Bhartiya Skill Development University

Syllabus for Ph.D. Entrance Test

Chemistry

Physical Chemistry

1. Basic principles and applications of quantum mechanics – hydrogen atom, angular momentum.
2. Variational and perturbational methods.
3. Basics of atomic structure, electronic configuration, shapes of orbitals, hydrogen atom spectra.
4. Theoretical treatment of atomic structures and chemical bonding.
5. Chemical applications of group theory.
6. Basic principles and application of spectroscopy – rotational, vibrational, electronic, Raman, ESR, NMR.
7. Chemical thermodynamics.
8. Phase equilibria.
9. Statistical thermodynamics.
10. Chemical equilibria.
11. Electrochemistry – Nernst equation, electrode kinetics, electrical double layer, Debye-Hückel Theory.
12. Chemical kinetics – empirical rate laws, Arrhenius equation, theories of reaction rates, determination of reaction mechanisms, experimental techniques for fast reactions.
13. Concepts of catalysis.
14. Polymer chemistry. Molecular weights and their determinations. Kinetics of chain polymerization.
15. Solids - structural classification of binary and ternary compounds, diffraction techniques, bonding, thermal, electrical and magnetic properties.
16. Collides and surface phenomena.
17. Data analysis.

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules.
3. Concepts of acids and bases.
4. Chemistry of the main group elements and their compounds. Allotropy, synthesis, bonding and structure.
5. Chemistry of transition elements and coordination compounds – bonding theories, spectral and Magnetic properties, reaction mechanisms.

6. Inner transition elements – spectral and magnetic properties, analytical applications
7. Organometallic compounds - synthesis, bonding and structure, and reactivity. Organometallics in homogenous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation techniques. Spectroscopic electro- and thermoanalytical methods.
10. Bioinorganic chemistry – photosystems, Porphyrines, Metalloenzymes, Oxygen transport, Electron transfer reactions, nitrogen fixation.
11. Physical characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry – nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis

Organic Chemistry

1. IUPAC nomenclature of organic compounds.
2. Principles of stereochemistry, conformational analysis, isomerism and chirality.
3. Reactive intermediates and organic reaction mechanisms.
4. Concepts of aromaticity.
5. Pericyclic reactions.
6. Named reactions.
7. Transformations and rearrangements.
8. Principles and applications of organic photochemistry. Free radical reactions.
9. Reactions involving nucleophotic carbon intermediates.
10. Oxidation and reduction of functional groups.
11. Common reagents (organic, inorganic and organometallic) in organic synthesis.
12. Chemistry of natural products such as steroids, alkaloids, terpenes, peptides, carbohydrates, Nucleic acids and lipids.
13. Selective organic transformations – Chemoselectivity, Regioselectivity, stereoselectivity, enantioselectivity. Protecting groups.
14. Chemistry of aromatic and aliphatic heterocyclic compounds.
15. Physical characterisation of organic compounds by IR, UV-, MS, and NMR.

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Chemistry

Interdisciplinary Topics

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

Suggested Readings –

1. Principles of Physical Chemistry by Puri, Sharma & Pathania
2. Chemical Kinetics by Keith J Laidler
3. A book of Physical Chemistry (Vol-III) by K L Kapoor
4. Quantum Chemistry through Problems and Solutions by R.K. Prasad
5. Fundamentals of Molecular Spectroscopy by Colin N. Banwell
6. Chemical Applications of Group Theory by F. Albert Cotton
7. Surface Chemistry by A Goel
8. Stereochemistry Conformation and Mechanism by P.S. Kalsi
9. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes
10. Organic Chemistry by - Clayden, Greeves, Warren and Wothers
11. Part-A: Structure and Mechanism by Francis A. Carey, Richard J. Sundberg
12. Part-B : Reactions and Synthesis by Francis A. Carey, Richard J. Sundberg
13. Organic Spectroscopy by William Kemp
14. Organic Photochemistry by James H. Coxon, B. Halton
15. Pericyclic Reactions by R T Morrison, R N Boyd
16. Inorganic Chemistry by J. E. Huheey
17. Concise Inorganic Chemistry by J. D. Lee
18. Inorganic Chemistry by Shriver & Atkins
19. Instrumental Method by Skoog, Holler & Crouch
20. Chemical Application of Group Theory by F A Cotton
21. Advanced Inorganic Chemistry by F A Cotton, Wilkinson, John Wiley
22. Organic Chemistry by R T Morrison and R N Boyd
23. Physical Chemistry by P W Atkins
24. Principles of Biochemistry by A L Leninger