VANITA VISHRAM WOMEN'S UNIVERSITY

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF CHEMISTRY

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

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

SEMESTERS 1

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 2021-2022

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.

5. Structure of the Programme

B.Sc. CHEMISTRY HONOURS STRUCTURE AND DISTRIBUTION OF COURSES						
Semester	**CC Total Credits (84)**	**DSE Total Credits (24)**	**GE Total Credits (24)**	**SEC Total Credits (08)**	**AECC Total Credits (08)**	**Total Credits**
1	CH11010 CH11020 CH11030 CH11040	--	CH13010 CH13020 (For non-chemistry discipline)	--	EN12010 BT12010	**84 + 24 + 24 + 08 + 08 = 148**
2	CH11050 CH11060 CH11070 CH11080	--	CH13030 CH13040 (For non-chemistry discipline)	--	EN12020 BT12030	
3	CH11090 CH11100 CH11110 CH11120 CH11130 CH11140	--	CH13050 CH13060 (For non-chemistry discipline)	CH11410 (CH11420)	--	
4	CH11150 CH11160 CH11170 CH11180 CH11190 CH11200	--	CH13070 CH13080 (For non-chemistry discipline)	CH11430 CH11440	--	
5	CH11210 CH11220 CH11230 CH11240	CH12010 CH12020 **OR** CH12030 **OR** CH12040 CH12050 CH12060	--	--	--	
6	CH11250 CH11260 CH11270 CH11280	CH12070 **OR** CH12080 **OR** CH12090 CH12100	--	--	--	

6. Structure of the Course

<table>
<tr><th colspan="5">B.Sc Chemistry Honours</th></tr>
<tr><th>Core Course</th><th>Discipline Specific Elective</th><th>Skill Enhancement Course</th><th>Generic Elective</th><th>Ability Enhancement Course</th></tr>
<tr><td colspan="5">SEMESTER-1</td></tr>
<tr><td>Inorganic and Physical Chemistry-I (CH11010)
Inorganic Chemistry Practical-I (CH11020)</td><td></td><td></td><td rowspan="2">Fundamentals of Chemistry-I (For non-chemistry discipline) (CH31010)
Fundamentals of Chemistry-I Practical (CH31020)
OR
Chemistry in Daily Life-I (CH31090)
Chemistry in Daily Life-I Practical (CH31100)</td><td rowspan="2">Communication Skills in English - I (EN12010)

Environmental Studies - I (BT12010)</td></tr>
<tr><td>Organic Chemistry-I (CH11030)
Organic Chemistry Practical-I (CH11040)</td><td></td><td></td></tr>
<tr><td colspan="5">SEMESTER-2</td></tr>
<tr><td>Inorganic and Physical Chemistry-II (CH11050)
Inorganic and Physical Chemistry Practical-II (CH11060)</td><td></td><td></td><td rowspan="2">Fundamentals of Chemistry-II (For non-chemistry discipline) (CH31030)
Fundamentals of Chemistry-II Practical (CH31040)
OR
Chemistry in Daily Life-II (CH31110)
Chemistry in Daily Life-II Practical (CH31120)</td><td rowspan="2">Communication Skills in English - II (EN12020)

Environmental Studies-II (BT12020)
OR
Good Laboratory Practices (CH12010)
OR
Chemistry in Everyday Life (CH12020)</td></tr>
<tr><td>Organic Chemistry-II (CH11070)
Organic Chemistry Practical-II (CH11080)</td><td></td><td></td></tr>
<tr><td colspan="5">SEMESTER-3</td></tr>
<tr><td>Inorganic Chemistry-III (CH11090)
Inorganic Chemistry Practical-III (CH11100)</td><td></td><td>Industrial Chemistry-I (CH11410)
Analytical Chemistry-I (CH11420)</td><td>Medicinal Chemistry (For non-chemistry discipline) (CH13050)
Medicinal Chemistry Practical (CH13060)</td><td></td></tr>
</table>

Organic Chemistry-III (CH11110) Organic Chemistry Practical-III (CH11120)				
Physical Chemistry-III (CH11130) Physical Chemistry Practical-III (CH11140)				
SEMESTER-4				
Inorganic Chemistry-IV (CH11150) Inorganic Chemistry Practical-IV (CH11160)		Industrial Chemistry-II (CH11430) Analytical Chemistry-II (CH11440)	Colour Chemistry (For non-chemistry discipline) (CH13070) Colour Chemistry Practical (CH13080)	
Organic Chemistry-IV (CH11170) Organic Chemistry Practical-IV (CH11180)				
Physical Chemistry-IV (CH11190) Physical Chemistry Practical-V (CH11200)				
SEMESTER-5				
Advance Organic Chemistry-I (CH11210) Organic Chemistry Practical-V (CH11220)	Physical Chemistry (CH12010) Organometallics and Bioinorganic Chemistry (CH12020) **OR** Introduction to Nanochem. & applications (CH12030) **OR** Advance Material			

