNIVERSITY, JABALPUR

Syllabus for M. Phil. and Ph.D. entrance test in chemistry w.e.f. 2018 and onward

(In accordance with the revised ordinance no.82 and 16 for M. Phil. and Ph.D. respectively)

The M. Phil. and doctoral entrance test will have the 100 multiple choice questions. The question paper shall consist of two sections, (A) and (B). Each section shall consist of 50 questions each of 1 mark. Section (A) will be based on research methodology and section (B) on Chemistry. The candidate must secure minimum 50% mark (45% for SC/ST/ OBC/ PH).

Section A: Research Methodology 50 Marks

Research aptitude

- Research: Meaning, Characteristics and type of research
- Steps of research, Methods of research
- Research ethics: Paper, Articles, Workshop, Seminar, Conference and Symposium.
- Thesis writing: Characteristic of thesis writing and format

Reasoning (Including Mathematical)

- Number series, Letter series and Codes
- Relationship and classification

Communication skill

- Communication: Nature, characteristics, types, barriers and effective class room communication

Information and communication technology

- Meaning of ICT, advantages, disadvantages and uses
- General abbreviation and terminology
- Basic of internet and Emailing

Section B: Chemistry 50 Marks

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo and heteronuclear molecules, including shapes of molecules (VSEPR theory).

3. Concepts of acid and bases, Hard –Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding industrial importance of the compounds.
5. Transition elements and coordination compounds: structure bonding theories. Spectral and magnetic properties, reaction mechanisms.
6. Metal carbonyls and nitrosyls: Structure and bonding
7. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
8. Organometallic compounds: synthesis, bonding and structure, and reactivity, Organometallics in homogeneous catalysis.
9. Cages and metal clusters.
10. Bioinorganic chemistry: photo systems, porphyries, metalloenzymes, oxygen transport electron–transfer reactions nitrogen fixation, metal complexes in medicine.
11. Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-Vis, NQR, Mass spectrometry and Electron spectroscopy.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.
13. Chemical applications of Group theory; symmetry elements and symmetry operations; matrix representation of symmetry operations; point groups; character tables; prediction of IR and Raman active modes.

Organic chemistry

1. IUPAC nomenclature of organic molecules including region-and stereoisomers.
2. Principle of stereochemistry: configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity stereo selectivity, enantioselectivity and diastereosslectivity.
3. Aromaticity: Benzenoid and non-benzenzenoid compounds- generation and reactions.
4. Organic reactive intermediates: Generation stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reaction with electrophonic or radical species. Determination of reaction pathways.
6. Common named reaction and rearrangements – application in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reduction; common catalysts and reagents (organic, inorganic, organomatallic and enzymatic). Chemo, regio and sterioselective transformations.
8. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction, substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio –discrimination. Resolution-optical and kinetic.
9. Pericyclic reaction: electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reaction. Principles and application of photochemical reactions in organic chemistry.

10. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatom (O, N, S).
11. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
12. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}NMR and Mass spectroscopic techniques.

Physical chemistry

1. Basic principle and application of quantum mechanics.
2. Approximate method of quantum mechanics: variation principle; perturbation theory up to second order in energy.
3. Atomic structure and spectroscopy; term symbols.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated pi electron system.
5. Molecular spectroscopy: rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules. Basic principle of magnetic response techniques.
6. Chemical thermodynamics: Laws state and path function and their application thermodynamics description of various type of processes: Maxwell relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le chatelier principle; thermodynamics of idea and non-ideal gases and solutions.
7. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities.
8. Electrochemistry : Nernst equation, redox systems, electrochemical cells; Debye Huckel theory ; electrolytic conductance- Kohlrausch's Law and its applications; ionic equilibria; conductometric and potentiometric titration.
9. Chemical kinetics : empirical rate laws and temperature dependence; complex reactions; steady state approximation ; determination of reaction mechanism; collision and transition state theories of rate constants; unimolecular reactions ; enzyme kinetics; salt effects; homogeneous catalysis ; photochemical reaction.
10. Colloids and surfaces: stability and properties of colloids; isotherms and surface area; heterogeneous reactions.
11. Solid state: crystal structures; Bragg law and applications; band structure of solids.

Interdisciplinary topics

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Environmental chemistry.
5. Analytical chemistry.
6. Polymer chemistry