

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



VANITA VISHRAM
WOMEN'S UNIVERSITY
— SURAT —

SEMESTER 4

Core Courses (CC), Skill Enhancement Course (SEC)

Syllabus applicable to the students seeking admission in the following programmes

B.Sc. Chemistry under LOCF
w.e.f. the Academic Year 2022-2023

1. 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.

**SEMESTER 4
CORE COURSE**

Inorganic Chemistry-IV (CH11150)

Course Objectives:

- To learn the bonding in metal carbonyl compounds
- To understand process of metallurgy and pure metal extraction
- Redox reaction and theories
- Nuclear Chemistry

Prerequisites:

- Basic coordination chemistry
- Basic of metal ores and its reaction
- Elementary idea of Nuclear chemistry

Unit-1 Metal Carbonyls

Mononuclear, Polynuclear, Non-bridged carbonyls, Bridged carbonyls, General methods of preparation of carbonyls, Physical and Chemical properties of metal carbonyls, chromium hexacarbonyl, iron pentacarbonyl, dicobalt octacarbonyl, nickel tetracarbonyl. Structure of CO molecule on the basis of VBT, MOT of CO molecule, EAN rule, Use of IR absorption spectra of metallic carbonyls.

Unit-2 Metals and Metallurgy

Occurrence of metals, various steps involved in metallurgical processes, concentration of ores, calcination, Roasting, Reduction to free metal, Electrometallurgy, Thermodynamics of the oxidation of metals to metal oxides, Ellingham diagram, Hydrometallurgy, Refining or purification, Zone refining.

Unit-3 Redox Reactions

Oxidation Number and Oxidation State, Calculation of oxidation number of elements, Difference between Oxidation number and Valency, Oxidation and reduction, Redox reaction and Half reaction, Oxidizing agent and reducing agents, Calculation of equivalent weight, Disproportionation reaction, Comproportionation reaction, Direct and Indirect Redox reaction, Importance of redox reaction, Storage Batteries.

Unit-4 Radioactivity

Introduction, Radioactivity or Natural Radioactivity, Artificial radioactivity, Types of radioactive rays, Half-life period of radioactive substances, Disintegration constant, Average life period, Radioactive equilibrium, Activity of Radioactive substance, Transmutation, Artificial transmutation, Application of Artificial transmutation.

Reference Books:

1. Principles of Inorganic Chemistry (Puri, Sharma, Kalia).
2. Advanced Inorganic Chemistry by Satyaprakash, Tuli, Basu and Madan.
3. Concise Inorganic Chemistry By J.D. Lee, 5th Ed(1996).
4. Advanced Inorganic Chemistry by Cotton & Wilkinson, John Wiley.
5. Inorganic Chemistry, 4th Edition by Catherine E. Houscroft, Alan G. Sharpe.
6. Shriver & Atkins Inorganic Chemistry by Atkins, Overton, Rourke, Weller, Armstrong, Hager.

Learning outcomes:

- Able to understand the bonding in metal carbonyl compounds and its properties.
- Understanding of Metal extraction processes.
- Able to understand redox chemistry.
- Nuclear chemistry and its principles.

Inorganic Chemistry Practical-IV (CH11160)

Course objectives:

- To perform qualitative analysis
- To perform gravimetric analysis

Prerequisite:

- Basic qualitative procedure
- Basic precipitation reaction

Practicals to be performed:

1. Inorganic qualitative analysis of binary salt mixture. (at least 6)
2. Gravimetric Analysis (i) Zn^{+2} as $Zn_2P_2O_7$ (ii) Ni^{+2} as $Ni(DMG)_2$

Learning outcomes:

- After completion of the course, the learner shall be able to perform and evaluate data obtained from qualitative and gravimetric analysis.

CORE COURSE

Organic Chemistry-IV (CH11170)

Course objective:

- Reduction reagents for alkenes and carbonyl compounds
- Familiarization with oxidizing reagents for alcohols.
- Nitrogen contains functional groups and their reactions.
- Organometallic compounds and their uses.
- Classification, structure, configurations, mechanism of reactions of few selected Carbohydrates.
- Understanding the structure, mechanism of reactions of selected heterocyclic compounds.

