

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



VANITA VISHRAM
WOMEN'S UNIVERSITY
— SURAT —

BACHELOR OF SCIENCE (B.Sc.) HONOURS CHEMISTRY
PROGRAMME

under Learning Outcomes-based Curriculum Framework (LOCF)
for Undergraduate (UG) Education

SEMESTERS 3

Core Courses (CC), Ability Enhancement Compulsory Courses (AECC),
Generic Elective Courses (GE)

Syllabus applicable to the students seeking admission in the following programmes

B.A. /B.Com./B.B.A./B.Sc./B.C.A. 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.

2. Introduction of the Programme

It is a three-year undergraduate course offered after completion of 10+2 schooling. The course aims to provide broad and balanced knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories. It will provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry, in related areas or multidisciplinary areas that can be helpful for self-employment / entrepreneurship. The course is designed to provide intellectual and laboratory skills according to the UGC module for CHOICE BASED CREDIT SYSTEM (CBCS) pertaining to B.Sc. Chemistry (Honours).

3. Programme Specific Objectives (PSOs)

- To provide knowledge of chemistry with board and balanced aspects
- Development of laboratory analysis skills.
- To develop critical thinking approaches for problem solving.
- To provide skill base training to hold out in the current competitive environment.
- Multidisciplinary approach for overall development.

4. Programme Specific Outcomes (PSOs)

- Identifying chemistry related problems, analysis and application of data using appropriate methodologies.
- Finding opportunity to apply subject-related skills for acquiring jobs and self-employment.
- Understanding new frontiers of knowledge in chemistry for professional development.
- Applying subject knowledge for solving societal problems related to application of chemistry in day to day life.
- Applying subject knowledge for sustainable environment friendly green initiatives.

BACHELOR OF SCIENCE (B.Sc.) CHEMISTRY HONOURS

SEMESTER 3 CORE COURSE PAPER (CH11090)

Inorganic Chemistry-III

Course Objectives

- To understand the role of metal ions in the biological system
- To study the chemistry of non-aqueous solvent
- To understand VSEPR and VBT of chemical bonding
- Study of hybridisation concept
- Study theory of acid-base

Course Outcomes

After completing the course, the students will be able to:

- Able to apply the knowledge of metal nutrition
- Able to understand the utility of non-aqueous solvent.
- Able to determine the structure and geometry of molecules.
- Able to distinguish acid and bases according to their classification.

COURSE CONTENTS

Unit-1 Role of Metal Ions in biological Systems.

Introduction – Na⁺, K⁺, Mg²⁺, Ca²⁺, Fe²⁺, Cu²⁺, Zn²⁺; harmful effect of excess of metals on human body, Structure and role of metal chelates in living systems, Structure of chlorophyll, Photosynthesis, role of Mg present in chlorophyll, Structure and role of haemoglobin in living system

Unit-2 Non-aqueous Solvents

Introduction, Protic solvents, Aprotic solvents, Ionizing solvents, non-ionising solvents, aqueous solvents, non-aqueous solvents, Relation between the dielectric constant (K) of an ionising solvent and the solubility of an ionic salt (solute) in it. Relation between the dielectric constant (K) and dipole moment (D) of an ionizing solvent. Physical properties of water, ammonia, and sulphur dioxide, liquid ammonia, Liquid HF.

Unit:3 The Covalent Bond

Introduction, The Lewis theory the octet rule Exceptions to the octet rule, Sidgwick- Powell theory, Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, Effect of electronegativity, Isoelectronic principle, Examples of VSEPR theory Shape and Geometry. Hybridization, The extent of d orbital participation in molecular bonding, Sigma and pi

bonds, Molecular orbital method, LCAO method, s-s combinations of orbitals, s-p combinations of orbitals, p-p combinations of orbitals, p-d combinations of orbitals, d-d combinations of orbitals, Non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals, Examples of molecular orbital treatment for homonuclear diatomic molecules, heteronuclear diatomic molecules.

