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

# MASTER OF SCIENCE (M.Sc.) CHEMISTRY/ORGANIC CHEMISTRY PROGRAMME
**under Learning Outcomes-based Curriculum Framework (LOCF) for Post Graduate (PG) Education**

# SEMESTER 1
**Core Courses (CC), Ability Enhancement Compulsory Courses (AECC), Generic Elective Courses (GE)**

***Syllabus applicable to the students seeking admission in the following programmes***
**M.Sc Chemistry/Organic Chemistry 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

Higher study in chemistry is a current need of the competitive environment. The M.Sc. organic chemistry and 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.

## 3. Programme Specific Objectives (PSOs)

- To motivate critical thinking and analysis skills to solve complex problems to improve human life.
- To impart the basic analytical and technical skills to work effectively in the various fields of chemistry.
- To demonstrate an ability to conduct experiments with mastery of appropriate techniques and proficiency using core chemical instrumentation.
- To provide professional services to industry, Research organization, institutes.
- To provide value based and ethical leadership in the professional and social life.

## 4. Programme Specific Outcomes (PSOs)

- In-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods of chemistry.
- Apply/implement interface between, on the one hand, the history of chemistry and natural science and, on the other hand, issues pertaining to the areas of modern technology, health, and environment.
- Skills in planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques.
- Skill in examining specific phenomena theoretically and/or experimentally
- Generation of new scientific insights or to the innovation of new applications of chemical research.

## 5. Structure of the Programme

| M.SC. CHEMISTRY/ORGANIC CHEMISTRY STRUCTURE AND DISTRIBUTION OF COURSES | | | | | | |
|---|---|---|---|---|---|---|
| **Semester** | **CC Total Credits (60)** | **DSE Total Credits (12)** | **GE Total Credits (4)** | **CC Practical (24)** | **Dissertation/ Project Work/ Seminar (16)** | **Total Credits** |
| **1** | CH21010<br>CH21020<br>CH21030<br>CH21040 | -- | -- | CH21050<br>CH21060 | -- | **60 + 12 + 4 + 24 + 16 = 116** |
| **2** | CH21070<br>CH21080<br>CH21090 | -- | CH-32010<br>OR<br>CH32020<br>OR<br>CH32030 | CH21100<br>CH21110 | -- | |

## 6. Structure of the Course

<table>
<tr><th colspan="6">M.Sc. Chemistry/Organic Chemistry (SEMESTERS 1 & 2)</th></tr>
<tr><th>Sem.</th><th>Core Course</th><th>Discipline Specific Elective Courses</th><th>General Elective</th><th>Core Course Practical</th><th>Dissertation/ Project Work/ Seminars</th></tr>
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<tr><td rowspan="3">2</td><td>Core Course 1<br>Inorganic Chemistry<br>(CH21070)</td><td rowspan="3">--</td><td rowspan="3">General Elective<br>(Group 1)<br>Analytical Chemistry/ Mathematics for Chemists/Biology for Chemists</td><td>Core Course Practical<br>A. Inorganic Chemistry<br>B. Organic Chemistry<br>(CH21100)</td><td rowspan="3"></td></tr>
<tr><td>Core Course 2<br>Organic Chemistry<br>(CH21080)</td><td rowspan="2">Core Course Practical<br>C. Physical Chemistry<br>D. Analytical Chemistry<br>(CH21110)</td></tr>
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**Master of Science (M.Sc.) Chemistry/Organic Chemistry**

**Semester-1**

**Core Course**

**CH21010**

**Inorganic Chemistry (Credit 4+1)**

## Course objective:

- Detail study based on Symmetry and symmetry elements, operation, types.
- Study of metal ions, their roles, toxicity.
- Inorganic polymer, their characterization, methods, synthesis
- General discussion on the properties of the non-transition elements and types

## Prerequisite:

- Detail study of symmetry of molecule and its character table
- Metal ions application in biological units and its overdose.
- Study of inorganic polymer, and different method to study weight of inorganic polymer
- Non transition elements detail study, silanes etc.

