SNDT Women's University, Mumbai

Bachelor Of Science
(Chemistry)

B.Sc. In Chemistry

As Per NEP – 2020

Semester – III & IV

Syllabus

(WEF. 2025-2026)

Structure with Course Titles

SN	Courses	Type of Course	Credits	Marks	Int	Ext
Semester III						
30132111	Physical chemistry I	Major (Core)	4	100	50	50
30132112	Organic chemistry I	Major (Core)	4	100	50	50
30132113	Fashion and jewelry design	Major (Core)	4	100	50	50
30332111	Plant Cultivation	Minor stream	2	50	0	50
30432111	Dialogue communication program	OEC	2	50	0	50
		AEC	2	50	50	0
31332101	Subject research project	FP	2	50	50	0
		CC	2	50	50	0
			22	**550**	**300**	**250**
SN	**Courses**	**Type of Course**	**Credits**	**Marks**	**Int**	**Ext**
Semester IV						
40132111	Analytical Chemistry I	Major (Core)	4	100	50	50
40132112	Inorganic Chemistry I	Major (Core)	4	100	50	50
40132113	Nutrition and Dietary	Major (Core)	4	100	50	50
40432111	Digital Literacy & Content creation	OEC	2	50	0	50
40732111	Cement technology	SEC	2	50	0	50
		AEC	2	50	0	50
41732101	Leadership and Development skills	CEP	2	50	50	0
		CC	2	50	50	0
			22	**550**	**250**	**300**

Exit with UG Diploma with 10 extra credits (44 + 10 credits)

Syllabus
Semester III

3.1 Major (Core)

Course Title	PHYSICAL CHEMISTRY
Course Credits	4 / 4
Course Outcomes	After going through the course, learners will be able to
	● The main objective of this paper is to give a basic and updated knowledge for students on Thermodynamics, Surface phenomena and phase equilibria, Electrochemistry, Chemical kinetics and Microwave Spectroscopy and Rotational Vibrational Spectroscopy.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● - Understand the basic principles of atomic structure, including the arrangement of electrons, protons, and neutrons within an atom. ● - Explain how the periodic table is organized based on atomic structure. ● - Predict the properties of elements based on their atomic structure.
Content Outline	● Review of Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to atomic structure -Introduction to Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it (no derivation). Significance of ψ andψThermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law non-ideal solutions. Vapor pressure-composition and temperature- composition curves of ideal and non-ideal solutions. Distillation of solutions. ● Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids-Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. ● Liquids: Surface tension and its determination using a stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● Bonding:

	• Differentiate between different types of chemical bonds, such as covalent, ionic, and metallic bonds. • Describe the factors that influence bond formation and strength. • Predict the type of bonding in a given compound based on its chemical formula.
Content Outline	• Ionic bonding, lattice energy, Statement of Born-Landé equation for calculation of lattice energy, • Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rulcs, ionic character in covalent compounds, dipole moment and percentage ionic character. • Covalent bonding: VB Approuch: Shapes of some inorganic molecules and ions on the basis of • VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar,tetrahedral, trigonal bipyramidal and octahedral arrangements.MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of Ist and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO". Comparison of VB and MỘ approaches
Module 3 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Determine surface tension using the drop number and drop weight methods, understanding the relationship between interfacial forces and liquid properties. • Analyze the variation of surface tension with detergent concentration, applying concepts of surfactant behavior and micelle formation. • Study the variation of viscosity with the concentration of sucrose, understanding the impact of solute-solvent interactions on viscosity.
Content Outline	After learning the module, learners will be able to, **Surface tension measurements.** • Determine the surface tension by (i) drop number (ii) drop weight method. • Study the variation of surface tension of detergent solutions with concentration. **Viscosity measurement using Ostwald's viscometer.** 1. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature. 2. Study the variation of viscosity of sucrose solution with the concentration of solute. • Determine the water equivalent of a calorimeter. • Calculate the heat of ionization of acetic acid. • Determine the heat of hydration of CuSO4, i.e., the heat of crystallization of CuSO4·5H2O. • Determine the solubility product of Ba (IO3)2 at room temperature.

Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Investigate the pH variation upon adding HCl/NaOH to acetic acid, sodium acetate, and their mixtures, interpreting buffer action. • Prepare buffer solutions of different pH values using acetic acid-sodium acetate and ammonium hydroxide-ammonium chloride, mastering buffer preparation techniques. • Perform pH metric titrations for (i) strong acid vs. strong base and (ii) weak acid vs. strong base, understanding pH changes during neutralization. • Determine the dissociation constant of a weak acid, applying pH metric methods to calculate equilibrium constants.
Content Outline	**pH metry** (a) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures. (b) Preparation of buffer solutions of different pH (i) acetic acid-sodium acetate (ii) ammonium hydroxide-ammonium chloride. (c) pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base. (d) Determination of dissociation constant of a weak acid.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE) :

Module 1: **Quantum Mechanics, Atomic Structure, and Solutions**

- **Description**: Explores the shift from classical to quantum mechanics in understanding atomic structure and the properties of ideal and non-ideal solutions, including their phase behavior and separation techniques.
- **Project Idea**:"Investigating Real-World Solutions and Deviations from Ideal Behavior.
- Description: Students research and present on a specific real-world solution (e.g., seawater, alloys, biological fluids) and analyze why it deviates from ideal behavior, discussing intermolecular forces and their impact on properties like vapor pressure and boiling point. They can also explore industrial distillation processes for such solutions.
- **Assessment:** Presentation (clarity, accuracy, depth of analysis), research quality (sources, data interpretation), and a short-written report summarizing their findings.

Module 2: Liquids - Surface Tension and Viscosity

- **Description**: Focuses on the properties of surface tension and viscosity of liquids, their measurement, and the effect of temperature and solute concentration on these properties.
- **Project Idea**: "Surface Tension and Viscosity in Everyday Applications."
- Description: Students investigate the role of surface tension and viscosity in everyday phenomena or applications (e.g., detergents, paints, lubricants, biological fluids). They will explain how these properties are crucial for the application's effectiveness and may involve simple experiments or data analysis from provided sources.
- **Assessment:** Presentation/demonstration of their chosen application, explanation of the role of surface tension and/or viscosity, and a brief report outlining their findings and any experimental procedures.

Module 3: Chemical Bonding - Ionic and Covalent Bonding

- **Description**: Covers the principles of ionic and covalent bonding, including theories like VSEPR and MO, and factors influencing bond characteristics and molecular shapes.
- **Project Idea**:"Molecular Architecture: Predicting and Visualizing Molecular Shapes and Bonding."
- Description: Students choose a set of molecules or ions and predict their shapes using VSEPR theory and describe their bonding using hybridization concepts. They can then use molecular modeling software (if available) or create physical models to visualize these structures. For more advanced students, they can attempt to draw qualitative MO diagrams for simple diatomics.
- **Assessment**: Accuracy of VSEPR predictions, correct application of hybridization, quality of molecular models/visualizations, and a written explanation of their bonding and geometry.

Module 4: pH Metry

- **Description**: Deals with the principles of pH measurement, buffer solutions, and pH metric titrations for determining acid-base properties.
- **Project Idea**: "Investigating Buffer Systems in Biological or Environmental Contexts."
- Description: Students research a specific buffer system relevant to biology (e.g., blood buffer, cellular buffers) or the environment (e.g., soil buffers, ocean buffering). They will explain how the buffer system works to maintain pH stability and its importance in the chosen context. They could also design a simple experiment to demonstrate the buffering action of a prepared buffer solution.
- **Assessment**: Clarity and accuracy of their explanation of the buffer system, its relevance to the chosen context, and (if applicable) the design and execution of their demonstration experiment. A short report summarizing their findings is also expected.

References:

1. Gurdeep Raj, ‗Advanced Physical Chemistry', 35thedition, Goel Publishing House, 2009.
2. Puri, Sharma Pathania, ‗Principles of Physical Chemistry', 42ndedition, Vishal Publishing & Co, 2007.
3. R. Stephen Berry, Stuart A. Rice & John Ross, ‗Physical Chemistry', 2ndedition, Ox-ford University press, 2000..Levin, ‗Physical Chemistry', 6thedition, Tata Mcgraw-Hill Education, 2011.

