Indrashil University

Department of Chemistry
School of Science

B.Sc. 2026-2030
Sem I-II

Chemistry

Course Profile

Academic Year 2026-2027

B.Sc. Chemistry Semester I
Course Structure

Course Code	Course Name	Course Type	L-T-P	Credits
***CH1 101**	Organic Chemistry-I: Basic Organic Chemistry	Major Discipline Core (**MDC**)	2-0-0	2
***CH1 102**	Inorganic Chemistry-I: Basic Inorganic Chemistry		2-0-0	2
***CH1 103**	Organic Chemistry -I Laboratory		0-0-4	2
***CH1 104**	Inorganic Chemistry-I Laboratory		0-0-4	2
***CH1 105PC**	Chemistry in Industry	Minor Discipline Elective (**MDE**)	2-0-0	2
***CH1 105IC**				
***CH1 106PC**	Chemistry in Industry Laboratory		0-0-4	2
***CH1 106IC**				
***CH1 107**	Chemistry in Daily Life	Multi-Disciplinary (**MDS**)	2-0-0	2
***CH1 108**	Chemistry in Daily Life Laboratory		0-0-4	2
***CH1 109**	Communication Skill-I	Ability Enhancement Course (**AEC**)	2-0-0	2
***CH1 110**	Quantitative Skills in Chemistry	Skill Enhancement Course (**SEC**)	2-0-0	2
***CH1 111**	Yoga for Wellness	Indian Knowledge System (**IKS**)	2-0-0	2
Total			**14L+0T+ 16P = 30 hrs.**	**22**

B.Sc. Chemistry Semester II
Course Structure

Course Code	Course Name	Course Type	L-T-P	Credits
***CH1 201**	Organic Chemistry-II: Chemistry of Oxygenated Hydrocarbons	Major Discipline Core (**MDC**)	2-0-0	2
***CH1 202**	Physical Chemistry-I: States of Matter		2-0-0	2
***CH1 203**	Organic Chemistry - II Laboratory		0-0-4	2
***CH1 204**	Physical Chemistry – I Laboratory		0-0-4	2
***CH1 205PC**	Chemical Analysis and Quality Systems	Minor Discipline Elective (**MDE**)	2-0-0	2
***CH1 205IC**				
***CH1 206PC**	Chemical Analysis and Quality Systems Laboratory		0-0-4	2
***CH1 206IC**				
***CH1 207**	Chemistry of Materials	Multi-Disciplinary (**MDS**)	2-0-0	2
***CH1 208**	Chemistry of Materials Laboratory		0-0-4	2
***CH1 209**	Communication Skill-II	Ability Enhancement Course (**AEC**)	2-0-0	2
***CH1 210**	Techniques of Chemical Analysis	Skill Enhancement Course (**SEC**)	2-0-0	2
***CH1 211**	Health and Nutrition	Value Added Course (**VAC**)	2-0-0	2
Total			**14L+0T+ 16P = 30 hrs.**	**22**

B.Sc. Chemistry Semester I

CH1 101: Organic Chemistry-I: Basic Organic Chemistry (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** I
Course Code: CH1 101	**Course Name:** Organic Chemistry-I: Basic Organic Chemistry

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives:

- Basics of organic compound nomenclature and hybridisation
- Learning electronic effects: inductive, resonance, hyperconjugation
- Knowledge about reactive intermediates: carbocations, carbanions, free radicals
- Understand the preparation, properties, and reactions of alkanes, alkenes, and alkynes
- Recognize the industrial applications and environmental impact of hydrocarbons

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

CO 1: Remember the concept of hybridisation, electronic displacement, the CIP rule of organic compounds and the name reaction

CO 2: Analyse the influence of inductive, resonance, electromeric, mesomeric, and hyperconjugation effects on the stability and reactivity of organic molecules.

CO 3: Discuss the name reactions such as the Kolbe Wurtz Reaction, Wurtz-Fittig reaction

CO 4: Implement the knowledge of electronic displacement and geometrical isomerism