Unit:4 Acid and Base

Introduction, Theories of Acid Base, Arrhenius Theory, Lawry Bronstade Acid base concept, Lewis theory, The Solvent System, Lux-Flud Concept, Usanovich, Hard and Soft Acid Base, Superacids and superbases

Reference Books

- J.D. Lee, Concise inorganic Chemistry, 5th Edition, Wiley- Blackwell, New Jersey, 1999.
- F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochman, Advanced Inorganic Chemistry, 6th edition, John Wiley & Sons. New York,1999
- Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
- S. Prakash, G.D. Tuli, Advanced inorganic Chemistry, S. Chand
- Inorganic Chemistry, 4th Edition by Catherine E. Houscroft, Alan G. Sharpe
- Shriver & Atkins Inorganic Chemistry by Atkins, Overton, Rourke, Weller, Armstrong, Hager

Inorganic Chemistry Practical-III (CH11100)

Course objectives:

- To perform basic volumetric titrations
- To perform inorganic qualitative analysis

Courses outcomes:

- After completion the course, the learner shall be able to perform simple volumetric and inorganic qualitative analysis

Practical to be performed:

1. Volumetric Analysis (Any Five)

1. To determine the amount of Nickel by EDTA.
2. To determine the amount of Copper by EDTA.
3. To determine the amount of Zinc by EDTA.
4. Determination of total hardness of water by EDTA.
5. To determine the strength of alkali content in an antacid tablet using HCl.
6. Estimation of Calcium in Milk

2. Gravimetric Analysis (Any One)

1. Fe^{2+} as Fe_2O_3
2. Ba^{2+} as BaSO_4

Reference Books

- Quantitative analysis by R.A. Day and A.L. Underwood.
- Vogel's qualitative organic analysis.
- Elementary Practical Organic Chemistry Part-I Small Scale Preparations by A. I. Vogel.
- Practical Pharmaceutical Chemistry by A. H. Beckett, Volume I & II.
- Elementary Practical Organic Chemistry Part-III Quantitative Organic Analysis by A. I. Vogel.

CORE COURSE PAPER (CH11110)

Organic Chemistry-III

Course Objectives

- Familiarization about classes of organic compounds and their methods of preparation.
- Basic uses of reaction mechanisms.
- Name reactions, uses of various reagents and the mechanism of their action.
- Organometallic compounds and their uses.
- Different reactions of carbonyl compounds.
- Reactions of enols, enolates and reactions and its application.

Course Outcomes

After completing the course, the students will be able to gain an understanding of major concepts, theoretical principles and chemistry of carbonyl compounds.

COURSE CONTENTS

Unit-1 Nucleophilic Addition to CO group

MO aspects, Hydration and cyanohydrin reaction, thermodynamic Vs. Kinetic control, Organometallic reagents for C-C bond formation (organolithium, magnesium and cerium compounds), ortho lithiation, transmetallation, metal halogen exchange, Stereochemistry of nucleophilic addition to carbonyl group, Conjugate addition reactions.

Unit-2 Nucleophilic Substitution to CO group

Nucleophilic substitution at C=O: nature of leaving group, carbonyl reactivity, hydrolysis of esters, amides and nitriles, esterification, transesterification, conversion of acid into acid derivatives, making ketones and aldehydes from esters.

Nucleophilic substitution at C=O with the loss of carbonyl oxygen: acetals, cyclic acetals, thioketal, imines, enamines, reductive amination, alternative methods for amines formation, LAH reduction of amides, Strecker synthesis of amino acids, Wittig reaction

Unit-3 Enols, enolates and reactions

Enols, enolates and reactions: Alkylation, kinetic and thermodynamic enolates, Aldol reaction, specific enol equivalents (lithium enolate, aza enolate, silyl enol ether, enamines, zinc enolates), Knoevenagel reaction, Perkin reaction, Reformatsky reactions, Cannizaro reaction, Mannich reaction, intramolecular aldol reaction, Acylation, Claisen condensation, Dieckman cyclization, Conjugate addition of enolates, Robinsons Annulation