3.2 Major (Core)

Course Title	ORGANIC CHEMISTRY
Course Credits	4 / 4
Course Outcomes	After going through the course, learners will be able to
	1. To acquire skills in the preparation of organic compounds, their separation, purification and identification
	2. Students understand the process of preparation of organic through various reactions
	3. To develop an insight into the preparation of organic compounds in various reactions
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students understand the process of preparation of organic through various reactions • Students understand reactive intermediate
Content Outline	• Structure, shape and reactivity of organic molecules • Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.Alkenes: Methods of preparation of alkenes by (i) dehydration of alcohols (ii) dehydrohalogenation. Saytezaff's elimination (Formation of highly substituted alkene, 2-butene), Hofmann orientation (Formation of least substituted alkene, 1-pentene). Chemical reactions of alkenes- Peroxide effect and its mechanism, hydroboration, oxidation, oxy-mercuration–reduction and mechanism, ozonolysis with respect to2-butene and 2-methyl2-butene, oxidation with KMnO4.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students learn about Baeyer's strain theory • Students understand Geometrical isomerism:
Content Outline	• Baeyer's strain theory, calculation of angle strain, Sachse Mohr theory of strain-less rings. Chair and boat forms of cyclohexane. Axial and equatorial bonds. • Conformational isomerism: Basic concept of conformational analysis with reference to ethane and butane.

	• Geometrical isomerism: definition, E and Z notation for 2-butene and butenedioic acid, rules for assigning notations. Determination of configuration of butenedioic acid by anhydride formation, dipole moment measurement, melting point and stability. • Optical isomerism: Chirality, van't Hoff-Lebel hypothesis, optical activity, D and L configurations, R and S notations, sequence and priority rules, enantiomers, diastereoisomers, epimers, anomers, racemic and meso (with suitable examples like lactic and tartaric acids.). • racemisation, resolution of racemic mixture by chemical method, asymmetric synthesis, Walden inversion
Module 3 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	1. Purification of Organic Compounds and Melting Point Determination • Purify organic compounds by crystallization using water, alcohol, or alcohol-water mixtures, understanding the principles of selective solubility. • Accurately determine the melting points of purified compounds, applying the concept of purity and phase transition. **2. Detection of Elements in Organic Compounds** • Detect the presence of nitrogen, sulfur, and halogens in unknown organic compounds, developing proficiency in elemental analysis techniques. • Interpret the results of qualitative tests based on color changes, precipitate formation, and gas evolution.
Content Outline	After learning the module, learners will be able to 1. Purification of organic compounds by crystallization using Water /Alcohol /Alcohol-Water and determination of their melting points. 2. Detection of elements (nitrogen, sulphur and halogens) in unknown organic compounds. 3. Chromatography (a) Checking the purity of supplied organic sample using paper/thin layer chromatographic technique. (b) Determination of the number of components present in a supplied organic mixture using

	paper/thin layer chromatographic technique. (c) Separation of a mixture of two amino acids by paper chromatography and determination of Rf. (d) Separation of a mixture of o-and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC) and determination of Rf of each of the component.
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Perform benzoylation of phenols (β-naphthol, resorcinol, or p-cresol) using the Schotten-Baumann reaction, applying acylation techniques. • Carry out the oxidation of ethanol or acetone using the iodoform reaction, identifying the formation of yellow precipitate. • Nitrate salicylic acid using a green approach with ceric ammonium nitrate, promoting sustainable chemistry practices. • Reduce p-nitrobenzaldehyde or m-nitrobenzaldehyde using sodium borohydride, learning reduction techniques. •
Content Outline	Organic preparations: (a) Benzolyation of phenols (β-naphthol/resorcinol/p-cresol) by Schotten-Baumann reaction. (b) Oxidation of ethanol/ acetone (Iodoform reaction). (c) Nitration of Salicylic acid by green approach (using ceric ammonium nitrate). (d) Reduction of p-nitrobenzaldehyde/ m-nitrobenzaldehyde by sodium borohydride. (e) Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde. (f) S-Benzylisothiouronium chloride from thiourea and benzyl chloride. (g) Aldol condensation using either conventional or green method. (h) Benzil-Benzilic acid rearrangement

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Structure, Shape, Reactivity, and Alkenes

- **Description**: This module introduces fundamental concepts of organic structure, bonding, reactivity (nucleophiles, electrophiles, reactive intermediates, acid/base strength), aromaticity, and the preparation and reactions of alkenes.
- **Project Idea**: "The Chemistry of a Common Alkene-Based Product."
- Description: Students choose a common product that utilizes alkenes or alkene reactions in its synthesis or function (e.g., polymers like polyethylene or polypropylene, industrial chemicals produced from alkenes). They will research the alkene starting material, the key reaction steps involved in its production, and the importance of alkene reactivity in this context.
- **Assessment**: Presentation (clarity, accuracy of chemistry), research quality (sources, understanding of industrial relevance), and a short report outlining the synthesis/function and the role of alkene chemistry.

Module 2: Stereochemistry and Conformations

- **Description**: This module focuses on the three-dimensional arrangement of atoms in organic molecules, including conformational isomerism in cyclic and acyclic systems, geometrical isomerism (cis/trans, E/Z), and optical isomerism (chirality, enantiomers, diastereomers, meso compounds, resolution).
- **Project Idea**: "Chirality in Pharmaceuticals or Natural Products."
- Description: Students investigate a chiral pharmaceutical drug or a natural product. They will identify the chiral center(s), discuss the importance of stereoisomers (e.g., one enantiomer being active while the other is inactive or has side effects), and briefly explain methods used for obtaining the desired enantiomer (resolution, asymmetric synthesis).
- **Assessment**: Accuracy in identifying chiral centers, understanding the biological/pharmacological significance of stereoisomers, clarity in explaining the methods of obtaining specific enantiomers, and a short written report.

Module 3: Purification and Identification of Organic Compounds

- **Description**: This module covers essential laboratory techniques for purifying organic compounds (crystallization) and identifying the elements present in them, as well as chromatographic methods for checking purity, separating mixtures, and determining Rf values.
- **Project Idea**: "Developing a Separation and Identification Scheme for a Mixture."
- Description: Students are given a hypothetical mixture of two or three organic compounds (with known properties provided). They need to propose a detailed step-by-step procedure involving crystallization and thin-layer chromatography (TLC) to separate and identify the components. They should justify their choice of solvents and TLC conditions based on the properties of the compounds.
- **Assessment**: Logical design of the separation and identification scheme, justification of chosen techniques and conditions, and a written proposal outlining the procedure and expected results (including predicted Rf values based on polarity).

Module 4: Organic Preparations

- **Description**: This module involves the synthesis of various organic compounds using different reaction types, including benzoylation, oxidation (Iodoform), nitration, reduction, semicarbazone formation, S-benzylisothiouronium salt preparation, aldol condensation, and benzil-benzilic acid rearrangement.
- **Project Idea**: "Designing a 'Greener' Synthesis of a Target Compound."

- Description: Students choose one of the organic preparations mentioned in the module (or another simple preparation). They need to research the conventional method and then propose a modification or an alternative procedure that aligns with the principles of green chemistry (e.g., using less hazardous reagents, milder conditions, fewer steps, or generating less waste). They should justify their proposed changes based on green chemistry principles.
- **Assessment**: Understanding of the chosen reaction, identification of areas for improvement based on green chemistry principles, feasibility and rationale for the proposed modifications, and a written proposal outlining the conventional and the "greener" approach with justifications.

References:

1. Organic Chemistry, T. W. Graham Solomons,Craig B. Fryhle, John Wiley & Sons; 10th edition(December, 2009)
2. Morrison and R. N. Boyd, „Organic Chemistry“, 6th Edition, Prentice Hall, 1992.
3. D. Nasipuri Stereochemistry of Organic Compounds“, 2nd Edition, New Age International (P) Ltd., Publishers, 1994.
4. Peter Sykes, „A Guide book to Mechanism in Organic Chemistry“, 6th Edition, Pearson Education, 2009.
5. P. S. Kalsi“ „Organic Reactions and their Mechanisms““, New Age International Publishers,2009.
6. J. Clayden, N. Greeves, S. Warren and P. Wothers, „Organic Chemistry“, 2nd edition, OxfordUniversity Press, 2012. ..

3.3 Major (Core)

Course Title	Fashion and jewellery design
Course Credits	4 / 4
Course Outcomes	After going through the course, learners will be able to
	• Students will learn about the traditional jewellery of India. • Students will understand the manufacturing technology of jewellery. • Students will learn about Gem and Gem stones. • Students will learn about the Jewellery Entrepreneurship.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	1. Students will understand the history of jewellery. 2. Students will learn the types of jewellery.
Content Outline	• Traditional Jewellery of India • Introduction to traditional jewellery-History of jewellery-Significance of Indian jewellery. • Bridal jewellery - Antique jewelry - Bead jewellery - Custom jewellery - Copper jewellery -Fashion jewellery - Filigree jewellery - Gold jewellery – Hand made jewellery - Ivory jewellery -Jadu jewellery.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students will learn the terminology of Gems and Gem stones. • Students will understand the properties of Gems and Organic gems.
Content Outline	• Jewelry Manufacturing technology • Introduction to tools used in the jewelry manufacturing -Safety measures taken while making jewelry-Dimensions used in the jewelry. • Process of jewelry making - Designing, Moulding, Casting, Polishing, Embellishment, • Finishing, Plating, Quality Checking, Packing and Transporting, Marketing.
Module 3 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Trace the history of jewellery making in India from ancient times to the present day • Explain the symbolic and cultural significance of jewellery in different regions and communities of India.

