



Pt. Ravishankar Shukla University

Raipur (C.G.), India 492010

CURRICULUM & Syllabus

(Based on CBCS & LOCF)

Ph. D. Entrance Exam - Chemistry

Session: 2025-26

टीप:- सत्र 2024-25 के पाठ्यक्रम को सत्र 2025-26 के लिए यथावत प्रभावशील किया जाता है।

Approved by
Board of Studies : Chemistry
Dates : 15.05.2025
Name of chairman : Prof. Kamlesh Kumar Shrivastava — K. Shrivastava
Name of Members : Prof. Kallol K. Ghosh (Head, SoS in Chemistry & (CBCS))
: Prof. M. K. Deb (Head, SoS in Environmental Science)
: Prof. N. K. Karade (External Members, RTM university)
: Prof. Shamsh Pervaz
: Prof. M. K. Rai
: Dr. M. L. Satnami
: Dr. Bhanushree Gupta
: Dr. Ajita Dixit
: Shree Hemant Deshmukh
: Shree B. L. Yadav
: Dr. Indrapal Karbhari
: Dr. Shobhana Ramteke

K. Shrivastava

Online

Prof. N. K. Karade

Prof. Kallol K. Ghosh

Prof. M. K. Deb

Prof. Shamsh Pervaz

Dr. M. L. Satnami

Dr. Bhanushree Gupta

Dr. Ajita Dixit

Shri H. Deshmukh

Shri B. L. Yadav

Dr. Indrapal Karbhari

Prof. Kamlesh K. Shrivastava
Chairman

Prof. N. K. Karade
(External member)

Prof. Kallol K. Ghosh
(member)

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Shri H. Deshmukh
(Member)

Shri B. L. Yadav
(Member)

Dr. Indrapal Karbhari
(Member)

Dr. M. K. Rai
SOS in chemistry

SYLLABUS

Ph. D. Entrance Exam - Chemistry

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids 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. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, 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, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.



Prof.
Kamlesh,
K. Shrivastava,
Chairman

Online

Prof. N. K.
Karade
(External
member)



Prof. Kallol K.
Ghosh
(member)



Prof. M. K.
Deb
(Member)



Prof. Shamsheer
Pervez
(Member)

Dr. M. L.
Sainami



Dr. Bhanushree
Gupta
(Member)



Dr. Ajita Dixit
(Member)



Shri H.
Deshmukh
(Member)



Shri B. L.
Yadav
(Member)



Dr.
Indrapal
Karbiwal
(Member)



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4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π -electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.

	Online											
Prof. Kamlesh.	Prof. N. K. Karade	Prof. Kallol K. Ghosh (member)	Prof. M. K. Deb (Member)	Prof. Shamsheer Pervaz (Member)	Dr. M. L. Satnam	Dr. Bhanushree Gupta (Member)	Dr. Ajita Dixit (Member)	Shri H. Deshmukh (Member)	Shri B. L. Yadav (Member)	Dr. Indrapal Karbhari	Dr. M. K. Rai SOS in chemistry	

4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. 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.
10. Pericyclic reactions – electrocycloaddition, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, ^1H & ^{13}C NMR and Mass spectroscopic techniques.

Analytical and Advanced Instrumentation

1. Principle, classification of chromatographic techniques, Technique and applications of paper chromatography, Thin-layer chromatography, HPTLC, Column chromatography. Liquid and Gas chromatography.
2. Principle, Instrumentation, Applications of TGA, DTA and DSC methods, C/H/S/N/O Analyzer.
3. Mathematical and statistical methods involved with the calculations in analytical chemistry
4. Theory, instrumentation and application of flame photometer, X-ray photo electron spectroscopy (XPS), Photo acoustic Spectroscopy (PAS), AES, ICP-AES and AFS.
5. Air and Water pollution monitoring and analysis
6. Chemical analysis involved in cement, iron processing, coal and thermal power plant.
7. Fundamentals of nanoscience, supramolecular chemistry and analytical methods of synthesis involved.

K. Shrivastha

Online

Prof. N. K. Karande

Prof. Kallol K. Choudhury

Prof. M. K. Dab

Prof. Shamsh Pervez

Dr. M. L. Satnam

Dr. Bhanushree Gupta

Dr. Ajita Dixit

Shri H. Deshmukh

Shri B. L. Yadav

Dr. Indrapal Kurbhal

Prof. Karishma K. Shrivastha
Chairman

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Course Content of Research Methodology for Ph.D. Entrance
Pt. Ravishankar Shukla University, Raipur

1. Introduction to Research

Meaning and Importance of Research, Types of Research, Research Design and Stages, Selection and Formulation of Research Problem, Objective(s) and Hypothesis Developing Research Plan – Exploration, Description, Diagnosis, Experimentation, Determining Experimental and Sample Design.

2. Data Collection Method and Sampling Techniques

Sources of Data – Primary and Secondary. Types of Data – Categorical (nominal and ordinal), Numerical (discrete, continuous, ratio and interval), Methods of Data Collection: Survey, Interviews (in-depth or Key Informant interviews), Focus Group Discussion, Observation, Records or Experimental Observations. Probability Sampling, Random, Stratified, Cluster, Systematic Sampling, Non probability Sampling: Convenience Judgement, Snowball, Quota Sampling

3. Data Analysis

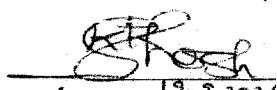
Statistical Graphics – Histograms, Frequency Polygon, Ogive, Dotplots, Stemplots, Bar Graphs, Pareto Charts, Pie Charts, Scatterplots, Boxplots Descriptive Analysis – Frequency Distributions, Measures of Central Tendency, Measures of Variation/Dispersion, Skewness and Kurtosis

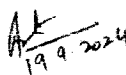
4. Scientific Writing and Presentation

Structure and Components of Scientific Reports – Types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, Structure and Language of Typical Reports – Illustrations and Tables – Bibliography, Use of Software, Referencing and Foot Notes, Preparation of the Project Proposal – Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and Work Plan – Budget and Justification – References and Citation, and literature Survey

5. Research Ethics

Research Ethics Committees/Institutional Review Board – Roles and Importance, Intellectual Property rights – Commercialization, Royalty Reproduction of Published Material – Citation and Acknowledgement, Plagiarism and Plagiarism Software


19-9-2024
(Prof. K. K. GHOSH)


19-9-2024
(Prof. Arti Parganika)


19/9/24
(Prof. Padma Bohara)

K. Shrivastava

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Dr. Indrapal Kumbhal
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REFERENCE BOOKS FOR RESEARCH METHODOLOGY

1. Research Methodology Methods and Techniques by C R Kothari and G Garg

New Age International Publishers

2. Research Methodology: A Step By Step Guide For Beginners, by Ranjit Kumar
Pearson

3. Research Methodology A Hand Book by R P Mishra

4. Research Methodology by Richa Verma, S Verma and Kumar Abhishek
Booksclinic Publishers

K. S. Singh

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