## Unit-I Symmetry and Group Theory in Chemistry

Concept of symmetry in chemistry, Symmetry operations & Symmetry elements: Rotation axis of symmetry and types of rotational axis, Plane of symmetry and types of planes, Improper rotational axis of symmetry, Inversion center and Identity element, More about symmetry elements-Molecular point groups: Definition and notation of point groups, Classification of molecules into C1, CS, Ci, Cn, $C_n$h, $C_\infty$V, $D_n$, $D_n$d, $D_\infty$h, $S_n$ (n=Even), Td, Oh, Ih groups, Symmetry and Dipole moment, Symmetry criteria for optical activity, Representation of groups: Reducible and Irreducible representations and their relation, The great orthogonality theorem, Preparation of character table for $C_2$v and $C_3$v point groups.

## Unit-II Bioinorganic Chemistry

Introduction, Classification and role of metal ions according to their action in biological system, Effect of metal ion concentration and it's physiological effect, Basic principles in the biological selection of elements, Oxygen transfer and storage: Heme and non-heme proteins, Haemoglobin and myoglobin as oxygen carriers, Bohr effect, Coordination chemistry of Fe(II) in haemoglobin and oxyhaemoglobin, Relaxed and tense (R & T) configurations of haemoglobin, Electronic formulations and mode of bonding of dioxygen in haemoglobin. Structure and functions of Cytochromes, Cytochrome C and Hemerythrins. Biochemistry of Iron storage and Transport: Ferritin, Transferrin; Metal ion transport and storage: Siderophores and metallothionein; Electron Transfer: Cytochromes, Iron-Sulfur Proteins and

Copper Proteins. Introduction to Ferredoxins, Blue copper proteins: Hemocyanin, Zinc protein (carbonic anhydrase), and Ironsulfur proteins, Bioinorganic chemistry of cobalt: Vitamin B12, Bio-inorganic chemistry of Magnesium, Chlorophyll, Mechanism of Photosynthesis I and II; Metal deficiency and disease, Toxic effects of metals.

**Unit-III Inorganic Polymer**s

Definition of polymers and their depiction, Characteristics of inorganic polymer, Characterization of inorganic polymer by molecular weight, Number average and Weight average, Determination of molecular weight by Viscometry and Osmometry, Structural features of polymer: Backbone bonding, Branching and Cross-linking, Chemical and stereo chemical variability, Classification of inorganic polymer, Synthesis, properties, structure and uses of polyphosphazene and polysiloxanes, Preceramic inorganic polymers like Silicon carbide, Silicon nitride, Boron nitride, Boron carbide, Aluminium nitride.

**Unit-IV Chemistry of Non-Transition Elements**

Introduction, Recapitulation of various aspects of s- and p-block elements, General discussion on the properties of the non-transition elements, Special feature of individual elements like Li and Be, Synthesis, properties and structure of their halides and oxides, Polymorphism of carbon, phosphorus and sulphur, Polyhedral borans, carboranes, Wade's rule, Borax and borazine molecule, Isolobal analogy, STYX number. Metalloboranes and metallacarboranes compounds with M-M multiple bonds, Synthesis, properties and structure of silicates, silicones, phosphazenes, sulphur, oxyacids of nitrogen, phosphorus, sulphur and halogens, Interhalogen, Paeudohalides and Noble gas compounds.

**Reference books:**


- Chemical Applications of group theory by F. A. Cotton, Wiley Estern Limited, 1976, New Delhi.
- 2. Group theory and its Applications by P. K. Bhattacharya, Himalaya Publishing House, Mumbai, 1986.
- 3. Group theory and symmetry by L. R. Hall, McGraw Hill, New York, 1989.
- 4. Chemical Application of Symmetry and Group theory by Rakshit Ameta & R. C. Ameta, CRC Press, 2017.
- 5. Symmetry & Spectroscopy of molecules by K. V. Reddy, New age International Publishers, New Delhi, 2009.
- Bioinorganic Chemistry by R. W. Hay, Ellis Harwood, England, 1984.
- Elements of Bioinorganic Chemistry, G. N. Mukherjee and A. Das, Dhuri& Sons, Calcutta, 1988.
- A Guidebook to Biochemistry, J. M. D. Yudkin and R. E. Offord, Cambridge University Press, 1980.
- A text book of Inorganic Polymers by G. R. Chatwal, Himalaya Publishing House, 2001.