Syllabus

Units	Content	Hours
Unit I: Organic Compounds	Classification and Nomenclature. Hybridisation, Shapes of molecules, Electronic Displacements: Inductive, electromeric, resonance effects, hyperconjugation, Homolytic and Heterolytic fission with suitable examples. Electrophiles and Nucleophiles Reactive intermediates: Carbocations, carbanions, and free radicals.	**10**
Unit II: Stereochemistry	**Geometrical isomerism**: Fischer Projection, D/L nomenclature, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations. **Optical Isomerism:** Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Diastereoisomers, Racemic mixture and resolution, meso compounds. Relative and absolute configuration: nomenclature of chiral compounds, C.I.P rules, and R/S notations.	**10**
Unit III: Aliphatic Hydrocarbons	**Alkanes**: General methods of preparation, physical and chemical properties of alkanes: Kolbe electrolysis, Wurtz Reaction, Wurtz-Fittig Reaction, Free radical substitutions: Halogenation -relative reactivity and selectivity. Applications and environmental aspects of alkane **Alkenes and Alkynes:** General methods of preparation, physical and chemical properties of alkenes and alkynes,Markovnikov's rule and Anti-Markovnikov addition Saytzeff elimination, ozonolysis. Saytzeff and Hofmann elimination reaction. Acidity of terminal alkynes. Oxidation and alkylation reactions of terminal alkynes.	**10**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	**3**	**1**	**1**	**-**	**-**
CO 2	**3**	**2**	**2**	**-**	**1**

CO 3	**2**	**2**	**3**	**-**	**1**
CO 4	**2**	**2**	**3**	**-**	**1**
Average	**2.5**	**1.75**	**2.25**	**-**	**0.75**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	This CO develops fundamental understanding of organic chemistry (**PO 1**). It also introduces to basic analytical (**PO 2**) and problem-solving abilities (**PO3**).
CO 2	This CO enhances conceptual understanding (**PO 1**) and promotes the application of stereochemical and mechanistic principles, contributing to analytical competency (**PO 2**) and scientific problem-solving skills (**PO 3**).
CO 3	This CO enhances analytical skills (**PO 3**) through understanding reaction mechanisms, electronic effects, and stereochemistry (**PO 1**).
CO 4	This CO helps students relate structural and electronic factors to reactivity, improving analytical reasoning and problem-solving skills (**PO 3**) in organic chemistry.

Reading References:

1. R. T. Morrison; R. N. Boyd. *Organic Chemistry.* Dorling Kindersley (India) Pvt. Ltd., Pearson Education, New Delhi. 2010, 7th Ed.
2. I. L. Finar. *Organic Chemistry (Volume 1).* Dorling Kindersley (India) Pvt. Ltd., Pearson Education, New Delhi. 2002, 6th Ed.
3. I. L. Finar. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products).* Dorling Kindersley (India) Pvt. Ltd., Pearson Education, New Delhi. 2002, 5th Ed.
4. E. L. Eliel; S. H. Wilen. *Stereochemistry of Organic Compounds.* Wiley, London. 1994, 1st Ed.
5. S. M. Mukherji; S. P. Singh; R. K. Kapoor. *Organic Chemistry, Volume 1.* Narosa Publishing House, New Delhi. 2017, 1st Ed.
6. A. Bahl; B. S. Bahl. *A Textbook of Organic Chemistry.* S. Chand Publications, New Delhi. 2019, 22nd Ed.
7. R. L. Madan. *Chemistry for Degree Students.* S. Chand Publications, New Delhi. 2016, 1st Ed.

CH1 102: Inorganic Chemistry-I: Basic Inorganic Chemistry-I: (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 102	**Course name:** Inorganic Chemistry-I: Basic Inorganic Chemistry

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives:

- Understanding atomic structure with different models, and the line- spectrum of hydrogen atoms.
- This course explains different principles of filling the electrons in different orbitals.
- This course also delivers the idea about acids and bases with HSAB principle.

Course Outcomes: At the end of this course students will be able to
CO 1: Describe the different models of the structure of the atom.
CO 2: Explain the concept of quantum numbers, orbit, and orbital
CO 3: Classify the line spectrum of the Hydrogen atom.
CO 4: Illustrate the concept of acids and bases and the usefulness of the HSAB Principle.

