

Chemistry


SYLLABUS FOR RESEARCH METHODOLOGY FOR PhD ENTRANCE TEST - 2020

TUMKUR UNIVERSITY, TUMKUR

1. **Research: Meaning-Purpose-Types** of research-significance of research in chemical sciences.
2. **Characteristics of Research and Research Worker:** Classification of Research in relation to Nature and Methods. Research Ethics.
3. **Steps in Research:** Identification, selection and formulation of research problem. Research objectives-Research design-Hypothesis-Significance, Formulation and Types.
4. **Review of Literature:** Reasons for surveying related literature, Allied and critical Literature.
5. **Experimental Research:** Meaning and Nature of Experimental Research, Sources of Experimental Invalidity. Experimental Designs: Pre, True and Quasi Experimental designs.
6. **Sampling Techniques:** Sampling theory-Types of sampling- Steps in sampling, sampling and Non-sampling error-Sample size- Advantages and limitations of sampling.
7. **Data for Research:** Primary data-Meaning-Collection methods-Observation-Interview-Questionnaire-Schedule-Pretest-Pilot study-Experimental and case studies-Secondary data-Meaning-Relevance, limitations and cautions. Online databases.
8. **Processing Data:** Checking-Editing-Coding-transcriptions and Tabulation-Data analysis-Meaning-Relevance, limitations and cautions. Online databases.
9. **Structuring the Report:** Chapter format-Pagination-Identification-Using quotations-Presenting footnotes-abbreviations-Presentation of tables and figures-Referencing-Documentation-Use and format of appendices-Indexing.
10. **Research Report:** Types of reports-Contents-Styles of reporting-Steps in drafting reports-Editing the final draft-Evaluating the final draft. Preparation of Research proposal. Referencing in academic writing.

Reference Books

1. Kothari C.R., "Research Methodology, Methods and Techniques" by "New Age International Publishers, 2ndedn.
2. Donald H, McBurney, "Research Methods", 5th Edition, Thomson Learning, ISBN:81-315-0047-0, 2006.


ಪ್ರಾಚಾರ್ಯ
ಸ್ನಾತಕೋತ್ತರ ರಾಸಾಯನಿಕ ವಿಜ್ಞಾನ ವಿಭಾಗ
ತುಮಕುರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ,
ತುಮಕುರು-572103

TUMKUR UNIVERSITY, TUMKUR

PhD Entrance Syllabus 2020

SUBJECT: CHEMISTRY

1. ANALYTICAL CHEMISTRY:

Statistical treatment of analytical data and sampling: Error, Accuracy, Precision, Statistical tests f-test, t-test, q test.

Principles and applications: Gravimetric analysis, titrimetric analysis, precipitation, acid-base, redox and complexometric titrations.

General principles and applications of Electro analytical methods: Electro-gravimetry, Potentiometry, Voltammetry and Polarography.

Thermal methods of analysis: Principles and applications of TGA, DSC and DTA.

Separation techniques: Solvent extraction, Chromatography- Principles and applications of column and thin layer chromatography. GC, HPLC and ion exchange chromatography.

Optical methods of analysis: Principles and applications of AAS, AES, spectrofluorimetry.

2. INORGANIC CHEMISTRY:

Ionic bond: Properties of ionic substances, structures of crystal lattices, Ionic radii, radius ratio rules, covalent character in ionic bonds, hydration energy and solubility of ionic compounds.

Covalent bond: VSEPR model for explaining structures of molecules including fluxional molecules, M.O. treatment for homonuclear and heteronuclear diatomic molecules.

Concepts of acids and bases: Arrhenius's, Bronsted, Lewis, Lux - Flood and Usanovich concepts, Solvent system and leveling effects. HSAB concept and theoretical back grounds.

General chemistry of 'd' block elements


Coordination Chemistry: Introduction to theories of bonding in transition metal complexes, Applications of these theories in the explanation of structure, magnetism and electronic spectra of coordination complexes, isomerism in coordination complexes.

Organometallic compounds:

16 and 18 electron rules, synthesis, structure and bonding in transition metal -carbonyls, nitrosyls, cyclopentadienyl and-olefin , complexes. Homogeneous catalysis-Olefin hydrogenation, Hydroformylation, Wacker process, Monsanto process. Compounds with metal-metal bonds and metal atom clusters.

General chemistry of f-block elements: Lanthanides and actinides; Separation, oxidation states, magnetic and spectral properties.