- Introductory polymer chemistry by G. S. Mishra, Wiley Estern limited, 1993. 3. Inorganic Polymers by J. E. Mark, H. R. Allcock& Robert West, Oxford University Press, 2005.
- 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


**Learning Outcome**

Will be able to identify the molecule symmetry on basis of their geometry, also will attain knowledge of inorganic polymers, the metal ion their importance and toxicity, also study of phosphorus, boranes, like non transition elements

**Core Course**

**CH21020**

**Organic Chemistry (Credit 4+1)**

**Course objective:**

- Preparation and its reactions of selected intermediates in organic chemistry
- Concepts and applications of substitution and elimination reactions and its stereochemistry aspects.
- Aromaticity and application in chemistry.
- Different Conformations and conformational analysis of acyclic and cyclic molecules.
- Importance and basics of dynamic stereochemistry and asymmetric synthesis.

**Prerequisite:**

- Elucidating reaction mechanisms for organic reactions.
- Electrophiles and nucleophiles and its classification.
- Conformational and configurational isomers.
- Absolute configuration like *R* and *S*, *E* and *Z.*

**Unit-I: Reaction Mechanism & Reactive Intermediates**

Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of – Carbocations (Classical and non-classical): Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Pinacole-Pinacolone, Rupe. Carbanions: Mechanism of condensation involving enolates - Aldol, Claisen, Mannich, Dieckmann, and Shapiro reactions. Carbenes: Mechanism of Arndt-Eistert reaction, Reimer-Tiemann reaction and Bamford Steven's rearrangement reaction. Free Radicals: Allylic halogenation (NBS), coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.

**Unit-II: Substitution and Elimination Reactions**

Mechanisms for nucleophilic substitution at saturated carbon atoms, $SN^1$, $SN^2$, $SN^i$ reaction, Contrasts between $SN^1$ and $SN^2$, The leaving group, Solvent and Nuleophiles in $SN^1$ and $SN^2$ reactions, Reactions of Allylic halides, neighbouring group participation by -OH, $-NH_2$, -COO-, -RS, - halogen, aromatic ring. Aromatic Nucleophilic Substitution: The $SN_2$, $SN_1$ and benzyne mechanisms, Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. Elimination reaction: Hoffmann and Zaitsev's rule of elimination, $E_1$, $E_2$ and $E_1CB$ Reaction mechanism and orientation.

**Unit-III: Aromaticity**

Benzene and aromaticity: Sources and Names of Aromatic Compounds, Structure and Stability of Benzene, Aromaticity, Frost circle diagram, heat of hydrogenation; Huckel's

rule; HMO method, Aromatic ions, Aromatic Heterocycles: Pyridine and Pyrrole, Polycyclic Aromatic, Compounds, Spectroscopy of Aromatic Compounds, Antiaromaticity, homoaromaticity, nonaromaticity; aromaticity in benzenoid compounds, Aromaticity non-benzenoid compounds

**Unit-IV: Stereochemistry**

Enantiomers and Distereomeric the Tetrahedral Carbon, Sequence Rules for Specifying Configuration (R-S and E-Z nomenclature), Chirality, Optical Activity, Meso Compounds, Racemic Mixtures and the Resolution of Enantiomers, Optical activity in the absence of chiral carbons biphenyl, allenes, spiranes, Chirality at Nitrogen, Phosphorus, and Sulfur, Prochirality, Stereo selective and Stereo specific reactions.

Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis (including enzymatic and catalytic nexus), enantio and diastereo selective synthesis. Conformational Analysis: Bond rotation allows chains of atoms to adopt, a number of conformations Conformation and configuration Barriers to rotation Conformations of ethane, propane, butane Ring strain A closer look at cyclohexane, Substituted cyclohexanes, Decalins. Effects of conformation on reactivity in acyclic compounds and substituted cyclohexanes.

**Reference book**:


- Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
- Organic chemistry 2nd ed. Jonathan Clayden, Nick Greeves, Stuart Warren.
- March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley.
- Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey &Sundberg (5thedition),2000, Springer.
- A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
- Reaction mechanism by Jagdambasingh.
- Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age international publishers.
- Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P. Doyle, Published by Wiley-Inter Science.
- Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri, New Age International (P) Ltd. Publisher.


**Learning Outcomes:** An understanding of major concepts, theoretical principles and chemistry of selected intermediates, substitution. elimination reactions, aromaticity and advanced stereoisomerism.

