

VANITA VISHRAM WOMEN'S UNIVERSITY
SCHOOL SCIENCE AND TECHNOLOGY
DEPARTMENT OF CHEMISTRY



VANITA VISHRAM
WOMEN'S UNIVERSITY
— SURAT —

Doctor of Philosophy (Ph.D.)
in
CHEMISTRY

ENTRANCE TEST SYLLABUS

Effective from A.Y. 2023-23

Syllabus applicable to the students seeking admission in the following programmes
Ph.D. Programme in Chemistry

Preamble – VVWU

Vanita Vishram Women's University (VVWU) is the First-ever Women's University of Gujarat approved by the Government of Gujarat under the provisions of the Gujarat Private Universities Act, 2009. It is a university committed to achieve Women's Empowerment through Quality Education, Skill Development, and by providing employment opportunities to its girl students through its model curriculum, integration of technology in pedagogy and best-in-class infrastructure. The focus is on prioritizing practical component and experiential learning supported through academia-industry linkages, functional MoUs, skill development training, internships etc. It aims at providing opportunities to the girl students for holistic development and self-reliance.

VISION

Empowerment of women through quality education and skill development, so as to make them strong pillars of stability in the society.

MISSION

To provide Education & Professional Training to all women for their all-round development, so as to enable them to become economically independent and socially empowered citizens.

Introduction of the Programme

Higher study in chemistry is a current need of the competitive environment. The Ph.D. in chemistry programmes provides knowledge and skill-based training to the students to flourish in research and in the professional career. The course offers a deep understanding of concept, theory and experiments that make students reach knowledge of chemistry. The dissertation in the end semester provides a research environment for the student to build a career in the research field.

Syllabus for Entrance Test for the Ph.D. Programme in the Subject of Chemistry

❖ Inorganic Chemistry

(32 %)

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.

Reference Book for Inorganic Chemistry:

- Chemical Applications of group theory by F. A. Cotton, Wiley Eastern Limited, 1976, New Delhi.
- Bioinorganic Chemistry by R. W. Hay, Ellis Harwood, England, 1984.
- Elements of Bioinorganic Chemistry, G. N. Mukherjee and A. Das, Dhuri & Sons, Calcutta, 1988.
- Inorganic Chemistry, J. E. Huheey, K. A. Keiter and R. L. Keiter, Harper Cottens College Publications, 1993.
- Concise Inorganic Chemistry by J.D. Lee, Chapman & Hall, 1996
- Atkins, P. W and Shriver D.N. Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).
- Inorganic Chemistry (5th Ed.) By Catherine E. Housecroft & Alan G. Sharpe, Pearson,
- Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.
- Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry Fourth Ed., Pearson, 2010

❖ Organic Chemistry

(32 %)

1. IUPAC nomenclature of organic molecules including stereoisomers.
2. Application of Addition, Substitution and Elimination Reactions.
3. Carbon-carbon bond formation: Chemistry of alkanes, cycloalkanes, alkenes and alkynes.
4. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds.
5. Aromaticity: Stability of Benzene, Concept of Aromaticity; Antiaromaticity; Homoaromaticity; Non Aromaticity, Huckel's rule; Aromatic ions, Aromatic Heterocycles, Polycyclic Aromatic Compounds.
6. Organic reactive intermediates and reaction mechanism: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes. Dakin reaction, Darzens glycidic ester synthesis, Wittig reaction, McMurry reaction, Michael addition, H. V. Z. reaction, Mannich Reaction, Arndt-Eistert reaction, Reimer-Tiemann reaction, Ugi reaction.
7. Molecular rearrangements: Pinacol-Pinacolone, Dienone-phenol, Demjanov, Favroskii, Benzil-Benzilic acid, Schmidt, Curtius, Beckmann, Neber, Sommelet-Hauser, Fries, Orton.
8. Organic transformations and some common organic reagents: Functional group interconversion including oxidations and reductions, Chemo, regio and stereoselective transformations. LiAlH_4 , NaBH_4 , DCC, Grignard reagent, Dess martin periodinane, DDQ, Diisobutyl aluminum hydride (DIBAL-H), Lithium diisopropylamide (LDA)
9. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, protecting groups.
10. Pericyclic reactions and photochemistry – electrocyclic and cycloaddition reactions of $4n$ and $4n+2$ Pi electron systems, 1, 3- dipolar cycloadditions, Diels-Alder reaction-stereoselectivity, Effect of substituents, sigmatropic rearrangements: suprafacial and antarafacial shifts involving H & C moieties, The Cope and Claisen rearrangements, Ene reaction, Examples of electrocyclic, cycloaddition and sigmatropic rearrangements. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds: Pyrrole, Thiophene, Furan, Pyridine, Benzofuran, Benzothiophene, Quinoline and Isoquinoline, Indole, Coumarins, Triazoles.
12. Chemistry of natural products: Carbohydrates, proteins and peptides, nucleic acids, terpenoids, alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, ^1H NMR.