Symmetry elements and symmetry operations: Concept of point group, assignment of point group to the molecules.


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3. ORGANIC CHEMISTRY:

ORGANIC REACTION MECHANISM:

Reaction intermediates: Structure, generation and reaction of Carbocations, carbanions, free radicals, carbenes, arynes, nitrenes .

Aliphatic Nucleophilic Substitution reactions: S_N1 , S_N2 , S_{Ni} mechanisms, stereochemistry of nucleophilic reactions, Solvent effects, Substituent effects, Neighbouring group participation.

Addition reactions: Addition to double bond-Electrophilic addition, Nucleophilic addition, Free radical addition, Markovnikov rule, Anti-Markovnikov rule.

Elimination reactions: E1, E2 and E1CB mechanisms, factors affecting E1 and E2 mechanisms, Orientation effects (Hoffmann and Saytzeff rules), Pyrolytic elimination, Hoffmann exhaustive methylation, Cope elimination and Chugaev reaction.

Aromatic Electrophilic Substitution: Arenium ion, mechanism - Nitration, Sulphonation, Halogenation, Friedel-Crafts alkylation and acylation.

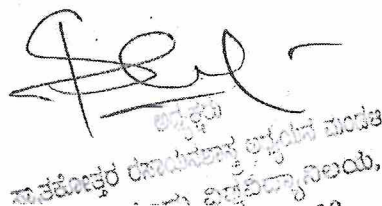
Aromatic Nucleophilic Substitution: Benzyne mechanism, S_NAr and S_N1 mechanisms.

COMMON ORGANIC REACTIONS, REARRANGEMENTS AND REAGENTS IN ORGANIC SYNTHESIS:

Organic Named reactions

Aldol, Perkin, Stobbe, Dieckmann condensations, Hofmann, Schmidt, Lossen, Curtius, Beckmann and Fries rearrangements; Reimer-Tiemann, Reformatsky and Grignard reactions, Diels-Alder reactions, Claisen rearrangement, Wittig reaction, Chichibabin reaction, Darzen condensation, Benzoin condensation, Cannizzaro reaction, Claisen-Schmidt condensation, Vilsmeier-Haack reaction, Bucherer reaction, Knoevenagel reaction, Sandmeyer reaction, Pinacol-Pinacolone rearrangement, Benzil-Benzilic acid, Baeyer-Villiger, Stevens, Wagner-Meerwein, Baker-Venkatraman rearrangements.

Use of following reagents in organic synthesis: $LiAlH_4$, $NaBH_4$, Hydrazine, Chromium and Manganese salts (CrO_3 , $K_2Cr_2O_7$, PCC, PDC, Sarret reagent, MnO_2 , $KMnO_4$), Peracids and Peresters, Periodic acid, Lead tetraacetate, Ozone, Osmium tetroxide, SeO_2 , Allylic halogenations-NBS, Dehalogenation with S, Se, Pt, Pd and Ni, Dess-Martin reagent, DIBAL-H, Sodium cyanoborohydride, Lindlar's catalyst, Wilkinson catalyst, dicyclohexylcarbodiimide (DCC), dichlorodicyanoquinone (DDQ), trimethylsilyl cyanide, Ziegler-Natta catalyst, diazomethane,


A handwritten signature is present above a circular stamp. The stamp contains text in Hindi, including the name 'Dr. J. K. Mishra' and the title 'Professor, Department of Chemistry, U.P. State University, Lucknow'.

4. PHYSICAL CHEMISTRY:

Chemical Energetics and Chemical Kinetics: Law of conservation of energy; enthalpy, entropy and free energy change and equilibrium, rates of chemical reactions, theories of chemical reactions and Arrhenius equation, Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; Collision and transition state theories of reaction rates; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

Electrochemistry: Strong and weak electrolytes, Electrochemical cells, electrode-electrolyte interface, electrolytic conductance – Kohlrausch's law and its applications; Reversible electrodes; Nernst equation, Redox systems; Concentration cells; Fuel cells, Debye Huckel theory of strong electrolytes; Debye-Huckel Onsager treatment; Ionic equilibria; Conductometric and Potentiometric titrations.

5. SPECTROSCOPY:

Microwave spectroscopy: Principles of rotation of molecules, Rotational spectra. Diatomic and Poly atomic molecules, techniques, instrumentation and applications.