## Core Course

## CH21030

## Physical Chemistry (Credit-4+1)

### Course objective:

- Familiar with a basic knowledge of the thermal properties of polymers, aspects of crystallization kinetics, glass transition; to teach how these properties depend on structure.
- To understand the different theories of chemical kinetics.
- To study thermodynamic properties of partial molar properties.
- Provide students with fundamentals of the chemistry colloidal solutions.

### Prerequisite:

- Basic understanding of polymer chemistry.
- Know-how of chemical kinetics.
- Through understanding of thermodynamic parameters and laws of thermodynamics.
- Basic understanding of colloids.

### Unit-I: Polymer Chemistry

Types of polymers, Stereochemistry of polymers, Mechanism of polymerization (free radical, anionic and cationic), Kinetics of free radical 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, Numericals

### Unit-II: Chemical Kinetics

Collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, Factors affecting reaction rates in solution. Effect of ionic strength on the rate constant. Kinetics and mechanism of following complex reactions in details: i) Reversibl**e**, ii) Parallel, iii) Consecutive, iv) Chain and v) Enzyme catalysed reactions, Photochemical reactions (Hydrogen-bromine and hydrogen-chlorine reactions), Numericals.

### Unit- III: Thermodynamics

Partial molar properties: Partial molar free energy, Partial molar volume, Partial molar heat content, Chemical Potential, and their significances, determination of these quantities. Non-ideal systems: Basic idea on Excess functions of non-ideal solutions, Thermodynamic probability and most probable distribution, Boltzmann Distribution law, Partition function and its significance, Rotational, Vibrational & translational partition function, Relation between Partition function and entropy. Partition function and equilibrium constant, Partition function and heat content, Numericals.

**Unit-IV: Colloids**

Introduction, lyophilic and lyophobic, sols or colloids, characteristics of lyophilic and lyophobic sols, preparation of sols dispersion methods, aggregation methods, purification of sols, dialysis, electrodialysis, ultrafiltration, optical properties of sols, tyndall effect, kinetic properties of sols, brownian movement, electrical properties of sols, electrical double layer, electrophoresis, electro-osmosis, coagulation, gold number, stability of sols

**Reference Books:**


- Physical Chemistry, P. W. Atkins, 6th Edition, ELBS.
- A Textbook of Physical Chemistry, Vol. 4, K. L. Kapoor, McMillan, 1985
- Textbook of Polymer Science by Billmeyer Wiley.
- Introduction to Polymer Science, V. R. Gowarikar, N. V. Vishwanathan & J. Sridhar, Wiley Eastern.
- Principles of Polymer Science P. Bahadur and N. V. Sastry, Narosa 2006.
- Chemical Kinetics, K. J. Laidler, 3rd Edition, Harper and Row, 1987.
- Basic Chemical Kinetics by G. L. Agrawal
- Thermodynamics of Chemist, Glasstone, Van Nostrand Co.
- Statistical Thermodynamics by Gupta M.C.
- Thermodynamic Properties of Non-electrolyte Solutions by W.E. Acree, Academic Press, 1984.
- An Introduction of Chemical Thermodynamics, R.P. Rastogi and R. R. Misra, Vikas Publishing House, New Delhi.
- Introduction to Colloid and Surface Chemistry by Shaw.


**Learning outcomes**

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

- Explain thermal properties of polymers, crystallization kinetic and understand how these properties depend on the structure of polymers.
- Solve questions basis on rates of different reactions
- Explain the main concepts of colloidal solution

## Core Course

## CH21040

## Analytical Chemistry (Credit-4+1)

### Course objectives:

- To understand Method of Analysis process
- Statistical aspect of analysis data
- To learn UV-Vis spectroscopy for qualitative analysis
- Solvent extraction method
- Thermal method of analysis TGA and Thermometric titration

### Prerequisites:

- Basic idea of analysis
- Energy levels in molecules
- Various effect observed in organic molecules
- Distribution coefficient
- Temperature effect on solid materials

### Unit-I: Introduction and Basic Tools of Analytical Chemistry

Analytical Chemistry, The Analytical Perspective, Common Analytical Problems (Quntitative and Qualitative Analysis), Fundamental Units of Measurement, Significant Figures, Units for Expressing Concentration, Converting Between Concentration Units, p-Functions, Stoichiometric Calculations, Use Conservation Principles in Stoichiometry Problems, Analysis, Determination, and Measurement , Techniques, Methods, Procedures, and Protocols, Classifying Analytical Techniques, Selecting an Analytical Method 1 Accuracy 2 Precision 3 Sensitivity 4 Selectivity.5 Robustness and Ruggedness 6 Scale of Operation 7 Equipment, Time, and Cost.8 Making the Final Choice Developing the Procedure 1 Compensating for Interferences 2 Calibration and Standardization 3 Sampling 4 Validation