	• Describe the unique features and purposes of bridal jewellery in Indian wedding traditions. • Distinguish between antique jewellery and contemporary interpretations of traditional designs. • Identify and describe the characteristics of bead jewellery and its diverse applications in Indian traditions.
Content Outline	1.Jewellery Identification and Material Analysis: To identify and classify traditional Indian jewellery and analyze their constituent materials. 2.Understanding Bridal Jewellery Components: To recognize and comprehend the significance of various elements within Indian bridal jewellery sets. 3.Bead Jewellery Creation - Basic Stringing and Design: To learn fundamental bead stringing techniques and create a simple designed piece. 4.Introduction to Jewellery Tools and Safety: To identify common jewellery tools and understand essential safety procedures for their use. 5.Measurement and Sketching for Jewellery Design: To practice basic measurement techniques and create dimensioned sketches for simple jewellery designs.
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Identify and name common hand tools and machinery used in jewellery making. • Explain the purpose and operation of key tools used in each stage of manufacturing. • List and explain essential safety precautions to be observed while working with jewellery manufacturing tools and processes. • Understand the importance of accurate dimensions and units of measurement in jewellery design and production.
Content Outline	Simple Wire Working - Creating Basic Shapes: To develop basic wire manipulation skills for forming fundamental jewellery shapes. Understanding Moulding Concepts (Clay Impression): To grasp the basic principle of moulding as it applies to jewellery manufacturing. Simulated Polishing and Finishing: To understand the concept of polishing and the importance of finishing processes in jewellery making. Quality Check and Packaging Exercise:

	To learn basic quality assessment procedures and understand considerations for jewellery packaging. Design Inspiration from Traditional Jewellery: To derive inspiration from traditional Indian jewellery for generating contemporary design concepts

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Traditional Jewellery of India

- **Description**: This module introduces the rich history, significance, and diverse categories of traditional Indian jewellery, including bridal, antique, bead, custom, copper, fashion, filigree, gold, handmade, ivory, and Jadu jewellery.
- **Project Idea**: "A Regional Study of Traditional Indian Jewellery."
- Description: Students will choose a specific region or state of India and research its unique traditional jewellery forms. They will investigate the historical influences, materials used, characteristic designs, cultural significance (including bridal traditions), and any unique techniques associated with that region's jewellery.
- **Assessment**: Research quality (historical accuracy, depth of cultural understanding, variety of sources), visual presentation (images, sketches), and a written report summarizing their findings and highlighting the distinctive features of the chosen region's jewellery.

Module 2: Jewellery Manufacturing Technology

- **Description**: This module covers the fundamental tools, safety measures, dimensions, and the step-by-step processes involved in jewellery manufacturing, from design to marketing.
- **Project Idea**: "Designing a Jewellery Piece and Outlining its Manufacturing Process."
- Description: Students will conceptualize and sketch a simple jewellery design. They will then create a detailed outline of the manufacturing process for their design, identifying the specific tools and techniques required for each stage (designing, moulding [if applicable for the design], casting [if applicable], polishing, embellishment, finishing, plating [if applicable], quality checking, packing, and transportation). They should also consider basic safety measures relevant to the identified processes.
- **Assessment**: Clarity and feasibility of the jewellery design, accuracy and completeness of the outlined manufacturing process, appropriate selection of tools and techniques, and consideration of safety measures.

Module 3: Jewellery Identification, Materials, and Basic Techniques

- **Description**: This module focuses on practical identification of jewellery types and materials, understanding bridal jewellery components, basic bead stringing, tool identification, safety, and fundamental measurement and sketching for design.
- **Project Idea**: "Creating a 'Mood Board' and Sample for a Specific Jewellery Category."
- Description: Students will choose one category of traditional Indian jewellery (e.g., bead jewellery, filigree-inspired fashion jewellery, etc.) or a component of bridal jewellery. They will create a visual "mood board" showcasing design elements, materials, colors, and textures relevant to their chosen category. They will also create a small, simple physical sample demonstrating a basic technique or design element associated with that category (e.g., a short strung bead bracelet, a simple wire-formed shape inspired by filigree).
- **Assessment**: Relevance and coherence of the mood board, quality and effort in the physical sample, and a brief explanation connecting the sample to the chosen jewellery category and its characteristics.

Module 4: Basic Manufacturing Skills and Design Inspiration

- **Description**: This module covers elementary hands-on skills like wire working, understanding moulding concepts, simulated finishing, quality checking, packaging awareness, and drawing design inspiration from traditional jewellery.
- **Project Idea**: "Developing a Contemporary Jewellery Concept Inspired by a Traditional Indian Motif."
- Description: Students will select a specific motif or design element from traditional Indian jewellery (e.g., a paisley, a lotus, a geometric pattern from temple jewellery). They will then create sketches or a digital design for a contemporary piece of jewellery that incorporates this traditional inspiration in a modern way. They should also briefly outline the potential materials and basic manufacturing techniques that could be used for their design, considering quality and packaging.
- **Assessment**: Clarity and creativity of the contemporary design, evident connection to and adaptation of the chosen traditional motif, feasibility of the proposed materials and techniques, and basic considerations for quality and packaging in their design concept.

References:

1. Research into Design: Supporting Sustainable Product Development, Amaresh Chakrabarti, Research Publishing Service, 2011
2. Industrial Engineering: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications, IGI Global, 20123. Entrepreneurship development - C.B. Gupta & N.P. Srinivasan.
3. Gems and Gemstones: Timeless Natural Beauty of the Mineral World, Lance Grande, Allison Augustyn, University of Chicago Press, 2009

3.4 Minor Stream

Course Title	Plant Cultivation technology
Course Credits	4 / 2
Course Outcomes	After going through the course, learners will be able to
	• Technologies and skills used for plant cultivation.
	• Factors affecting plant cultivation.
	• Steps for plant cultivation.
	• Definition and Introduction
	• What is the Aim of Plant cultivation.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Develop the ability to identify different plant species based on their characteristics. • Master various technique for propagating plants, such as seeds, cuttings, division, and grafting (if applicable).
Content Outline	• Theory: Seed as a propagule, Germination of seeds, Seed dormancy and viability, Seed • Production – method of collection and processing, Seed treatment, Classes of seed, Seed testing, commercial vegetable seedling production. • Practicals: Demonstration of seed germination; Raising of seedlings on beds and in trays; • Demonstration of seed collection, processing, packing and storage; Demonstration of seed • Testing; Demonstration of seed treatment methods; chemicals and organic preparations used • For seed treatment; Demonstration of commercial seedling production of vegetables (chili, • Knol-khol, brinjal).
Module 2 (Credit 1)	

Learning Outcomes	After learning the module, learners will be able to
	• Learn proper planting techniques, spacing requirements, and ongoing care practices like watering, fertilization, pest management, and weed control.
Content Outline	• Theory: Seed as a propagule, Germination of seeds, Seed dormancy and viability, Seed • Production – method of collection and processing, Seed treatment, Classes of seed, Seed testing, commercial vegetable seedling production. • Practicals: Demonstration of seed germination; Raising of seedlings on beds and in trays; • Demonstration of seed collection, processing, packing and storage; Demonstration of seed • Testing; Demonstration of seed treatment methods; chemicals and organic preparations used • For seed treatment; Demonstration of commercial seedling production of vegetables (chili, Knol-khol, brinjal).

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

- **Description**: This module covers the fundamental aspects of seeds as propagules, including germination, dormancy, viability, production methods (collection, processing), seed treatment, seed classes, seed testing, and commercial vegetable seedling production.
- **Project Idea**:" Developing a Seed Production and Quality Control Plan for a Specific Crop."
- Description: Students choose a specific vegetable or crop. They will research and develop a detailed plan for its seed production, including methods of collection, processing techniques to ensure quality, appropriate seed treatment strategies, and a basic outline of seed testing procedures to assess viability and purity. They should also consider the different classes of seeds and their significance in the production cycle.
- **Assessment**: Comprehensiveness of the seed production plan, accuracy of information regarding collection, processing, and treatment for the chosen crop, understanding of seed testing principles, and awareness of seed classes. A written report detailing their plan is expected.