	Chemistry (CH12040)			
Analytical Chemistry-I (CH11230) Analytical Chemistry Practical-V (CH11240)	Inorganic Chemistry Practical-V (CH12050) Physical Chemistry Practical-V (CH12060)			
SEMESTER-6				
Advance Organic Chemistry-II (CH11250) Organic Chemistry Practical-VI (CH11260)	Inorganic Spectroscopy (CH12070) **OR** Environmental Chemistry (CH12080) **OR** Biochemistry (CH12090) and Seminar (CH12100)			
Analytical Chemistry-II (CH11270) Physical Analytical Chemistry Practical-VI (CH11280)	Spectroscopy Practical-VI (CH12110)			

BACHELOR OF SCIENCE (B.Sc.)
CHEMISTRY HONOURS

SEMESTER 1
CORE COURSE PAPER 1 (CH11010)

Inorganic & Physical Chemistry-I

Course Objectives

- Solids, lattice parameters – its calculation, solid characteristics of simple salts.
- Understanding the basics of chemical kinetics
- Chemical kinetics: type of reactions, determination of order and rate of reactions.
- Learning scientific theory of atoms, concept of wave function
- Physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and position in the periodic table.

Course Outcomes

At the end of the course, the students will be able to:
After completion the course, the learner shall be able to understand:
Solids lattice parameters, basics of chemical kinetics, scientific theory of atoms and concept of wave function

COURSE CONTENTS

Unit-1: Solid State (Theory)

Nature of the Solid State, Types of Solids, Isotropy and Anisotropy, The Habit of a Crystal, Law of Constancy of Interfacial Angles, Symmetry of Crystals, Elementary ideas of Symmetry, Symmetry elements, Miller indices, Crystal structure, Unit Cells and its parameters, Calculation of Mass of the Unit Cell, Seven crystal systems and fourteen bravais lattices; Coordination number of a crystal lattice, X-Ray Diffraction, Bragg's Law, Measurement of Diffraction angle, A Simple Account of Rotating Crystal Method and Powder Pattern Method. Analysis of the crystal structure of NaCl and CsCl.

Unit-2 Chemical Kinetics-I (Theory)

Chemical kinetics and its scope, Reaction rate, Average rate of reaction is a function of time, Instantaneous rate of reaction, Rate laws, Order of a reaction, Molecularity of a reaction, Molecularity of a reaction of (a) Elementary reactions and (b) Complex reactions, molecularity versus order of reaction, Pseudo–order reactions, Zero order reactions, First order reactions, Examples of first order reactions, Numericals

Unit -3 Wave mechanics concepts of atomic structure (Theory)

Bohr's theory, its limitations and atomic spectrum of hydrogen atom, de Broglie's concept of dual nature of matter; de Broglie's equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Normalized and orthogonal wave functions. Shapes of s, p, d f orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations.

Unit-4- Periodic properties of Elements (Theory)

Periodic table, group trends and periodic trends in physical properties. Classification of elements on the basis of electronic configuration. Modern IUPAC Periodic table. General characteristics of s, p, d and f block elements. Effective nuclear charges, screening effects, atomic radii, ionic radii, covalent radii. Ionization enthalpy, electron gain enthalpy and electronegativity. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. General trends of variation of electronic configuration, elemental forms, metallic nature, magnetic properties, catenation and catalytic properties, oxidation states, properties and reactions of important compounds such as hydrides, halides, oxides, oxy-acids, complex chemistry in respect of s-block and p-block elements.

Reference Books:

- J.D. Lee, Consice 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
- Essentials of physical chemistry by A. S. Bhal and G. D. Tuli, Pub: S. Chand
- Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
- Ball, D. W. Physical Chemistry Thomson Press, India (2007). 5. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

SEMESTER 1
CORE COURSE PAPER 2 (CH11030)

Organic Chemistry-I

Course Objectives

- Basic of organic molecules, structure, bonding, reactivity and reaction mechanisms.
- Understanding hybridization and geometry of atoms, identifying chiral canters.
- Reactivity, stability of organic molecules, structure, stereochemistry.
- Electrophile, nucleophiles, free radicals, electronegativity, resonance, and intermediates along the reaction pathways.
- Basic concept of addition, elimination and substitution reactions.
- To understand the definition, basic concepts, importance of stereochemistry.
- To provide knowledge about the structure, classification, nomenclature and designating the chiral compounds.
- To develop skills for various isomerism and stereo selective, specific synthesis and its application in organic chemistry.

Course Outcomes

At the end of the course, the students will be able to:

After completion the course, the learner shall be able to understand:
Basic concepts about organic compounds and organic reactions, organic qualitative and quantitative analysis and stereochemistry

COURSE CONTENTS

Unit-1 Basics of Organic Chemistry (Theory)

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes). Organic reactions and their mechanism: Addition, Elimination and Substitution reactions. Systematic IUPAC Nomenclature.

Unit-2 Organic Qualitative and Quantitative analysis (Theory)

A) Organic Qualitative Analysis: Elemental Analysis (Lassaigne's Test with equation), Solubility of Organic Compound, Chemical Methods: Solubility in $NaHCO_3$, NaOH and HCl, Acid, Base and Phenol and amphoteric compounds (Sulphanilic acid and Anthranilic acid)

B) Organic Quantitative Analysis: Determination of Empirical Formula and its relation with Molecular Formula, Determination of Nitrogen by Kjeldahl's method and Kjeldahl's method modified with boric acid. Molecular weight of organic acid by Ag-salt method and organic base by Chloroplatinate method, Numerical based on empirical and molecular formula.