### Unit-II: UV-Visible Spectrophotometry

Types of electronic transition, auxochrome, chromophore, Bathochromic effect, Hypso chromic effect, Hyper chromic effect, Hypo chromic effect, Factor affecting lambda max like resonance, hyper conjugation, hydrogen bonding, steric effect, Woodward's rules for α, β-unsaturated ketones, Diene systems, aromatic system, Effect of solvent on absorption bands, law of absorption with derivation, Instrumentation, Sampling, Application.

### Unit-III: Solvent Extraction

Introduction, The Distribution Coefficient, The Distribution Ratio, Mechanism of Extraction; weak Acids and bases, Extraction of a metal as chelate compound, Extraction involving Ion pairs and solvates, Multiple extraction with successive potions, Craig Counter Current

Extraction and its apparatus, Accelerated and Microwave-Assisted Extraction, Solid Phase extraction, Numerical.

**Unit-IV: Thermal Method of Analysis Introduction, Type of Thermal Analysis**

Thermo-gravimetric Analysis, Instrumentation, Thermo-balance, Furnace, Programmer, Sample, Crucible, Temperature Calibration, The atmosphere, Thermo-gravimetric analysis of various samples. Thermometric Titration (TT), Introduction, Instrument, Applications of TT in Neutralization Titration, Precipitation Titration, Complexometric Titration and Redox titration.

**Reference Books:**


- Instrumental Method of Chemical Analysis by G. R. Chatwal and S. K. Anand
- Quantitative Analysis by R. A. Day & A. L. Underwood, 6 th ed. Pub. Prentice Hall of India ltd,.
- Analytical Chemistry by Gary D. Christian
- Instrumental Analysis by Willard, Merritt, Dean and Settle
- Vogel's Textbook of Quantitative Chemical Analysis, Fifth Edition.
- Chromatography Concept and Contrast, James M. Miller
- Spectroscopy by H. Kaur, Pragati Prakashan
- Introduction to Spectroscopy By Pavia, Lampman, Kriz, Vyvyan
- Thermal Methods of Analysis Principles, Applications and Problems by P. J. Haines
- Thermometric Titrimetry by L. S. Bark, S. M. Bark, R. Belcher and H. Freiser


**Course outcomes:**

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

- Able to understands method development steps
- Apply the knowledge of spectral data to identify the compounds
- Able to understand the thermal method of analysis for gravimetry and titration.

## Core Course

## CH21050

## Inorganic Chemistry Practical (Credit-2)

**I. Inorganic Qualitative Analysis:** (Minimum 5 Separations)

Mixture having 6 radical 3 positive, 3 Negative including 2 less familiar from the following: (1) Molybdenum (2) Tungsten (3) Lithium (4) Thorium (5) Zirconium (6) Cerium (7) Vanadium (8) Beryllium

**II. Inorganic Preparation:** (Minimum Four)

i. Hexa-amine nickel (II) chloride
ii. Mohr's salt (Ferrous Ammonium sulphate)
iii. Sodium trioxalato ferrate trihydrate
iv. Sodium cobaltinitrite
v. Tetra amine cupric silphate
vi. Reineek's salt (Ammonium tetrathiocyanate diamine Chromate)

**Reference books:**


- Quantitative Chemical Analysis, R.B. Fischer and D.G. Peters, 3rd Edition, D.B. Saunders Company, 1968 or latest edition.
- Laboratory directions for analytical separation and determinations, C.T. Kenner, MacMillan Company, New York, 1971.
- Inorganic Qualitative analysis, A.I. Vogel, 5th Edition, ELBS/ Longman, 1989.
- ogel's text books of Quantitative Chemical Analysis, Revised by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Danney, Fifth Edition, ELBS/ Longman, 1989.
- Spot tests in inorganic analysis, F. Feigel, 5th Edition, Elsevier (1958).
- Colorimetric methods of analysis, Snell and Snell, D. Van Nostrand, latest edition. E.D.T.A. titrations, latest edition, Fleshka, Pergamon process.