Module 2: Practical Demonstrations in Seed Handling and Seedling Raising

- **Description**: This module focuses on practical demonstrations of key techniques in seed germination, seedling raising (on beds and in trays), seed collection, processing, packing, storage, seed testing, seed treatment methods (chemical and organic), and commercial seedling production of specific vegetables.
- **Project Idea**: "Designing and Documenting a Comparative Seed Germination or Seedling Raising Experiment."
- Description: Students will design and document a simple experiment comparing different factors affecting seed germination (e.g., temperature, light, moisture) or seedling raising (e.g., different soil mixes, container types). They will set up the experiment (if resources allow, even on a small

scale), observe and record data on germination rates or seedling growth, and analyze their findings. Alternatively, they could document and compare different seed treatment methods (drawing information from demonstrations and research) and propose the most suitable method for a specific scenario.

- **Assessment**: Experimental design (clear variables, controls), accuracy of observations and data recording, logical analysis of results (if an experiment is conducted), or a well-documented comparison of seed treatment methods with justifications for their suitability. A written report with observations and conclusions is expected.

References:

1. Adriance, W. and R. Brison. 1979. Propagation of Horticultural plants, Tata McGraw Hill
2. Publishing Com. Pvt. Ltd., New Delhi.
3. Hartmann, H.T. and D.E. Kester. 1975. Plant Propagation, Englewood cliffs, New Jersy, Printice Hall.
4. Jitendra Singh 2004, Bosic Horticulture, Kalyain Publications, New Delhi.
5. N. Kumar. 1993. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
6. Sadhu, M. 1991. Plant Propagation.

3.5 OEC

Course Title	Dialogue communication program and group Discussion
Course Credits	4 / 2
Course Outcomes	After going through the course, learners will be able to
	• Directions of communication
	• Channels of communication
	• Nature of communication
	• Process of communication
	• The concept of communication
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students understand about Seven Cs of Effective Communication • Students gain knowledge about communication types
Content Outline	• Completeness, Conciseness, Consideration, • Concreteness, Clarity, Courtesy, Correctness • Understanding Business Communication: Nature and Scope of Communication, Non-verbal • Communication, Cross-cultural communication, Technology-enabled Business Communication
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students know about Writing Business Messages and Documents • Students Understanding Specific Communication Needs
Content Outline	• Business writing, Business Correspondence, • Instructions: Business Reports and Proposals, Career building and Resume writing. • Developing Oral Communication Skills for Business: Effective Listening, Business Presentations and Public Speaking, Conversations, Interviews Meetings and Conferences, Group

	Discussions and Team Presentations, Team Briefing, • Understanding Specific Communication Needs: Communication across Functional Areas

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Principles and Nature of Business Communication

- **Description**: This module introduces the foundational principles of effective business communication, known as the seven C's, explores the nature and scope of communication in a business context, and examines the impact of non-verbal, cross-cultural, and technology-enabled communication.
- **Project Idea**: "Analyzing a Business Communication Failure."
- Description: Students will identify and analyze a documented or well-known instance of business communication failure (e.g., a misinterpreted marketing campaign, a cross-cultural misunderstanding in a negotiation, a poorly written internal memo leading to confusion). They will apply the seven C's to diagnose the breakdown in communication, analyze the role of non-verbal and cross-cultural factors (if applicable), and discuss how technology might have contributed or could have mitigated the failure.
- **Assessment**: Depth of analysis using the seven C's, insightful identification of contributing factors (non-verbal, cross-cultural, technological), clarity in explaining the communication breakdown, and well-supported conclusions on how the failure could have been avoided or improved. A written report or presentation is expected.

Module 2: Business Writing and Oral Communication Skills

- **Description**: This module focuses on developing practical skills in various forms of business writing (correspondence, instructions, reports, proposals, resume writing) and enhancing oral communication abilities crucial for professional success (effective listening, presentations, public speaking, conversations, interviews, meetings, group discussions, team presentations, team briefing, and understanding communication across different functional areas within a business).
- **Project Idea**: "Developing a Multi-Modal Communication Strategy for a Business Scenario."
- Description: Students will choose a specific business scenario requiring communication (e.g., introducing a new company policy, responding to a customer complaint, proposing a new project to management, recruiting for a specific job role). They will then develop a comprehensive communication strategy that includes:
    - A written component (e.g., a memo, a formal letter, a proposal, a job description and resume).
    - An oral communication element (e.g., a presentation outline, a script for a phone conversation, a plan for conducting an interview).
    - Consideration of communication across different functional areas that might be involved.
- **Assessment**: Quality and appropriateness of the written communication, clarity and effectiveness of the oral communication plan, coherence and integration of the different communication modes, understanding of the target audience and communication objectives, and consideration of communication across functional areas. A portfolio of their developed communication materials and a brief justification of their strategy are expected.

References:

1. Angenot, Marc. 2008. Dialogues de sourds. Traité de rhétorique. Paris: Mille et Une Nuits.
2. Asher, N. and Lascarides, A. 2003. Logics of conversation. Cambridge: Cambridge University Press.
3. Bakhtin, Mikhail. 1981. The dialogical imagination: Four essays by M.M. Bakhtin. Austin: University of Texas Press.
4. Bakhtin, Mikhail. 1986. Speech genres and other late essays. Austin: University of Texas Press.
5. Bayley, Paul (ed.). 2004. Cross-cultural perspectives on parliamentary discourse. Amsterdam: John Benjamins.
6. Bazzanella, Carla (ed.). 1996. Repetition in dialogue. Tübingen: Niemeyer.
7. Bazzanella, Carla. (ed.). 2002. Sul dialogo: Contesti e forme di interazione verbale. Milano: Guerini.

3.7 Field Project

Course Title	Field Project
Course Credits	4 / 2
Course Outcomes	After going through the course, learners will be able to
	● Field reports are also an opportunity to obtain evidence through methods of observing professional practice that challenge or refine existing theories.
	● Field reports facilitate the development of data collection techniques and observation skills and allow you to understand how theory applies to real world situations
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● To develop the practice of field training challenges and theories. ● To understand the background and study of the organisation and company. ● To gather the data of the tables and graphs from the organisation.
Content Outline	● INTRODUCTION – to the topic under study, e.g. if it is a study on Marketing Research practices, an Introduction as to what is Marketing Research and its practices, and other information should be given. ● BACKGROUND – A brief background about the company/organization under study, like Name, Location Etc. and also relevant details like organization structure, existing systems related to the particular subject Under study and a brief write up of the problem you want to study in that organization. ● METHODOLOGY – It forms the crux of the report. It should clearly identify the Problem, the main Objectives of the study, the scope which indicates the usefulness of the project, how applicable it is, and How it can be used by the organization for improved performance. ● Review of Literature can be done included, which indicates the research done so far with regard To the particular subject. ● The relevant data gathered should be presented in the form of tables, graphs, flow charts etc. ● Detailed discussion about the present practices related to the subject. If new practices/augments Have been introduced, a discussion of the same may be done. ● Analysis of the data collected or the effect of the new practices on the existing one.
Module 2 (Credit 1)	

Learning Outcomes	After learning the module, learners will be able to
	• To study and understand the value of an organisation/ company. • To learn the techniques to improve the system and cost savings techniques.
Content Outline	• Based on the study done, what conclusions/inferences can be Drawn? Recommendations are based on the conclusions of the study. It is important lo indicate that a set of Recommendations should follow from the conclusions inferred. The recommendations should have value to the Organization. If possible quantify the benefits that can be gained from following the recommendations. • Indications as to what other techniques can be applied to improve the systems viz. Cost saving techniques, Precautions. • LIMITATIONS of the study if any should be highlighted.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Introduction to Research and Methodology

- **Description**: This module introduces the fundamental components of a research study, including defining the research topic, providing background information on the organization and problem, outlining the research methodology (problem statement, objectives, scope), conducting a literature review, and presenting data effectively.
- **Project Idea**: "Developing a Preliminary Research Proposal."
- Description: Students will choose a specific topic of interest relevant to their field of study. They will then develop a preliminary research proposal that includes:
- A clear introduction to the topic.Background information on a hypothetical or real organization where this topic could be studied. A well-defined problem statement. Specific and measurable research objectives. A clearly articulated scope of the study and its potential usefulness. A brief outline of potential literature to be reviewed.
- **Assessment**: Clarity and focus of the research topic, logical flow of the proposal, well-defined problem statement and objectives, realistic scope, and a relevant initial literature review outline.

