Awadhesh Pratap Singh University
Rewa (M.P.)

Ph.D. Entrance Exam

2022-23

Syllabus

For

Chemistry

Awadhesh Pratap Singh University, Rewa (M.P.)
Syllabus for Ph.D. Entrance Examination
SUBJECT- CHEMISTRY

Part A (Research Methodology)

- Objective of research, types of research, Research approaches, significance of research, Research methods versus research methodology, Research process, Criteria of good research.
- Meaning of research design, need for research design, feature of good design, important concepts relating to research design: Dependent and independent variables, Extraneous variable, control, confounded relationship, research hypothesis, experimental and non-experimental hypothesis, experimental and control groups, treatments, experiment, Experimental unit (s), Research Designs in case of exploratory research studies, Descriptive and Diagnostic Research Studies.
- Research Problem, Selecting the problem, necessity of defining the problem, technique involved in defining problem.
- Quantitative and Qualitative data, classification of measurement scales: Normal scale, ordinal scale, interval scale, ratio scale, goodness of measurement scale: Validity, Reliability and Practicality.
- Types of data: Primary and secondary, methods of collecting primary data: Observation method, interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedule, collection of secondary data.
- Classification of data, tabulation diagrammatic and graphical representation of data: Bar chart, Pic chart, Box plot, Histogram, Frequency polygon, Frequency curve.
- Measure of Central Tendencies: Mean, Median, Mode.
  Measures of Variability: Range, Quartile Deviation, Standard Deviation and Coefficient of variation.
- Meaning of Correlation, Scatter diagram, Karl Pearson Coefficient of Correlation, Rank Correlation, Regression lines, Regression coefficients, Properties of regression coefficient, normal distribution and its properties.
- Testing of Hypothesis and test of significance: Null and Alternative Hypothesis, Type I and Type II errors, Critical region, level of significance, One-Tailed and two-Tailed tests, large sample tests: test of significance for single proportion, Difference of proportions, single mean and difference of means, Chi-Square test of goodness of fit and independence of attributes. Small

sample tests: t-test for single mean, t-test for difference between two sample means, paired t-test for difference of means, F-test for equality of population variances.

- Analysis of Variance.
- Computer languages and operating system (OS)-Assembly language, machine language, MS-DOS and Windows.
- MS-Word and Power point presentation.

Part B (Chemistry)

Physical chemistry

- Basic principle and application of quantum mechanics.
- Approximate method of quantum mechanics: variation principle; perturbation theory up to second order in energy.
- Atomic structure and spectroscopy; term symbols.
- Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated pi electron system.
- Molecular spectroscopy: rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules. Basic principle of magnetic response techniques.
- 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.
- Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities.
- Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye Huckel theory; electrolytic conductance- Kohlrausch's Law and its applications; ionic equilibria; conductometric and potentiometric titration.
- 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.
- Colloids and surfaces: stability and properties of colloids; isotherms and surface area;

heterogeneous reactions.

- Solid state: crystal structures; Bragg law and applications; band structure of solids.

Organic chemistry

- IUPAC nomenclature of organic molecules including region-and stereoisomers.
- Principle of stereochemistry: configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity stereo selectivity, enantioselectivity and diastereosslectivity.
- Aromaticity: Benzenoid and non-benzenzenoid compounds- generation and reactions.
- Organic reactive intermediates: Generation stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
- Organic reaction mechanisms involving addition, elimination and substitution reaction with electrophonic or radical species. Determination of reaction pathways.
- Common named reaction and rearrangements – application in organic synthesis.
- 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.
- 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.
- Pericyclic reaction: electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reaction. Principles and application of photochemical reactions in organic chemistry.
- Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatom (O, N, S).
- Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
- Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}NMR and Mass spectroscopic techniques.

Inorganic Chemistry

- Chemical periodicity
- Structure and bonding in homo and heteronuclear molecules, including shapes of

molecules (VSEPR theory).

- Concepts of acid and bases, Hard –Soft acid base concept, Non-aqueous solvents.
- Main group elements and their compounds: Allotropy, synthesis, structure andbonding industrial importance of the compounds.
- Transition elements and coordination compounds: structure bonding theories.Spectral and magnetic properties, reaction mechanisms.
- Metal carbonyls and nitrosyls: Structure and bonding
- Inner transition elements: spectral and magnetic properties, redox chemistry,analytical applications.
- Organometallic compounds: synthesis, bonding and structure, and reactivity, Organometallics in homogeneous catalysis.
- Cages and metal clusters.
- Bioinorganic chemistry: photo systems, porphyries, metalloenzymes, oxygen transport electron–transfer reactions nitrogen fixation, metal complexes in medicine.
- Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-Vis, NQR, Mass spectrometry and Electron spectroscopy.
- Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.
- 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.

Interdisciplinary topics

- Chemistry in nanoscience and technology.
- Catalysis and green chemistry.
- Medicinal chemistry.
- Environmental chemistry.
- Analytical chemistry.
- Polymer chemistry