Unit-4 Aromatic heterocycles 1: structures and reactions

Introduction to heterocycles and their importance. Nomenclature of ring systems: (a) Trivial System (b) Replacement system (c) Fusion system, (d) Hantzsch-Widman nomenclature, Structure, reactivity and synthesis of five membered Heterocycles: (a) Pyrrole: Paal Knorr, Hantzsch Methods, etc, (b) Thiophene: Paal Knorr, Hinsberg method, etc. (c) Furan: Paal Knorr, Feist-Benary, Industrial Method, etc.; (d) Pyrazole, Imidazole, Oxazole, Thiazole, (e) Synthesis using modern methods

Reference Books:

- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press Inc., New York (2001).
- Solomons, T.W G., Fryhle, B. Craig. Organic Chemistry, John Wiley & Sons, Inc (2009).
- McMurry, J.E. Fundamentals of Organic Chemistry, Seventh edition Cengage Learning, 2013.
- P Sykes, A GuideBook to Mechanism in Organic Chemistry, 6th Edition (1997), Orient Longman, New Delhi.
- Morrison R. T. and Boyd R. N. Organic Chemistry, Sixth Edition Prentice Hall India, 2003.
- Topics in Heterocyclic Chemistry. G. W. Gribble. Springer-Verlag Berlin Heidelberg, 2010.
- Modern Heterocyclic Chemistry. 4 Volume Set. Julio Alvarez-Builla, Juan Jose Vaquero, José Barluenga. Wiley. 2011.

Organic Chemistry Practical-III (CH11120)

Course objectives:

- Identification of functional groups.
- Identification of organic compounds
- Observation of different chemical tests.
- Preparation and use of reagents in various organic transformation reactions.
- Derivatives of compounds.

Courses outcomes:

- An ability to conduct experiments and interpret results, while observing responsible and ethical scientific conduct.

Organic Chemistry Practical-III

1. Qualitative Analysis of given binary mixture (Solid+Solid): Detection of type (Acid/Phenol/Base/Neutral), Separation of mixture, Identification with M.P./B.P., Purification (Recrystallisation).
2. Preparation of Solutions and their standardization.
 1. Estimation of Vitamin-C.
 2. Estimation of Phenol

Reference Books

- Quantitative analysis by R.A. Day and A.L. Underwood.
- Vogel's qualitative organic analysis.
- Elementary Practical Organic Chemistry Part-I Small Scale Preparations by A. I. Vogel.
- Practical Pharmaceutical Chemistry by A. H. Beckett, Volume I & II.
- Elementary Practical Organic Chemistry Part-III Quantitative Organic Analysis by A. I. Vogel.

CORE COURSE PAPER (CH11130)

Physical Chemistry -III

Course objectives:

- To understand electrolysis concept with transport number
- Understand the Kohlrausch's law
- To understand the concept of photochemistry
- To understand the theoretical concept of molecular spectroscopy.
- Study the basics of thermodynamics and the first law of thermodynamics.

Course outcomes:

- Able to apply the Kohlrausch's law for the real salt system
- Able to explain photochemical interaction in various system
- Able to explain phenomenon take place in the molecules when interact with radiation
- Able to explain the utilization of first law of thermodynamics

COURSE CONTENTS

Unit-1 Theory of Electrolytic Dissociation

Arrhenius theory of Ionisation, Migration of ions, Relative speed of ions, Transport Number, Determination of Transport number, Hittorf's method, Moving boundary Method, Kohlrausch's law, Applications of Kohlrausch's law, (1) Calculation of λ_{∞} for Weak electrolytes, (2) Calculation of Absolute Ionic mobilities, (3) Calculation of the solubility of sparingly soluble salts, (4) Calculation of the Degree of Dissociation or Conductance Ratio, (5) Calculation of the Ionic product for Water, Numericals