Module 2: Data Analysis, Conclusions, Recommendations, and Limitations

- **Description**: This module focuses on the subsequent stages of research, including the detailed discussion and analysis of collected data (presented visually), drawing logical conclusions and inferences based on the analysis, formulating practical and valuable recommendations for the organization, suggesting further improvement techniques, and acknowledging the limitations of the study.
- **Project Idea**: "Analyzing Hypothetical Data and Formulating Recommendations."
- Description: Students will be provided with a hypothetical set of data (tables, graphs, or a brief scenario describing findings related to a problem identified in Module 1). Based on this data, they will:
    - Write a detailed discussion and analysis of the presented information.
    - Draw logical conclusions and inferences from the analysis.
    - Formulate a set of specific and actionable recommendations for the hypothetical organization.
    - Suggest potential further techniques for improvement or cost-saving measures.
    - Identify any limitations inherent in the provided data or the scope of their analysis.

- **Assessment**: Quality of data analysis and interpretation, logical connection between data and conclusions, practicality and value of the recommendations, thoughtful suggestions for further improvement, and realistic identification of limitations.

Semester IV

4.1 Major (Core)

Course Title	ANALYTICAL CHEMISTRY
Course Credits	4 / 4
Course Outcomes	After going through the course, learners will be able to
	• Imparting skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in chemical analysis.
	• Developing skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds
	• Understanding of principle and working of the range of instrumental methods in analytical chemistry
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students understand the concept of QA QC • Students understand samplings types
Content Outline	• Concepts of Quality, Quality Assurance & Quality Control. Importance of quality in industries. • Error, Accuracy & Precision. • Chemical Calculations Percentage composition of elements in chemical compounds. Mean, • Median, Average deviation, relative average deviation, standard deviation. • Sampling Terms involved, importance of sampling, sampling techniques, Sampling of solids - • Sample size – Bulk ratio size to weight ratio. Size reduction Methods. Sampling of compact solids Sampling of liquids – Homogeneous and heterogeneous, static and flowing liquid. • Sampling of Gases – Ambient and stack sampling. Apparatus and methods used for sampling.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students learn about analysis of water. • Students will learn the resources for contaminated water.
Content Outline	• Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, determination of dissolved oxygen (DO) of a water sample, • Analysis of total hardness, analysis of total suspended solid, analysis of total dissolved solid, analysis of oil& grease in water
Module 3 (Credit 1)	

Learning Outcomes	After learning the module, learners will be able to
	• Separate and identify cations (Fe^{2+}, Mn^{2+}, and Cd^{2+}) by paper chromatography and calculate their Rf values, applying ion-exchange principles. • Separate monosaccharides (glucose and fructose) by paper chromatography, accurately determining their Rf values. • Separate a mixture of dyes by TLC and identify them based on their Rf values, mastering thin-layer chromatography techniques. • Separate and identify amino acids by TLC, applying principles of adsorption chromatography and calculating Rf values. • Separate cations (Pb^{2+} and Cd^{2+}) by TLC, determining their Rf values and interpreting the separation efficiency.
Content Outline	**Chromatography**: (a) Separation of a mixture of cations (Fe2+, Mn2+ and Cd2+) by paper chromatography and reporting the Rf values. (b) Separation of monosaccharides present in a given mixture (glucose & fructose) by paper chromatography and reporting the Rf values. (c) Separation of a mixture of dyes by TLC technique and identify them based on their Rf values. (d) Separation of a mixture of amino acids by TLC technique and identify them based on their Rf values. (e) Separation of a mixture of cations (Pb2+ and Cd2+) by TLC technique and identify them based on their Rf values.
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Extract iodine from an aqueous solution, demonstrating skills in liquid-liquid extraction techniques. • Separate Ni^{2+} and Fe^{2+} by complexation with DMG and extract the Ni^{2+}-DMG complex into chloroform, applying the principles of metal-ligand complexation.

	• Determine the concentration of the Ni^{2+}-DMG complex by spectrophotometry, mastering quantification techniques through absorbance measurements
Content Outline	**Solvent extractions:** (a) Extraction of iodine from an aqueous solution (b) Separation of a mixture of Ni2+ & Fe2+ by complexation with DMG and extracting the Ni2+ -DMG complex in chloroform, and determine its concentration by spectrophotometry. 3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Foundations of Analytical Chemistry

- **Description**: This module introduces fundamental concepts of quality in analysis, error analysis, basic chemical calculations, and the principles and techniques of sampling various types of materials (solids, liquids, gases).
- **Project Idea**: "Developing a Sampling Strategy for a Specific Material."
- Description: Students choose a specific type of material (e.g., soil from a particular area, water from a local source, air quality in a specific environment, a batch of solid product). They will research and develop a detailed sampling strategy, considering the heterogeneity of the material, the purpose of the analysis, appropriate sampling techniques, sample size determination, and any necessary pre-treatment steps (like size reduction for solids).
- **Assessment**: Justification for the chosen sampling location and technique, appropriate consideration of sample size and heterogeneity, detailed description of the sampling procedure, and understanding of potential sources of error during sampling. A written report outlining their sampling strategy is expected.

Module 2: Water Analysis

- **Description**: This module focuses on the analysis of water quality, covering sources of contamination, sampling methods, and the determination of key parameters like dissolved oxygen (DO), total hardness, total suspended solids (TSS), total dissolved solids (TDS), and oil & grease.
- **Project Idea**: "Analyzing the Water Quality of a Local Source (Hypothetical or Real)."
- Description: Students will either analyze data from a real local water source (if accessible and safe) or work with provided hypothetical data for a specific water source. They will evaluate the levels of DO, total hardness, TSS, TDS, and oil & grease against established water quality standards. They will then discuss the potential sources of contamination based on the data and suggest possible remediation strategies if the water quality is deemed poor.
- **Assessment**: Accurate analysis and interpretation of water quality data, correct comparison with relevant standards, logical identification of potential contamination sources, and thoughtful

suggestions for remediation. A written report summarizing their findings and recommendations is expected.

Module 3: Chromatography

- **Description**: This module introduces the principles and applications of paper chromatography and thin-layer chromatography (TLC) for separating and identifying components in mixtures, including cations, monosaccharides, dyes, and amino acids, based on their Rf values.
- **Project Idea**: "Designing a Chromatographic Separation for a Specific Mixture."
- Description: Students will be given a hypothetical mixture of compounds (e.g., a mixture of food dyes, a mixture of metal ions). They need to propose a detailed chromatographic method (either paper or TLC) for separating these components. This includes selecting an appropriate stationary phase, mobile phase, and a method for visualizing the separated components. They should also predict the relative Rf values based on the properties of the compounds and the chosen solvents.
- **Assessment**: Logical selection of stationary and mobile phases, understanding of the factors affecting Rf values, a well-defined experimental procedure, and reasonable predictions of separation and Rf values. A written proposal outlining their chromatographic method is expected.

Module 4: Solvent Extraction and pH Measurement

- **Description**: This module covers the principles and applications of solvent extraction for separating components from a mixture and the use of pH measurements for analyzing various everyday substances.
- **Project Idea**: "Developing a Solvent Extraction Scheme or Investigating the pH of Common Substances."
    - Option 1 (Solvent Extraction): Students design a solvent extraction procedure to separate two or more components from a hypothetical mixture, considering the partition coefficients and solubility of the components in different solvents.
    - Option 2 (pH Measurement): Students collect and measure the pH of a variety of common household substances (e.g., different brands of aerated drinks, fruit juices, shampoos, soaps). They will then analyze and compare the pH values, discuss the chemical nature (acidic, basic, neutral) of these substances, and relate the pH to their properties or uses.
- **Assessment**:
    - Option 1: Logical selection of solvents, understanding of partition coefficients, and a well-defined extraction procedure.
    - Option 2: Accurate pH measurements, correct classification of substances based on pH, and meaningful discussion relating pH to the properties and uses of the substances. A written report detailing their procedure and findings is expected for either option.

References:

1. Mendham J., Denney R.C., Barnes J.D., Thomas M., ‗Vogel's Text book of Quantitative Chemical analysis', 7th edition, Pearson education, 2008.Sharma, B.K., Instrumental Methods of Chemical Analysis', Goel Publishing House, Merrut,1997.