Unit-3 Chemistry of Aliphatic Hydrocarbons (Theory)

A) Carbon-Carbon sigma bonds: Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free radical substitutions: Halogenation - relative reactivity and selectivity.

B) Carbon-Carbon pi-bonds: Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff / Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, Diels- Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions.

C) Cycloalkanes: Cycloalkanes and stability, Preparation & Properties, Baeyer strain theory,

Unit-4 Stereochemistry of organic compounds (Theory)

Optical isomerism-elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism- determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds, Conformational Isomerism-Difference between configuration and conformation. Newman projection and Sawhorse formulae, Fischer and flying wedge formula

Reference Books:

- F. A. Carey, Organic Chemistry, Seventh Edition, Tata McGraw Hill (2008).
- F. A. Carey, R. J. Sundberg, Advanced Organic Chemistry, Part A: Structure and mechanism, Kluwer Academic Publisher, (2000).
- Vogel's qualitative organic analysis.
- Organic Chemistry by Bahl & Bahl.
- "Text book of Organic Chemistry" by P. S. Kalsi, 1999, MacMillan of India Pvt. Ltd.

SEMESTER 1
CORE COURSE PAPER 1 (CH11020)

Inorganic Chemistry Practical-I

Course Objectives

- To perform Inorganic qualitative analysis of single salt with various combinations of anion and cation.
- To perform simple acid-base, redox volumetric exercises.

Course Outcomes

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

Inorganic qualitative analysis of single salt and able to perform simple acid-base, redox based volumetric exercises

COURSE CONTENTS

A. INORGANIC QUALITATIVE ANALYSIS (Inorganic qualitative analysis of single salt) (Practical)

N. B. Candidates should perform the analysis of at least 7 compounds.

B. VOLUMETRIC EXERCISE (Practical)

H_2SO_4 vs $NaHCO_3$ vs HNO_3
$KMnO_4$ vs $H_2C_2O_4$ vs KOH
$KMnO_4$ vs $FeSO_4$ $7H_2O$ vs $K_2Cr_2O_7$
$H_2C_2O_4$ vs $KMnO_4$ vs $FeSO_4$
N. B. Candidates should perform at least 2 volumetric exercises.

SEMESTER 1
CORE COURSE PAPER 2 (CH11040)

Organic Chemistry Practical-I

Course Objectives

- To perform Organic qualitative analysis of single substances with various functional groups.
- To perform melting point and boiling point detection.

Course Outcomes

At the end of the course, the students will be able to:

After completion the course, the learner shall be able to:
Identify unknown organic substances and melting point and boiling point.

COURSE CONTENTS

A. ORGANIC QUALITATIVE ANALYSIS OF SINGLE SUBSTANCE (Practical)

1. Organic Qualitative Analysis: Detection of the elements (N, S and halogens) and functional groups: PhOH, -COOH, R R'C=O, -CHO, Ar-NH_2, Ar-NO_2, -$CONH_2$ etc.
2. Determination of the melting points of given organic compounds and unknown organic compounds (using Kjeldahl method/electrically heated melting point apparatus).
3. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)

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.

TEACHING METHODOLOGY

The teaching methodologies utilized for effective learning process in the course are:

1. Direct instruction/Lecture method
2. Problem solving Method
3. Small group teaching
4. The discussion Method
5. The study assignment method
6. ICT based teaching
7. Demonstration Method
8. Seminar based Learning
9. Project based Learn in

KEYWORDS

- Credit: A course *credit* is a unit that gives weighting to the value, level or time requirements of an academic course taken at a *school* or other *educational* institution.
- Atom: A chemical element in its smallest form, made up of protons and neutrons within the nucleus and electrons circling the nucleus.
- Bond: Any persistent attraction between atoms, ions, or molecules that enables the formation of chemical compounds. Bonds are created as a result of a wide variety of electrochemical forces, whose strengths can vary considerably; they are broken when these forces are overcome by other forces. The types, strengths, and quantities of bonds holding together chemical substances dictate the structure and bulk properties of matter.
- Catalyst: Any element or compound that facilitates an increase in the speed of a chemical reaction but which is not consumed or destroyed during the reaction. It is considered both a reactant and a product of the reaction.
- Distillation: The process of separating the component substances of a liquid mixture by exploiting differences in the relative volatility of the mixture's components through selective boiling and subsequent condensation. The apparatus used to distil a substance is called a still, and the re-condensed substance yielded by the process is called the distillate.
- Electrolyte: A solution that conducts a certain amount of electric current and can be split categorically into weak and strong electrolytes.
- Isomers: Ions or molecules with identical chemical formulas but distinct structures or spatial arrangements. Isomers do not necessarily share similar properties. The two main types of isomers are structural isomers and stereoisomers.

For Further information: https://en.wikipedia.org/wiki/Glossary_of_chemistry_terms