Unit-2 Photochemistry

Photochemical reactions, Difference between Photochemical and Thermochemical reactions, Thermopile, Photoelectric cell, Chemical actinometer, Laws of photochemistry, Grothus-draper law, Stark-einstein law of Photochemical equivalence, Quantum yield (or quantum Efficiency), Calculation of quantum Yield, Photosensitized reactions Photophysical processes, Fluorescence, Phosphorescence, Chemiluminescence, Numericals

Unit -3 Molecular Spectroscopy

Introduction to molecular spectra, Electromagnetic spectrum, Electromagnetic radiation with wavelength and energy, Molecular energy levels:(a) Rotational energy; (b) Vibrational energy; and (c) Electronic energy, Molecular energy Quantization, Absorption spectrophotometer, Types of molecular spectra, Electronic Spectra, Vibrational Spectra, Rotational Spectra, Vibrational-Rotational spectra, Infrared Spectroscopy, Ultraviolet-visible (UV-Vis) spectroscopy, Calculation of bond-length, force constant, Numerical Problems.

Unit-4 First Law of Thermodynamics

Thermodynamic terms, System, boundary, Surroundings, Homogeneous and Heterogeneous systems, Types of thermodynamic Systems, Intensive and extensive properties, State of a system, Equilibrium and non-Equilibrium states, Thermodynamic processes, Reversible and Irreversible processes, Nature of heat and work, Pressure Volume Work, Isothermal reversible Expansion work of an ideal Gas, Isothermal irreversible, Expansion work of an ideal, Gas Maximum work done in Reversible expansion, Internal energy, Units of internal energy, First law of Thermodynamics, Enthalpy of a system, Molar heat capacities. Numericals

Reference Books:

- Atkins P. and De Paula, J. Physical Chemistry Tenth Ed., OUP, 2014.
- Castellan, G. W. Physical Chemistry 4th Ed., Narosa, 2004.
- Engel, T. and Reid, P. Physical Chemistry 3rd Ed., Prentice Hall, 2012.
- Essentials of physical chemistry by A. S. Bhal and G. D. Tuli, Pub : S. Chand
- Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
- Levine, I. N. Physical Chemistry 6th Ed., Tata McGraw-Hill, 2011.

Physical Chemistry Practical-III (CH11140)

Course objectives:

- To study of acid vs base conductometric titrations
- To study the rate of given chemical reactions with their kinetic study.
- To study experimental verification of Lambert-Beer's law.

Courses outcomes:

- An ability to conduct experiments and interpret results, based on conductometric titration, chemical kinetics and spectrophotometry.

Experiments Planned:

1. Conductometric Titration: To determine the normality of the given HCl solution by the conductometric titration with the given 0.1 N NaOH solution
2. Chemical Kinetics - Ester hydrolysis: To study the monomolecular reaction in the hydrolysis of methyl acetate in 0.5 N HCl at different initial concentrations.
3. Saponification: To investigate the reaction in saponification of Ethyl acetate by NaOH.
4. Viscosity: To determine the viscosity of the given liquids and the % of unknown mixture 'C'.
5. Colourimetry: To verify Lambert-Beer's law for KMnO_4 solution.

Reference Books

- Quantitative analysis by R.A. Day and A.L. Underwood.
- Vogel's qualitative organic analysis.
- Elementary Practical Organic Chemistry Part-I Small Scale Preparations by A. I. Vogel.
- Practical Pharmaceutical Chemistry by A. H. Beckett, Volume I & II.
- Elementary Practical Organic Chemistry Part-III Quantitative Organic Analysis by A. I. Vogel.

Skill Enhancement Course

CH11410

Industrial Chemistry-I

Course objective:

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

- The concept of Unit Process and unit operation, reaction mechanisms of various unit processes.
- Synthesis and Uses of selected compounds by applying unit processes.
- Basic idea about the manufacturing process of pulp and paper.
- Concepts about detergency, synthesis, classification of detergents and their importance.

Course Outcomes:

- A familiarity with chemistry and industrial applications of Nitration, Amination and Sulphonation reactions.
- Basic concept of detergents and aware of the manufacturing process of pulp and paper in industry.