4.2 Major (Core)

Course Title	INORGANIC CHEMISTRY
Course Credits	4 / 4
Course Outcomes	After going through the course, learners will be able to
	● Understanding of anomalous behavior of elements
	● Ability to understand, explain predict various rules involved in chemical bonding
	● In-depth knowledge about standard electrode potential and volumetric analysis
	● Understand the importance and application of chemical bonds, intermolecular and intramolecular weak chemical forces and their effect.
	● Understand the periodicity in atomic and ionic radii, electronegativity, ionization energy,electron affinity of elements of the periodic table
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● Students will understand the properties of s-block elements.
	● Students will understand different types of bonding.
Content Outline	● S block elements General characteristics – atomic and ionic radii – ionization energies – ● electropositive character – reducing properties – hydration of ions – flame coloration – lattice ● energies – chemical properties – extraction of alkali and alkaline earth metals – uses of alkali ● and alkaline earth metals – complexes of alkali and alkaline earth metals – compounds of alkali ● and alkaline earth metals and their applications.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● Students will learn the concept of alkaline earth metals and their industrial applications.
	● Students will learn the periodicity of elements.
Content Outline	● PERIODICITY OF ELEMENTS S, P, D, F block elements, the long form of periodic table. ● Detailed discussion of the following properties of the elements, with reference to s and p-block. ● (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective ● nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) ● Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization

	• enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) • Electron gain enthalpy, trends of electron gain enthalpy (g) Electronegativity, Pauling's/ • Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of • electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio
Module 3 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Accurately determine the alkali content of antacid tablets using HCl, demonstrating the application of acid-base titration in pharmaceutical analysis.
	• Estimate the calcium content in chalk by precipitating calcium oxalate, enhancing skills in gravimetric analysis.
Content Outline	**Acid-Base Titrations** (a) Determination of alkali content of antacid tablets using HCl. (b) Estimation of calcium content in chalk as calcium oxalate. (c) Estimation of carbonate and hydroxide present together in mixture. (d) Estimation of carbonate and bicarbonate present together in a mixture. (e) Estimation of free alkali present in different soaps/detergents **Oxidation-Reduction Titrations** (a) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution. (b) Estimation of oxalic acid and sodium oxalate in a given mixture. (c) Estimation of Fe(II) with K2Cr2O7 using internal (diphenylamine, anthranilic acid) and external indicator
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Synthesize cuprous chloride (Cu2Cl2) from copper sulfate, demonstrating basic inorganic synthesis techniques.
	• Prepare manganese phosphate (MnPO4·xH2O) from manganese nitrate, understanding the principles of precipitation reactions.
Content Outline	**Inorganic preparations** (a) Cuprous Chloride (Cu2Cl2) from copper sulphate. (b) Preparation of Manganese phosphate (MnPO4·xH2O) from manganese nitrate [Mn(NO3)2].

	(c) Preparation of chrome alum [$K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$] and potash alum [$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$]

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: s-Block Elements

- **Description**: This module covers the general characteristics, extraction, uses, and compounds of alkali and alkaline earth metals, including their atomic and ionic properties, reactivity, and complex formation.
- **Project Idea**: "Alkali and Alkaline Earth Metals in Biological or Industrial Applications."
- Description: Students choose a specific alkali or alkaline earth metal and research its significant roles in biological systems (e.g., sodium and potassium pumps, calcium in bones) or industrial processes (e.g., lithium in batteries, magnesium in alloys, calcium in cement). They will present on the metal's properties that make it suitable for these applications and discuss the importance of its compounds.
- **Assessment**: Accuracy of the chemical properties discussed, depth of understanding of the chosen application(s), clarity in explaining the role of the metal and its compounds, and quality of the research and presentation.

Module 2: Periodicity of Elements

- **Description**: This module focuses on the long form of the periodic table and a detailed discussion of periodic trends in physical properties (effective nuclear charge, atomic radii, ionic radii, covalent radii, ionization enthalpy, electron gain enthalpy, electronegativity) for s- and p-block elements, including the factors influencing these trends and different electronegativity scales.
- **Project Idea**: "Predicting and Explaining Trends in a Specific Group or Period."
- Description: Students choose a specific group (e.g., halogens, alkali metals) or period (e.g., Period 3) and analyze the trends in at least three of the discussed periodic properties (atomic radius, ionization enthalpy, electronegativity). They will explain these trends based on the underlying principles (effective nuclear charge, shielding, etc.) and compare the predictions from different electronegativity scales if applicable.
- **Assessment**: Accurate description of the chosen trends, correct application of the underlying principles to explain the trends, comparison of different electronegativity scales (if relevant), and clarity of their analysis and explanation in a written report or presentation.

Module 3: Acid-Base and Oxidation-Reduction Titrations

- **Description**: This module focuses on practical applications of acid-base titrations (alkali content in antacids, calcium in chalk, mixtures of carbonates and hydroxides/bicarbonates, free alkali in soaps/detergents) and oxidation-reduction titrations (estimation of Fe(II) and oxalic acid, mixtures of oxalic acid and sodium oxalate, Fe(II) with dichromate using indicators).
- **Project Idea**: "Designing a Titration Experiment for a Real-World Sample."
- Description: Students will choose a real-world sample (e.g., a specific brand of antacid, a type of soap, a sample of iron supplement). They will then design a detailed titration experiment (either acid-base or redox, depending on the sample's properties) to determine the concentration of a specific analyte. This includes selecting appropriate titrants, indicators (if applicable), and outlining the calculation steps.
- **Assessment**: Appropriateness of the chosen titration type for the sample, detailed and logical experimental design, correct selection of reagents and indicators, and a clear outline of the

calculations required to determine the analyte concentration. A written experimental plan is expected.

Module 4: Inorganic Preparations

- **Description**: This module involves the practical preparation of specific inorganic compounds: cuprous chloride, manganese phosphate, chrome alum, and potash alum.
- **Project Idea**: "Investigating the Properties and Applications of a Prepared Compound."
- Description: Students will choose one of the inorganic compounds they prepared (or a similar compound if lab access is limited). They will then research the key chemical and physical properties of this compound and explore its various applications in different fields (e.g., cuprous chloride in organic synthesis, alums in water purification or dyeing). They will present their findings on the relationship between the compound's properties and its uses.
- **Assessment**: Accuracy of the described properties, thoroughness of the research on applications, clear connection between properties and uses, and quality of the presentation or written report.

Textbooks:

1. Puri B R, Sharma L R, Kalia K K, _Principles of Inorganic Chemistry‘, 23rd edition, Shoban
2. Lal Nagin
3. Chand & Co, New Delhi, 1993.
4. Lee J. D., _Concise Inorganic Chemistry‘, Black Well Science, UK. 2006
5. Soni P. L., _Text Book of Inorganic Chemistry‘, S, Chand & Co, New Delhi, 2006.

Reference Books:

1. Madan R. D., Tuli G. D and Malik S. M., _Selected Topics in Inorganic chemistry‘, S. Chand &Co,New Delhi, 2006.
2. S. F. A. Kettle, _Physical Inorganic Chemistry‘, Spectrum, 1996.
3. B. E. Dogulas DH McDaniel‘s and Alexander, _Concepts and Models of Inorgani Chemistry‘,Oxford IBH, 1983

4.3 Major (Core)

Course Title	Nutrition and Dietary
Course Credits	4 / 4
Course Outcomes	After going through the course, learners will be able to
	• To know the effect of the various diseases on nutritional status and nutritional and dietary requirements.
	• Understand the regulation of metabolism
	• Understand the metabolism of nutrients in health and diseases
	• Learn the role of nutrients in foods and deficiency diseases.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students understand the Chemistry and Metabolism of Carbohydrates. • Students learn Water and Electrolyte balance
Content Outline	• Definition Classification Biological role Metabolism - Digestion and absorption, Glycolysis, • Krebs cycle, Electron Transport System, Gluconeogenesis, Glycogenesis, Glycogenolysis, HMP • pathway, Galactose Metabolism, Fructose Metabolism, Disorders related to Carbohydrate metabolism. • Water and Electrolyte balance • Functions of Water Distribution of Body Water Water Intake And Water Output Electrolyte • Composition of Body Fluids Regulation of Electrolyte Balance Dehydration and Over hydration.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students understand organ Function Tests • Students will learn definition Classification Mechanism of Action Hormones
Content Outline	• Liver Function Tests Kidney Function Tests Gastric Function Tests Pancreatic Function Tests • Thyroid Function Tests • Hormones • Definition Classification Mechanism of Action Hormones of Hypothalamus, Pituitary Gland, • Thyroid Gland, Adrenal Gland, Gonads and Gastrointestinal Hormones.
Module 3 (Credit 1)	