Prerequisite:

- Stereochemistry of carbonyl, alcohols and amines. R & S configuration of tetrahedral carbon.
- Applications of heterocyclic compounds in pharmaceuticals/drugs and the mechanism of actions.
- Pharmaceuticals/Biomedical applications of carbohydrates.
- Nitrogen contains organic compounds/heterocyclic compounds in synthetic chemistry.

Unit-1 Chemoselectivity: selective reactions and protection

Regio-, stereo-, and chemoselectivity, Reagents for reduction of alkenes and carbonyl compounds, Removal of functional groups, Reduction of benzene rings; Protection of aldehydes, ketones, alcohols, and amines, Reagents for oxidation of alcohols.

Unit-2 Nitrogen Containing Functional Groups

Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium salts: Preparation and synthetic applications.

Unit-3 Carbohydrates

Classification of Carbohydrates, Depicting Carbohydrate Stereochemistry: Fischer Projections, D and L sugar, Configurations of Aldoses, Cyclic Structures of Monosaccharides: Anomers, Reactions of Monosaccharides, The Eight Essential Monosaccharides, Disaccharides, Polysaccharides and Their Synthesis, Other Important Carbohydrates, Step up & Step down reactions, Methods of Methylation of sugar.

Unit-4 Aromatic heterocycles: structures and reactions

Structure, reactivity and synthesis of Six Membered Heterocycles: (a) Pyridine: Synthesis, Properties, Uses and canonical structures, heterynes, pyridones, Fused Heterocycles: (a) Benzopyrrole, Benzothiophene, Benzofuran, N-oxides Aromatic heterocycles: a) Indole: Fischer indole synthesis, Bischler synthesis, Madelung synthesis, Domino and cascade methods of indole synthesis, (b) Quinoline and Isoquinoline, (c) Coumarins and Chromones.

Reference Books:

1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press Inc., New York (2001).
2. Solomons, T.W G., Fryhle, B. Craig. Organic Chemistry, John Wiley & Sons, Inc (2009).
3. McMurry, J.E. Fundamentals of Organic Chemistry, Seventh edition Cengage Learning, 2013.
4. Topics in Heterocyclic Chemistry. G. W. Gribble. Springer-Verlag Berlin Heidelberg, 2010.
5. Modern Heterocyclic Chemistry. 4 Volume Set. Julio Alvarez-Builla, Juan Jose Vaquero, José Barluenga. Wiley. 2011."
6. Stereochemistry by Giulio Natta.
7. Stereochemistry by N. L. Allinger, E.L. Eliel, S. H. Wilen.
8. Stereochemistry of Organic Compounds by D. Nasipuri.
9. Stereochemistry: Conformation and Mechanism by P.S. Kalsi.

Learning Outcomes:

- An ability to understand the chemistry of reducing, oxidizing agents
- An ability to understand different functional groups containing nitrogen.
- An ability to understand carbohydrates
- An ability to understand heterocycle its industrial applications.

Organic Chemistry Practical-IV (CH11180)

Course objectives:

- Calculation of Theoretical Yield.
- Understand the techniques to monitor the reaction.
- Preparation and use of reagents in various organic transformation reactions.
- Understand the method of crystallization.
- Calculation of Percentage Yield.

Prerequisites:

- Molar Ratio.
- Lab safety and precautions.
- Concept of Purification of Compounds.
- Basic knowledge of chromatographic techniques.

Practicals to be performed:

1. Paper Chromatography (Binary Mixture)
2. Preparation of Organic Compounds: (i) m-nitroaniline, (ii) Nitroacetanilide, (iii) Bromoacetanilide, (iv) Dibromocinnamic acid (v) Azo dye (vi) 4-methyl-7-hydroxy coumarin (vii) Resacetophenone

Note: Candidates should perform at least 6 Practical.

Reference Book:

1. Vogel's Textbook of practical organic chemistry, 5th edition, B. S. Furniss, A. J. , P. W. G. Smith, A. R. Tatchell (Pearson Education).
2. Comprehensive practical organic chemistry: Preparation and Quantitative analysis, V. K. Ahluwalia, Renu Agarwal (Universities Press).