## Core Course

## CH21050

## Organic Chemistry Practical (Credit-2)

### Course objective:

- To understand the separation techniques of organic mixtures
- Identification of organic molecules through different reactions.
- Purification of compounds through the crystallization and its derivatization.

### Prerequisite:

- Students should be aware of functional groups.
- Basic idea about acid-base reactions.
- MSDS of chemicals.

### Organic Chemistry Practical

1. Qualitative analysis of given organic mixture: (Minimum eight mixtures) Tertiary mixture to be given. (S+S+S), Semisolids or (L+L+L). Type determination. Separation by physical and chemical methods. (both permitted in case of liquids)
2. Paper Chromatography

### Reference book:

- A text book of practical organic chemistry – A. I. Vogel
- Practical organic Chemistry – Mann and Saunders
- A handbook of quantitative and qualitative analysis – H. T. Clarke
- Comprehensive Practical Organic Chemistry: Qualitative Analysis V K Ahluwalia& S. Dhingra.
- Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis V K Ahluwalia& R. Aggarwal Universities Press.
- An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal

### Learning Outcomes:

An ability to conduct experiments to develop intellectual and laboratory skills.

**Core Course**

**CH21060**

**Physical Chemistry Practical (Credit-2)**

## Course objective:

- Use of pH metry and potentiometry for titrations for suitable chemical reaction.
- Verification of Onsager's equation by conductometry.
- Determination of CMC of a given surfactant by different physico-chemical methods.
- To find concentration of supplied unknown solution colorimetrically.
- To study the phase diagram.
- Determination of energy of activation for the given reaction.

## Prerequisites:

- Theoretical understanding and operational knowledge of pH meter and potentiometer.
- Theoretical understanding of Onsager's equation and operational knowledge of conductometry.
- Concept of micellization process.
- Theoretical understanding of phase diagrams.
- Brief knowledge of energy of activation

## Experiments:

1. Determine the dissociation constant of a given monobasic acid pH-metrically.
2. Determine the amount of ferrous sulphate / ferrous ammonium sulphate in a given flask potentiometrically using cerric salt solution.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes
4. Determine the CMC of a surfactant by conductivity measurements.
5. Calculate the molar absorptivity of each of the given two solutions (A) and (B) and also find out concentration of supplied unknown solution colorimetrically.
6. Investigation the reaction between $K_2S_2O_8$ and KI at two different temperatures and calculate the energy of activation for the reaction.
7. To study the phase diagram of a three-component system Water – acetic acid – chloroform.
8. Determination of CMC and area per molecule of a surfactant by surface tension measurement.

## Learning outcomes

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

- Find dissociation constant of a given acid and amount of complex salt by suitable methods.

- Understand the micellization process and can find the CMC of a given surfactant.
- Study and analyse the phase diagram of a three-component system

## Core Course

## CH21060

## Analytical Chemistry Practical (Credit-2)

**Course objectives:**

- To perform quantitative spectral analysis and determine mole ratio of complexes.
- To perform metal ores analysis.
- To perform pH metry to determine dissociation constant of weak electrolytes
- To perform solvent extraction of metal complex and quantification
- To perform electrogravimetric analysis.

**Prerequisites:**

- UV-Vis quantitative analysis
- Dissolution and classical quantification
- Solvent extraction theory
- Electrolysis

**Practical:**

1. Spectrophotometric determination of the $Fe^{+3}$ ion concentration with 1,10 Phenanthroline using calibration curve method.
2. Experiment for mole ratio method or Job's method to study the metal ligand mole composition of complexes.
3. Analysis of Dolomite sample for its chemical constituent.
4. Analysis of Pyrolusite sample for its chemical constituent.
5. Determination of Ka1 and Ka2 of phosphoric acid by pH metry
6. Simultaneous determination of $Cr^{+3}$ & $Co^{+2}$ in a mixture.
7. To separate a mixture of $Ni^{+2}$ & $Fe^{+2}$ by complexation with DMG and extracting the Ni2+-DMG complex in chloroform, and determine its concentration by spectrophotometry.
8. Electrogravimetry analysis of Cu+2 in aqueous solution

**Course outcomes:**

- Able to apply the knowledge of taught concepts during practical performance.

## 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