Syllabus

Units	Content	Hours
Unit I: Atomic Structure Models	**Atomic Structure**: Structure of atom (Initial Postulates), e/m Calculation, Rutherford Model, alpha-scattering experiments, and its defects, Bohr's model of the atom, radii, and Energy of an electron in Bohr orbit, calculation of radii and energy value, the atomic spectrum/ line spectrum of the hydrogen atom, Rydberg equation and concept of Rydberg constant, Bohr's theory of H-spectra. Shapes of s, p, d, and f orbitals. limitations of Bohr's theory.	**10**
Unit II: Quantum Numbers and the Concept of Orbital	Quantum numbers and their significance, the concept of orbit and orbital, quantum numbers and orbitals relation, the spatial orientation of atomic orbital, shape of the orbitals, Pauli's Exclusion Principle, Hund's rule and orbital filling, Aufbau's principle and its limitations, Variation of orbital energy with atomic number, (n+l) rule, Concept of Exchange Energy (E_{ex})	**10**
Unit II: Acid-Base concepts, HSAB principle	**Concept of Acids & Bases**: Modern theory of acids and bases: The Arrhenius concept, The protonic concept (Bronsted-Lowry concept), The electronic concept (Lewis's theory), and their demerits. Hard and soft acids-bases principle (HSAB principle), concept of Hard Acids, Hard Bases, Soft Acids, Soft Bases, usefulness of HSAB principle, relative strength of Acids & Bases and effects of substituents and solvents on acidity and basicity, leveling effect of water.	**10**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	**3**	**1**	**2**	**-**	**-**
CO 2	**3**	**2**	**2**	**-**	**-**
CO 3	**3**	**2**	**3**	**1**	**-**
CO 4	**3**	**3**	**3**	**1**	**-**
Average	**3**	**2.00**	**2.50**	**1**	**-**

Correlation levels:

1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	Develops fundamental knowledge of atomic structure and atomic models (PO1), with basic analytical (PO2) and critical thinking skills (PO3).
CO 2	Enhances understanding of quantum numbers and electronic configurations (PO1), while developing analytical ability (PO2) and problem-solving skills (PO3).
CO 3	Strengthens knowledge of hydrogen spectra and electronic transitions (PO1), promotes analytical reasoning (PO2), and improves scientific problem-solving skills (PO3).
CO 4	Develops understanding of acid-base theories and HSAB principle (PO1), enhances analytical competency (PO2), and supports critical thinking and application of chemical concepts (PO3, PO4).

Reading References:

1. J. D. Lee. *Concise Inorganic Chemistry.* Blackwell Science, Oxford. 2008, 5th Ed.
2. R. P. Sarkar. *General and Inorganic Chemistry, Vol. I & II.* New Central Book Agency, Kolkata. 2012, 1st Ed.
3. F. A. Cotton; G. Wilkinson; Paul L. Gaus. *Basic Inorganic Chemistry.* Wiley, New York. 2007, 3rd Ed.
4. R. L. Madan. *Chemistry for Degree Students.* S. Chand and Company Ltd., New Delhi. 2010, 2nd Ed.

CH1 103: Organic Chemistry-I Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 103	**Course name:** Organic Chemistry-I Laboratory:

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/week	2	60	Lab	CCE, ESE	50	40

Course Objectives:
This is a practical course in organic chemistry. This course covers learning about the techniques of purification/crystallization of organic compounds. This course also deals with the determination of the melting point, identification, and separation of given organic compounds. This course also involves the synthesis of simple organic compounds such as acetanilide and *m*-nitrobenzoic acid.

Course Outcomes: At the end of this course students will be able to
CO 1: Identify the suitable methods for the separation of organic mixtures.
CO 2: Understand the separation techniques and of organic molecules
CO 3: Demonstrate the preparation of acetanilide
CO 4: Distinguish between saturated and unsaturated hydrocarbons by the Baeyer reagent test
CO 5: Connect the preparation of an organic compound and the separation technique

Syllabus

Sr. No.	Name of the Experiment	Hours
1	To determine the melting points of given organic compounds a melting point apparatus	**12**
2	Solubility classification of organic compounds	**6**
3	To purify a volatile compound from a mixture of components by distillation	**12**
4	To select suitable solvents for the purification/crystallization of organic compounds	**12**
5	To identify and separate the sugars present in the given mixture by paper chromatography	**6**
6	To prepare acetanilide from aniline using Zn/acetic acid (Green method)	**12**
7	Identification of Saturated and Unsaturated Hydrocarbons Using Baeyer's Reagent Test	**6**

CO-PO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5
CO 1	2	3	2	–	1
CO 2	2	2	2	1	–
CO 3	3	3	2	1	2
CO 4	2	3	3	1	2
Average	**2.25**	**2.75**	**2.25**	**0.75**	**1.25**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	This CO develops knowledge of separation and purification techniques **(PO1)** and laboratory skills **(PO2)** with basic problem-solving ability **(PO3).**

CO 2	This CO enhances understanding of chirality and chromatography, improving scientific knowledge **(PO1),** analytical skills **(PO2),** and problem-solving **(PO3).**
CO 3	This CO develops practical knowledge of organic synthesis, strengthening scientific understanding **(PO1)** and laboratory competency **(PO2).**
CO 4	This CO connects synthesis with separation techniques, improving analytical reasoning **(PO3)** and technical skills **(PO2).**