Learning Outcomes	After learning the module, learners will be able to
	Demonstrate proper technique for collecting capillary blood samples Perform serial dilutions to prepare standard protein solutions Execute multiple analytical procedures for liver enzyme assays Calibrate ion-selective electrode instruments correctly Perform proper patient preparation and sample collection for OGTT
Content Outline	Practical • Determination of Blood Glucose Levels Using Glucometer • Estimation of Serum Total Protein by Biuret Method • Liver Function Tests Panel Analysis • Determination of Serum Electrolytes by Ion-Selective Electrodes • Oral Glucose Tolerance Test (OGTT)
Module 4 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	Execute immunoassay techniques for thyroid hormone measurement Measure serum creatinine using Jaffe reaction methodology Perform protein electrophoresis techniques on urine samples Perform enzymatic assays for cholesterol and triglycerides Execute radioimmunoassay procedures with proper safety precautions
Content Outline	Practicals Thyroid Function Tests Analysis Assessment of Renal Function Investigation of Urinary Protein Profiles Lipid Profile Analysis Hormone Measurements by Radioimmunoassay

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Macronutrients and Water-Electrolyte Balance

- **Description**: This module covers the definition, classification, biological roles, and metabolic pathways of carbohydrates, along with the principles of water and electrolyte balance in the body.
- **Project Idea**: "Designing a Dietary Plan for an Individual with Specific Carbohydrate Metabolism Considerations."
- Description: Students will create a dietary plan for an individual with a specific condition related to carbohydrate metabolism (e.g., newly diagnosed type 2 diabetes, lactose intolerance, a marathon runner preparing for a race). The plan should detail meal timings, food choices, portion sizes, and consider the metabolic pathways involved and the individual's specific needs.

- **Assessment**: Nutritional accuracy of the dietary plan, justification of food choices based on metabolic understanding, consideration of the individual's specific condition, and a well-structured and practical dietary plan with supporting explanations.

Module 2: Clinical Assessments and Hormonal Influence

- **Description**: This module focuses on clinical function tests for major organs and the definition, classification, mechanisms of action, and functions of key hormones, emphasizing their role in nutrition and metabolism.
- **Project Idea**: "Interpreting Clinical Lab Reports in the Context of Nutritional Status."
- Description: Students will be provided with hypothetical clinical laboratory reports including liver function tests, kidney function tests, thyroid function tests, and hormone levels. They will analyze these reports to assess the nutritional status of the hypothetical patient, identify potential imbalances or dysfunctions, and suggest possible dietary interventions or further investigations based on their interpretation.
- **Assessment**: Accurate interpretation of lab values, logical reasoning in connecting lab results to nutritional status and potential underlying issues, and appropriate dietary recommendations or suggestions for further investigation.

Module 3: Practical - Basic Biochemical Assays

- **Description**: This practical module involves hands-on experience with common biochemical assays, including blood glucose measurement, serum total protein estimation, liver function test panel analysis, serum electrolyte determination, and the oral glucose tolerance test (OGTT).
- **Project Idea**: "Developing a Standard Operating Procedure (SOP) for One of the Practical Assays."
- Description: Students will choose one of the practical assays performed in this module (e.g., determination of blood glucose using a glucometer, estimation of serum total protein by Biuret method). They will create a detailed Standard Operating Procedure (SOP) outlining the principle of the assay, reagents and equipment required, step-by-step procedure, quality control measures, and safety precautions.
- **Assessment**: Accuracy and completeness of the SOP, clear and logical sequencing of steps, appropriate inclusion of safety and quality control measures, and understanding of the underlying biochemical principles of the chosen assay.

Module 4: Practical - Advanced Biochemical and Hormonal Assays

- **Description**: This practical module covers more advanced biochemical and hormonal analyses, including thyroid function tests analysis, assessment of renal function, investigation of urinary protein profiles, lipid profile analysis, and hormone measurements by radioimmunoassay.
- **Project Idea**: "Analyzing a Case Study Involving Multiple Biochemical and Hormonal Parameters."
- Description: Students will be presented with a case study that includes results from several assays covered in this module (e.g., thyroid function tests, lipid profile, renal function markers). They will analyze the data to identify potential correlations or patterns, interpret the overall biochemical and hormonal status of the patient, and discuss the possible implications for their nutritional management and overall health.
- **Assessment**: Ability to integrate and analyze data from multiple biochemical and hormonal assays, logical interpretation of the results in the context of a clinical scenario, and well-reasoned conclusions about the patient's condition and potential nutritional implications.

References:

1. Mahan L. K., Escott- Stump, S. and Raymond J. L. (2012): "Krause's Food and the Nutrition Care Process", 13th Edition, Elsevier.
2. Ross, A.C., Caballero B., Cousins R. J., Tucker K.L. and Ziegler T. (2014)Modern Nutrition in Health and Disease. Wolters Kluwer Health/ Lippincott Williams and Wilkins. Ed 11th
3. Garrow, J. S., James, W.P.T. and Ralph, A. (2000): Human Nutrition and Dietetics. 10th Edition, Churchill Livingstone.
4. Nix Staci (2013) William's Basic Nutrition and Diet Therapy. Elsevier Ed.

4.4 OEC

Course Title	Digital Literacy & Content Creation
Course Credits	2
Course Outcomes	This course introduces students to essential digital tools and platforms used in academia, business, and media. It emphasizes content creation for various digital formats including text, graphics, and multimedia. Students will gain hands-on experience in designing, editing, and publishing content using freely available tools.
	Demonstrate proficiency in using basic digital tools for document creation, collaboration, and organization. Create original content in various digital formats including blogs, infographics, and videos. Apply ethical and responsible practices while working in the digital space. Develop a personal or academic digital portfolio using content creation platforms.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	- Navigate and apply common digital platforms for academic and professional tasks - Demonstrate collaborative work using online tools - Analyze the reliability of online content and practice safe browsing
Content Outline	1. Introduction to digital literacy: relevance in the 21st century 2. Google Workspace (Docs, Slides, Sheets, Forms) for collaboration 3. Microsoft Office basics and formatting for reports and presentations 4. Cloud storage & file management (Google Drive, OneDrive, Dropbox) 5. Cybersecurity basics: passwords, phishing, digital hygiene 6. Netiquette and digital ethics 7. Online research and source evaluation Practical Assignments: - Group activity using Google Docs/Slides - Create a short survey using Google Forms - Evaluate and cite online sources

Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	- Create content for various platforms with visual and written impact - Use editing tools to enhance digital communication - Develop a personal content portfolio showcasing skills
Content Outline	1. Content types: blogs, videos, infographics, reels, and podcasts 2. Visual design basics using Canva or Adobe Spark 3. Blog writing and publishing (Blogger/Medium/WordPress) 4. Video content creation using mobile tools (CapCut, InShot) 5. Introduction to basic editing: images, sound, and video 6. Creating reels or short videos for education/marketing 7. Portfolio development and digital presence Practical Assignments: - Design a digital poster/infographic using Canva - Write and publish a short blog post - Create a 60–90 second informative video reel - Compile and share a digital portfolio

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Digital Literacy Essentials

- **Project Idea**: Collaborative Digital Toolkit for a Social Cause
- **Description**: Students will form small groups and work collaboratively on a digital project focused on a chosen social issue such as mental health, digital safety, gender equality, or environmental awareness. They will use Google Docs to compile information, Google Slides for an awareness presentation, Google Forms to design a feedback or awareness survey, and Google Sheets or Notion to track progress. This activity emphasizes teamwork, effective use of digital tools, ethical internet use, and content curation.
- **Assessment:** Evaluation will be based on clarity and accuracy of content, use of appropriate digital tools, collaboration, digital ethics, and creativity in presentation.

Module 2: Content Creation & Digital Expression

- **Project Idea**: Create Your Digital Content Portfolio
- **Description**: Students will individually create a basic digital portfolio showcasing their content creation skills. This includes designing one infographic or poster using Canva, writing and publishing a short blog post (on Blogger or Medium), and creating a 60–90 second video reel

(using InShot or CapCut) on an educational or awareness topic. The portfolio will reflect the student's ability to plan, create, and present digital content with aesthetic appeal, originality, and clarity.

- **Assessment**: Students will be assessed on content relevance, technical skill in editing and design, originality, visual presentation, platform usage, and completion of all required elements in the portfolio.

References:

1. Belshaw, D. (2023). The Essential Elements of Digital Literacy. Independently published.
2. Ribble, M. (2022). Digital Citizenship in Schools: Nine Elements All Students Should Know (4th ed.). International Society for Technology in Education.
3. Davidson, C. N., & Goldberg, D. T. (2023). The Future of Learning Institutions in a Digital Age. MIT Press.
4. Jenkins, H., Purushotma, R., Weigel, M., Clinton, K., & Robison, A. J. (2021). Confronting the Challenges of Participatory Culture: Media Education for the 21st Century. MIT Press.
5. Beetham, H., & Sharpe, R. (2020). Rethinking Pedagogy for a Digital Age: Principles and Practices of Design (3rd ed.). Routledge.