COURSE CONTENTS

Unit-I: Unit Processes in Organic Chemistry

(A) Nitration: Definition, Nitrating agent, Reaction mechanism of Nitration. Nitration of acetylene, Nitration of Benzene, Nitration of Naphthalene Artificial perfumes: Musk xylene, Musk ketone, Musk ambrette. Explosives: Trinitrophenol, Trinitrotoluene, Trinitro glycerine, Emitol.

(B) Amination: Definition, Amination by reduction: Metal - Acid reduction, Metal - Alkali reduction, Catalytic reduction, Sulphide reduction. Amination by ammonolysis: Amination of chlorobenzene, Phenol & Sulphonic acid. Importance of amination in industry in the manufacture of m-Phenylenediamine, HMDA, Anthranilic acid, Hexamethylene tetramine.

(C) Sulphonation - Definition, Methods of sulphonation, sulphonating agents, mechanism of sulphonation. Sulphonation of Benzene, Toluene, Naphthalene

Unit II Detergents, Pulp & Paper Industry

[A] Detergents: Introduction, Principles detergency, classification of surface-active agents, Anionic detergents, Cationic detergents, Non-ionic detergents, Amphoteric detergents, Suds regulators, Builders and Additives. (1) Propylene tetramer (2) ABS (3) LAS

[B] Type of pulp, Manufacture of chemical pulp by Sulphate pulp process, Sulphite pulp process, manufacture of paper (conversion of pulp into paper, beating process, importance of fillings, sizing, colouring materials in manufacture of paper and calendaring).

Reference books:

- Shreve Chemical Process Industries 5 ed. George. T. Austin. Mag. Hill. Book Agency
- Reigel's Industrial Chemistry Ed. By James A. Kent.
- Unit Process in Organic Synthesis by D. H. Groggins.
- An Introduction to Industrial Chemistry by Peter Wiseman, Applied Science Pub. Ltd. London.
- Industrial Chemistry by B. K. Sharma Goel Pub.

Skill Enhancement Course

CH11420

Analytical Chemistry-I

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

Course objectives:

- To understand basic of Analytical Chemistry
- Qualitative and Quantitative Aspect
- Concept of Errors and its elimination
- Process Involved in Gravimetric Analysis
- To get basic idea of thermal analysis

Courses outcomes:

- Able to classify analytical methods
- Apply the knowledge of concept in titrimetric and gravimetric analysis.
- Able to perform basic chromatography separation.

COURSE CONTENTS

Unit-1 Introduction to Analytical Chemistry and Data Treatment

A) Brief History, Analytical Process, Type of Analysis: Qualitative and Quantitative Analysis, Classical Method and Instrumental Method of analysis, Advantages and Disadvantages, Classification of Analytical Method According to Sample Size. Sampling technique

B) Treatment of analytical data: Error Definition, Types of errors: Determinates errors, indeterminate errors, constant and proportional errors. Define and explain the following terms – Accuracy and Precision, mean, median, deviation, average deviation, standard deviation, variance, coefficient of variation, relative mean deviation, range, absolute errors, relative errors. Minimization of determinates error, Normal error curve. Significant Figures, Rejection of result from a set of results, 2.5 d rule, 4.0 d rule and Q-test. Numerical

Unit-2 Chromatography

Introduction, chromatography Classification of chromatography according to mobile phase and stationary phase. Paper chromatography, one dimensional, two dimensional and radial paper chromatography, Rf value, Use of paper chromatography in amino acid separation, Application. Thin Layer Chromatography, Preparation of Thin layer plate, Sample Application, Plate Development, Spot Detection, Qualitative and Quantitative analysis. Basic Idea of Column chromatography.

Reference Book:

- Quantitative Analysis by R. A. Day & A. L. Underwood, 6th ed. Pub. Prentice Hall of India Ltd.,
- Analytical Chemistry by Gary D. Christian.
- Vogel's Textbook of Quantitative Chemical Analysis, Fifth Edition.
- Chromatography Concept and Contrast, James M. Miller
- Fundamental of Analytical Chemistry by Skoog, Holler and Crouch