Reading References:

1. B. S. Furniss. *Vogel's Textbook of Practical Organic Chemistry.* Pearson Education, New Delhi. 2011, 5th Ed.
2. Arthur I. Vogel. *Practical Organic Chemistry.* Pearson Education Limited, London. 1995, 5th Ed.
3. A. K. Nad; B. Mahapatra; A. Ghoshal. *An Advanced Course in Practical Chemistry.* New Central Book Agency, Kolkata. 2022, 3rd Ed.
4. V. K. Ahluwalia; Sunita Dhingra. *Practical Organic Chemistry.* New Central Book Agency, Kolkata. 2017, 1st Ed.
5. N. K. Vishnoi. *Advanced Practical Organic Chemistry.* Vikas Publishing House, New Delhi. 2009, 3rd Ed.

CH1 104: Inorganic Chemistry-I Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 104	**Course name:** Inorganic Chemistry-I Laboratory

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/week	2	60	Lab	CCE, ESE	50	40

Course Objectives:

- Develop essential laboratory skills in volumetric analysis, including precise measurement, titration, calculation and data interpretation.
- Determine the molar concentration of a base through acid-base titration using a standard acid solution.
- Gain hands-on experience in measuring the pH of unknown acid and base solutions using a pH meter
- Learn to prepare solutions of various molarities, molalities and normalities accurately for use in titrations and other chemical analyses.

Course Outcome: At the end of this course, the students will learn to
CO 1: Describe the concentration of solutions in normality, molarity, and percentage-wise wise
CO 2: Discuss the determination of the acidity/basicity of different chemicals
CO 3: Classify the relative strength of acids and bases
CO 4: Analyze the relation between acidity and basicity with pH

Syllabus

Sr. No.	Name of the Experiment	Hours
1	To perform titrimetric analysis: Calibration of unknown solutions.	**10**
2	To prepare solutions with different molarity/normality of titrants	**6**
3	To determine the density of unknown inorganic samples.	**6**
4	To determine the pH of unknown acids and bases with the help of a pH meter.	**6**
5	To determine polyprotic acid pKas: Titrate H_3PO_4 with NaOH; identify three inflection points or use a derivative plot.	**6**
6	To estimation the strength of oxalic acid by titrating it with $KMnO_4$ solution	**6**
7	To determine the molar concentration of a base from the known concentration of an acid.	**10**
8	To study the preference of hard and soft acids and bases using competitive reactions based on the HSAB principle.	**10**

CO-PO Mapping Table 2

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	3	1	-	1
CO 2	2	3	2	-	1
CO 3	2	2	3	-	1
CO 4	2	3	3	1	1
Average	**2.00**	**2.75**	**2.25**	**0.25**	**1**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	Develops understanding of solution concentration units such as molarity, normality, and percentage concentration (**PO1**), while strengthening laboratory and calculation skills (**PO2**).
CO 2	Enhances knowledge of acid-base chemistry (**PO1**) and develops practical analytical skills through titration and pH measurements (**PO2, PO3**).
CO 3	Promotes understanding of the relative strength of acids and bases (**PO1**) and improves analytical reasoning and problem-solving abilities (**PO2, PO3**).
CO 4	Develops the ability to correlate pH with acidity and basicity (**PO1**), interpret experimental data (**PO2**), and analyze chemical behavior using scientific reasoning (**PO3, PO4**).

Reference Materials:

1. G. H. Jeffery; J. Bassett; J. Mendham; R. C. Denney. *Vogel's Textbook of Quantitative Chemical Analysis.* Orient Longman, New Delhi. 1989, 5th Ed.
2. G. Svehla. *Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis.* Orient Longman, New Delhi. 1982, 5th Ed.
3. Mala Nath. *Inorganic Chemistry: A Laboratory Manual.* Alpha Science International Ltd., Oxford. 2016, 1st Ed.

CH1 105IC/PC: Chemistry in Industry **(L-T-P-C: 2-0-0-2)**

Program: B. Sc. Chemistry	**Semester:** I
Course Code: CH1 105IC/105PC	**Course Name:** Chemistry in Industry

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objective: To introduce students to the role of chemical sciences in healthcare, industry, and sustainable development, while providing fundamental knowledge of chemical products, manufacturing processes, quality systems, safety practices, ethics, and environmental responsibility.