4.5 SEC

Course Title	Cement technology
Course Credits	4 / 2
Course Outcomes	After going through the course, learners will be able to
	• To understand its composition, manufacture and its influence on performance.
	• The course is design to familiarise the students with some special cement and application of cement .
	• The objective of the course to understand chemical aspect of cement,
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students learn about sampling and raw products in cement • Students understand the Cement manufacturing process.
Content Outline	• Sampling and pre blending of cement raw materials, estimation of Silica Modulus, Alumina Modulus, Hydraulic Modulus, Lime saturation Factor, Liquid Content, • Cement manufacturing process, chemical composition of various types cement, cement component and their phase relation, Binary and ternary compounds of cement . • Introduction to Geopolymeric cement, characteristic of fly ash, Granulated blast furnace slag for cement production. • Durability consideration of concrete, sulphate attacks, corrosion of reinforcing steel in concrete, attack by acid and other aggressive agencies.
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	• Students learn about Special Cement • Students understand Oil Well Cement
Content Outline	• Special Cement: Chemical, Mineralogical and physical Characteristic of some of special cement such as Portland Pozzolana Cement (PPC) Portland Slag Cement (PSC) –Super sulfate Cement – • Oil Well Cement Application of Cement and Performance Requirement: A).Concrete and mortars, introduction to various infrastructure and use of cement,.

	Requirement of setting, strength and durability of different concrete constructions, B) effect of chemical composition and physical characteristic of cement on performance, fineness and particle size distribution , tailoring performance of cements.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

Module 1: Cement Raw Materials and Manufacturing

- **Description**: This module covers the sampling and pre-blending of cement raw materials, key modulus and factor calculations, the cement manufacturing process, the chemical and phase composition of various cement types, and introduces geopolymeric cement and the use of industrial by-products like fly ash and slag. It also addresses the durability considerations of concrete, including various forms of chemical attack.
- **Project Idea**: "Developing a Raw Material Sourcing and Pre-Blending Strategy for a Specific Cement Type."
- Description: Students choose a specific type of cement (e.g., Ordinary Portland Cement, Portland Slag Cement). They will research the required raw materials, their typical sources, and develop a pre-blending strategy that considers the target modulus (Silica, Alumina, Hydraulic) and Lime Saturation Factor. They should also outline the quality control measures for the raw materials and the pre-blending process.
- **Assessment**: Accuracy in identifying raw material requirements, logical development of the pre-blending strategy to achieve target moduli, understanding of quality control principles for raw materials, and a well-structured written report outlining their strategy.

Module 2: Special Cements, Applications, and Performance

- **Description**: This module delves into the characteristics and applications of special cements like Portland Pozzolana Cement (PPC), Portland Slag Cement (PSC), Super Sulfate Cement, and Oil Well Cement. It also explores the application of cement in concrete and mortars for various infrastructure projects, the performance requirements (setting, strength, durability) for different constructions, and the effect of cement's chemical and physical characteristics on its performance.
- **Project Idea**: "Analyzing the Suitability of Different Cement Types for a Specific Infrastructure Project."
- Description: Students will choose a specific infrastructure project (e.g., a dam, a bridge in a coastal region, a high-rise building, an oil well). They will research the specific performance requirements for the cement used in such a project (considering setting time, strength development, durability against specific environmental factors). They will then analyze and compare the suitability of different cement types (including special cements) for this application, justifying their choice based on their chemical, mineralogical, and physical characteristics.
- **Assessment**: Clear understanding of the performance requirements for the chosen infrastructure project, accurate comparison of different cement types based on their properties, well-reasoned justification for the selected cement type, and a comprehensive written report outlining their analysis and recommendation.

Reference Books :

1. Chemistry of Cement and Concrete: F M Lea, Arnold, London
2. Properties of Concrete : Neville, A.M. Longmans.
3. Cement Industry Data Book, CAM , New Delhi.

4. World Cement Directory: CEMBUREAU

4.7 CE

Course Title	Leadership and Development skills
Course Credits	4 / 2
Course Outcomes	After going through the course, learners will be able to
	● To understand and gain Conceptual knowledge of Leadership. ● To demonstrate an understanding of the current leadership theories and how they apply to the modern organizations. ● To Analyze the impact of effective leadership perspectives on organizational performance ● To Reengineer the mindset of students which will help them to become effective leaders ● To analyze the current issues in leadership.
Module 1 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● Students understand about international leadership ● Students understand models of leaders
Content Outline	● Traits, styles, skills, behaviors, vision, inspiration and momentum of leadership-International ● framework for analyzing leadership-Personality Types and Leadership-Five factor model of ● personality ● Great Man Theory-Trait theory- Behavioral Theories: Michigan studies, Ohio State University ● studies, Leadership Grid, Role theory- Contingency Theories: Casual model of Leadership, ● Normative Decision model, Hersey Blanchard situational model, Vroom & Jago's model, ● House's Path Goal theory- Contemporary leadership styles
Module 2 (Credit 1)	
Learning Outcomes	After learning the module, learners will be able to
	● Students will learn about type and characteristics of leadership ● Students understand about level of development for leadership
Content Outline	● Characteristics, types and evaluation of Leadership Development- Leadership Succession- ● Choosing a successor, Emotional aspects of leadership succession, developing pool of ● successors, Followership- Essential qualities of effective followers, Collaboration between ● leaders and followers. ● Levels of Leadership- Leadership Traits of Highly productive Organizations- Leadership ● strategies for Productivity improvement- Corporate culture- Purpose- Foundations of a ● Productivity focused culture- Managerial culture. Leader's action that fosters teamwork- ● Leadership Commitment.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Foundations of Leadership

- **Description**: This module introduces fundamental concepts of leadership, including traits, styles, skills, behaviors, vision, inspiration, and momentum. It explores international frameworks for analyzing leadership, the relationship between personality types (including the Five-Factor Model) and leadership, and various leadership theories (Great Man, Trait, Behavioral, Role, Contingency, and Contemporary).
- **Project Idea**: "Analyzing the Leadership Style of a Prominent Leader."
- Description: Students will choose a well-known leader from any field (business, politics, social activism, etc.). They will research the leader's background, key achievements, and how they operate. Students will then analyze the leader's style using the concepts and theories learned in the module (e.g., identifying dominant traits, classifying their style based on the Leadership Grid or Situational Leadership Model, discussing their vision and inspirational techniques).
- **Assessment**: Application of relevant leadership theories and frameworks, insightful analysis of the chosen leader's style and behaviors, quality of research and supporting evidence, and a well-structured presentation or written report.

Module 2: Leadership Development, Followership, and Productivity

- **Description**: This module focuses on the characteristics, types, and evaluation of leadership development, the process of leadership succession, the essential qualities of effective followership and the collaboration between leaders and followers. It also explores levels of leadership, traits of highly productive organizations, leadership strategies for productivity improvement, corporate culture, and the leader's role in fostering teamwork and commitment.
- **Project Idea**: "Developing a Leadership Development Plan or a Strategy for Improving Team Productivity."
    - Option 1 (Leadership Development Plan): Students will identify a specific leadership skill they want to develop or a leadership gap within a hypothetical organization. They will then create a detailed leadership development plan, outlining specific activities, resources, timelines, and methods for evaluating the effectiveness of their plan.
    - Option 2 (Productivity Improvement Strategy): Students will analyze a hypothetical scenario of a team or organization facing productivity challenges. They will then develop a leadership strategy that focuses on improving productivity, considering factors like corporate culture, teamwork, communication, and leader commitment.
- **Assessment**:
    - Option 1: Clarity and feasibility of the development plan, appropriate selection of activities and resources, realistic timeline and evaluation methods.
    - Option 2: Identification of key factors affecting productivity in the scenario, well-reasoned leadership strategies for improvement, consideration of corporate culture and teamwork, and a clear outline of the proposed strategy. A written plan or proposal is expected for either option.

Reference Books:

1. Peter G. Northouse, "Leadership", 2015, 6th Ed, Sage Publications.
2. Lussier/Achua, Effective Leadership, 3rd Ed, Cengage Learning, 2016.
3. Richard L. Daft, Leadership, Cengage Learning, 2015.
4. Gary Yukl, Leadership in Organizations, 6th Edition, Pearson Education, 2016.