Learning outcomes:

1. Able to understand the concept of Chromatography.
2. Able to understand the Purification techniques.
3. Able to perform experiments based on learnt concepts.

CORE COURSE
Physical Chemistry-IV (CH11190)

Course objectives:

- To understand adsorption concept with applications
- To understand the concept of Ionic Equilibria and Solubility Product
- To understand the concept of partition coefficient and distribution law.
- To understand the second law of thermodynamics in brief.

Prerequisites:

- Basic understanding of adsorption.
- Understanding of Ionization, solubility and solubility products.
- Basic understanding of partition and distribution phenomenon.
- Understanding of basics of thermodynamics and first law of thermodynamics

Unit-1: Adsorption

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, Isotherm Adsorption of solutes from Solutions, Applications of adsorption

Unit-2: Ionic Equilibria

Ostwald's dilution law for strong and weak electrolytes, Experimental verification of Ostwald's law, Limitation of ostwald's law, Theory of strong Electrolytes, Ghosh's formula, Debye-huckel theory, Relaxation Effect, Electrophoretic Effect, Debye-Huckel-Onsagar Conductance Equation, Degree of dissociation, The common-ion effect, Factors affecting degree of Dissociation(1) nature of solute, (2) nature of the solvent (3) concentration(4) temperature, Numerical.

Unit-3 Distribution Law

Nernst's distribution law, Solubilities and Distribution law, Explanation of Distribution law, Limitations of Distribution law, Modification of distribution by change in Molecular state; Solutes Association and Dissociation, Henry's law, Extraction with a solvent, Liquid-liquid Chromatography, Applications of Distribution law, Solvent extraction, Partition chromatography, Desilverization of lead (parke's Process), Confirmatory test for bromide and

Iodide, Determination of association, Determination of dissociation, Determination of solubility, Distribution indicators, Numericals

Unit-4 Second law of thermodynamics

Introduction, Spontaneous Processes, Criteria of Spontaneity, Entropy, Spontaneity and Randomness, Statement of The Second Law, Statement of The Third Law, Numerical Definition of Entropy, Standard Entropy, Standard Entropy of Formation, Cyclic Process, Heat Engines, Efficiency of a Heat Engine, the Carnot Cycle, Isothermal Reversible Expansion, Adiabatic Reversible Expansion, Isothermal Reversible Compression, Adiabatic Reversible Compression, Calculation of Thermodynamic Efficiency, Numericals

Reference Books:

1. Atkins P. and De Paula, J. Physical Chemistry Tenth Ed., OUP, 2014.
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa, 2004.
3. Engel, T. and Reid, P. Physical Chemistry 3rd Ed., Prentice Hall, 2012.
4. Essentials of physical chemistry by A. S. Bhal and G. D. Tuli, Pub : S. Chand
5. Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill, 2011.
6. Four Laws that drive the Universe, by Peter Atkins.

Learning Outcomes:

After completion the course, the learner shall be able to understand:

Theory and significance of :

1. Adsorption isotherms and their significance.
2. Ostwald's dilution law and Debye-huckel theory in brief.
3. Distribution/Partition law and their applications.
4. Second law of thermodynamics.

Physical Chemistry Practical-IV (CH11200)

Course objectives:

- To perform adsorption desorption equilibrium in the real system.
- To utilize pH metry for acid-base titration.
- Application of Partition law
- To determine the heat of solution

Prerequisites:

- Adsorption isotherms
- pH variation in titration
- Law of partition

Practicals to be performed:

1. Adsorption: To study the adsorption of given organic acid (acetic acid/oxalic acid) on animal charcoal.
2. pH metry: To determine the normality of weak acid pH metrically using a strong base.
3. Partition Coefficient: To determine the molecular condition of Benzoic acid in its solution in Kerosene/Benzene by the method of partition coefficient.
4. Relative Strength: To determine the relative strength of H_2SO_4 and HCl acids.
5. Heat of Solution: To determine the Heat of solution of organic acid (benzoic acid, phthalic acid) by finding the solubility of the acid at two different temperatures.

Learning outcomes:

Able to perform practicals with taught concepts and knowledge gained during the semester.