Reference Books for Organic Chemistry:

- J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Ed., (2012), Oxford University Press.
- F.A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
- Organic Chemistry by Bahl & Bahl.
- Organic Chemistry, Seventh Edition Paula Yurkanis Bruice, Person, Prentice Hall Genres, 2019.
- Morrison, R. N. & Boyd, R. N. Organic Chemistry, 6th Edn., Dorling Kindersley (India) Pvt. Ltd.
- Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh, McMillan India Ltd.
- March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by Michael B. Smith
- Photochemistry and Pericyclic Reactions by Jagdamba Singh.
- Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.

● Physical Chemistry

(32 %)

1. Chemical Kinetics : Reaction Rate, Units of Rate, Rate Laws, Order of a Reaction, Zero Order Reaction, Molecularity of a Reaction, Pseudo-order Reactions, Zero Order Reactions, First Order Reactions, Second Order Reactions, Units of Rate Constant, Half-life of a Reaction, How to Determine the Order of a Reaction, Collision Theory of Reaction Rates, Effect of Increase of Temperature on Reaction Rate, Activation Energy and Catalysis.
2. Colloids : Lyophilic and Lyophobic Sols or Colloids, Characteristics of Lyophilic and Lyophobic Sols, Preparation of Sols, Purification of Sols, Dialysis, Optical Properties of Sols, Tyndall Effect, Kinetic Properties of Sols, Brownian Movement, Electrical Properties of Sols, Electrophoresis, Gold Number, Stability of Sols, Associated Colloids, Cleansing Action of Soaps and Detergents, Emulsions, Gels Applications of Colloids
3. Solutions: Ways of Expressing Concentration; Molarity, Molality, Normality etc., Henry's Law Solutions of Liquids In Liquids, Azeotropes, Theory of Fractional Distillation, Steam Distillation, Solutions of Solids in Liquids, Determination of Solubility, Solubility of Solids in Solids.
4. Polymer chemistry: Types of polymers, Stereochemistry of polymers, Mechanism of polymerization, Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & mass average molecular mass, Molecular mass determination (Osmometry and Viscometry), Thermal transitions in polymer: glass transition temperature and its significance.
5. Surfactants: Surface active agents, classification of Surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, Krafft point and cloud point, counter ion binding to micelles, solubilization, microemulsion, reverse micelles.
6. Adsorption: Adsorbate and Adsorbent, Adsorption versus Absorption, Mechanism of adsorption, Types of adsorption, Physical Adsorption, Chemisorption, Adsorption of gases by Solids, Factors affecting Adsorption, Surface area, Nature of gas, Effect of temperature and pressure, Heats of Adsorption, Comparison of Physisorption versus Chemisorption Adsorption isotherms, Freundlich Adsorption Isotherm, Langmuir adsorption Isotherm, Derivation of Langmuir, Applications of adsorption

Reference Books for Physical Chemistry:

- Physical Chemistry, P. W. Atkins, 6th Edition, ELBS.
- Physical Chemistry by Protuon and Marron
- Essentials of Physical Chemistry by Arun Bahl and B.S. Bahl
- Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill, 2011
- Textbook of Polymer Science by Billmeyer Wiley.
- Introduction to Polymer Science, V. R. Gowarikar, N. V. Vishwanathan & J. Sridhar, Wiley Eastern.
- Chemical Kinetics, K. J. Laidler, 3rd Edition, Harper and Row, 1987.
- Introduction to Colloid and Surface Chemistry by Shaw.

Interdisciplinary topics**(4 %)**

1. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods
2. Chemistry in nanoscience and technology.
3. Catalysis and green chemistry.
4. Medicinal chemistry.
5. Supramolecular chemistry.
6. Environmental chemistry.

Note: The topics of above syllabus for PhD Entrance will be based on UG and PG level.