Infrared spectroscopy: Principles of the vibrating diatomic molecule, the diatomic vibrating rotor, vibration-rotation, interactions, influence of rotation on the spectra of molecules,

Techniques, instrumentation and applications.


Raman spectroscopy: Theory, Principles of pure rotational Raman spectra, vibrational-Raman spectra, polarization of light and the Raman effect, structural determination of samples from Raman and infrared spectroscopy

Electronic spectroscopy of Molecules: Electronic structure of diatomic molecules, Principles of electronic spectra of diatomic and polyatomic molecules and their applications

Spin Resonance Spectroscopy: Principles of Spin and an applied field, Nuclear Magnetic Resonance Spectroscopy-Hydrogen Nuclei, Nuclei other than hydrogen. 2D NMR; Electronic spin resonance spectroscopy, techniques and their application to organic, inorganic, organometallic, coordination compounds and solids.


Mossbauer Spectroscopy: Principles and applications of Mossbauer spectroscopy.

Mass spectrometry: Principles, instrumentation, methods of ionization, General rules for fragmentation pattern, types of rearrangement, Evaluation of thermodynamic data, Application to identify compounds, molecular weight determination


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Reference Books

1. Fundamental of Analytical Chemistry, D.A.Skoog, D.M.West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Quantitative Analysis, R.A.Day and A.L.Underwood, 6th edition, 1993 prentice Hall, Inc. New Delhi.
3. Vogel's Text book of Quantitative Chemical Analysis, J.Mendharn, R.C.Denney, J.D.Barnes and M.J.K.Thomas, 6th edition, Third Indian Reprint, 2003 Pearson education Pvt. Ltd., New Delhi.
4. Analytical Chemistry Principals, John H.Kennedy, 2nd edition, Saunders College Publishing California, 1990.
5. Inorganic Chemistry (4th Edition): J.E.Huheey, E.A.Keiter and R.L.Keiter (1993); Harpes Collins.
6. Introduction to Modern Inorganic Chemistry (4th Edition): K.M.Mackey and R.A.Mackey (1989); Blackie.
7. Advanced Inorganic Chemistry (5th Edition): F.A.Cotton and G. Wilkinson (1990); Wiley.
8. Concise Inorganic Chemistry (5th Edition): J.D.Lee (2000); Blackwell Science.
9. Chemistry Of Elements: Greenwood and Earnshaw (1986); Pergamon Press.
10. E. L. Eliel and S. H. Wilen, Stereochemistry of Organic Chemistry, John-Wiley & Sons, New York, 1994.
11. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
12. Robert & Casereo, "Basic principles of Organic Chemistry".
13. R. K Bansal, "Organic Reaction Mechanism, Tata McGraw Hill, New Delhi, 1978.
14. J. March, "Advanced Organic Chemistry", Wirley, NY, 2000.
15. Petersykes, " A guide book to mechanism in Organic Chemistry".
16. P S Kalsi, "Organic reactions and their mechanisms", New Age, New Delhi, 1996.
17. P Y Bruice, "Organic Chemistry", Pearson Education, New Delhi, 2002.
18. Mukherji, Singh and Kapoor, Organic Chemistry-Vol. I & II-Wiley-Eastern, New Delhi, 1985.
19. Elements of Physical Chemistry – Lewis and Glasstone.
20. Physical Chemistry by P.W.Atkins, ELBS, 4th Edition, Oxford University Press (1990).
21. Introduction to Electrochemistry by S.Glasstone.
22. Chemical and Electrochemical Energy Systems – R.Narayan and B.Vishwanathan, Universities Press, India (1998).
23. Electrochemistry – Principles and Applications by E.G.Potter.
24. Electrochemistry by Reiger, Prince Hall (1987).
25. Introduction to Molecular Spectroscopy by G.M.Barrow, McGraw Hill, New York (International Student Edition) (1972).
26. Spectroscopy Vol. 1 and 2 by B.P.Straughan.and S.Walker, John Wiley and Sons Inc., New York (1976).
27. Vibrational Spectroscopy, Theory and Applications by D.N.Sathyanarayana, New age International Publications, New Delhi (1996).
28. Physical Methods of Inorganic Chemistry by R.S.Drago, Affiliated East-West Pvt. Ltd. (Student Edition) (1972).
29. Principles of Instrumental Analysis by D.A.Skoog, F.J.Holler and T.A.Nieman, 5th Edition, Saunders College Publishing, Philadelphia.


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