Skill Enhancement Course (SEC)
Industrial Chemistry-II and Analytical Chemistry-II (CH15020)
(Credit 4)

Course Objectives:

- To learn the methods for determination of Adulteration.
- Analyze the various aspects of the fermentation technology and application and production of Fermented products.
- Understanding the manufacturing process, flow chart and applications of Industrially useful chemical
- To learn spectroscopic method and its application
- To understand the application of chromatographic technique
- Basic knowledge of water pollution and its assessment criteria

Prerequisites:

- List of names and Uses of compounds obtained by fermentation.
- Basic idea about different types of operation performed in Industrial processes e.g. Distillation, Crystallization, Scrubbing etc.
- Basic idea about Food articles.
- Elementary idea of spectrum and spectroscopic technique.
- Classification of chromatography.

Unit-1 Fermentation Industry

Definition, condition favorable for fermentation process (pH, temperature, presence of other substances, absence of preservatives, concentration). Manufacture of ethanol, citric acid, acetone and butanol, Acetic acid, Lactic acid from molasses, manufacture of penicillin-G.

Unit-2 Food Adulteration

Define Adulteration & Adulterant, Reasons of Adulteration, Types of Adulterants, Health Hazards of Food Adulteration, Precaution to be taken by the public regarding adulteration, Methods for detection of different adulterants in some common food items.

(1) Milk, (2) Milk Products: Sweet curd, Rabdi, Khoa & its product, Chhana or Paneer, Ghee; Cottage cheese; condensed milk; Khoa, milk powder; Ghee, Butter, (3) Oil and Fats: Oil and Fats, Mustard oil, Edible oil, Coconut oil etc., (4) Spices: Whole spices and Powdered Spices, (5) Sweetening agents: Sugar, Pithi sugar, Honey, Jaggery, Bura sugar, Sweet meats, Ice-cream and beverages, (6) Food grain and their product, (7) Spices: Whole spices and Powdered spices, (8) Miscellaneous Product

Unit-3 Spectroscopy

Types of spectrum, Process involved in interaction with matter (Fluorescence, Phosphorescence), Components of spectrophotometer-Sources, Grating and Prism as dispersing device, Sample handling, Detectors- Photo tube, Photomultiplier tube. Block diagram and working of single beam and double beam spectrophotometer. Terms involved in Beer's law (no derivation). Causes of deviation from Beer's law. Analysis of unknown by calibration curves method, standard addition method, and ratio method. Determination of Cu^{+2} , Fe^{+3} , NO_2^{-1} , F^{-} using spectrophotometer

Unit-4

A. Ion Exchange Chromatography

Synthesis and Characterization of ion exchanger, Basic requirements of ion exchange resin. Types of ion-exchange resin. Technique of ion exchange, Application of ion exchange for Separation

B. Water Pollution

Types of water pollutants, Trace elements in water and their effects; Determination of BOD, COD, DO, Total hardness, Total dissolved solids, Ozone treatment process for wastewater

Reference Books:

1. Basic Concepts of Analytical Chemistry by S. M. Khopkar, Wiley Eastern Ltd. New Delhi.
2. Quantitative Analysis Day & Underwood Prentice Hall of India, Pvt. Ltd. 10
3. Instrumental Method of Analysis B. K. Sharma, Krishna Pub. House, Merrut
4. Introduction to Chromatography Theory and Practice by V. K. Srivastava and K. K. Srivastava - S. Chand Pub.
5. Environmental Chemistry by. A. K. De.
6. <http://www.fssi.gov.in/Portals/0/pdf/Final-test-manual-part-II>
7. An Introduction to Industrial Chemistry by Peter Wiseman , Applied Science Pub. Ltd. London.
8. Reigel's Industrial Chemistry Ed. By James A. Kent.
9. Industrial Chemistry by B. K. Sharma Goel Pub.
10. Shreve Chemical Process Industries 5 ed. George. T. Austin . Mag. Hill. Book Agency.
11. Food Science Book By B Srilakshmi

Learning outcomes:

1. Able to understand the industrial process and functioning of the fermentation industry.
2. Understanding of adulteration and awareness of its effect.
3. Able to understand optical instrumentation of spectroscopy and its components.
4. Able to apply knowledge of water assessment criteria to determine water pollution.