Course Outcomes: At the end of this course students will be able to
CO 1: Explain the fundamental role of chemical sciences in healthcare, industry, society, and sustainable development, and classify major types of chemicals and chemical products.
CO 2: Describe the basic concepts of chemical manufacturing, product development, quality control, and quality assurance in pharmaceutical, industrial, and sustainable chemical sectors.
CO 3: Identify safe laboratory and industrial practices and explain the importance of ethics, environmental protection, waste minimization, and sustainability in chemical sciences.

Syllabus

Units	Content	Hours
Unit I: Chemicals and Society	Evolution of chemical sciences, Role of chemistry in healthcare, industry, agriculture, and environment, Classification of chemicals and chemical products, Natural and synthetic chemicals, Importance of chemistry in sustainable development.	**10**
Unit II: Chemical Products and Manufacturing	Raw materials and feedstocks, Basic concepts of chemical manufacturing, Introduction to pharmaceutical products, industrial chemicals, and eco-friendly products, Product life cycle: raw material to consumer, Introduction to quality control and quality assurance.	**10**
Unit III: Safety, Ethics, and Sustainability	Laboratory and industrial safety, Hazard communication and safety symbols, Chemical waste and pollution, Principles of waste minimization, Ethical responsibilities of chemists	**10**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	-	-	-	2
CO 2	3	2	1	-	1
CO 3	1	1	-	3	3
Average	**2.33**	**1.00**	**0.33**	**1**	**2.0**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification

CO 1	This CO develops fundamental knowledge of chemical sciences and their applications in society and sustainable development (**PO1, PO5**).
CO 2	This CO strengthens understanding of chemical manufacturing and quality systems while introducing technical and analytical concepts (**PO1, PO2, PO3**).
CO 3	This CO promotes awareness of safety, ethics, environmental protection, and sustainable practices in chemical sciences (**PO2, PO4, PO5**).

Reading References:

1. T. L. Brown; H. E. LeMay; B. E. Bursten; C. J. Murphy; P. M. Woodward. *Chemistry: The Central Science*. Pearson Education, New Delhi, 2018, 14th Ed.
2. D. Ganderton; T. Jones. *An Introduction to Pharmaceutical Sciences*. Pharmaceutical Press, London, 2007, 1st Ed.
3. B. K. Sharma. *Industrial Chemistry*. Goel Publishing House, Meerut, 2014, 16th Ed.

CH1 106IC/PC: Chemistry in Industry Laboratory **(L-T-P-C: 0-0-4-2)**

Program: B. Sc. Chemistry	**Semester:** I
Course Code: CH1 106IC/PC	**Course Name:** Chemistry in Industry Laboratory

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/ week	1	30	Lecture	CCE, ESE	25	40

Course Objective: To introduce students to basic laboratory practices, chemical product analysis, quality assessment, safety protocols, and sustainable waste management through hands-on experiments related to pharmaceutical, industrial, and environmental applications of chemistry.

Course Outcomes: At the end of this course students will be able to

CO1: Identify laboratory equipment, safety symbols, hazard communication systems, and safe chemical handling practices.
CO2: Explain the basic principles of chemical product analysis, quality assessment, and environmental monitoring.
CO3: Perform simple laboratory experiments involving solution preparation, titrimetric analysis, pH measurement, and evaluation of chemical products.

Syllabus

Sr. No.	Name of the Experiment	Hours
1.	Laboratory orientation, safety rules, emergency procedures, and familiarization with laboratory equipment.	**4**
2.	Study of hazard communication, GHS symbols, safety labels, and Material Safety Data Sheets (MSDS).	**4**
3.	Segregation and management of laboratory waste according to safety and environmental guidelines.	**4**
4.	Identification and classification of common household, pharmaceutical, agricultural, and industrial chemicals.	**8**
5.	Analysis of packaging, labeling, batch number, expiry date, and certification marks of pharmaceutical and consumer products.	**4**
6.	Measurement of pH of common consumer products using pH paper and pH meter.	**8**
7.	Determination of acidity in vinegar or fruit juice by acid-base titration.	**8**
8.	Determination of hardness of water by EDTA titrations.	**8**
9.	Determination of total dissolved solids (TDS) or conductivity of water samples.	**12**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	-	3	1
CO 2	3	2	1	-	2
CO 3	2	3	2	-	-
Average	**2.00**	**2.33**	**1.0**	**1.0**	**1.0**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	This CO develops awareness of laboratory safety, hazard communication, and responsible chemical handling, contributing to technical competency and ethical practices (**PO2, PO4**).
CO 2	This CO strengthens understanding of chemical analysis, quality assessment, and environmental monitoring, supporting scientific knowledge and analytical skills (**PO1, PO2, PO5**).
CO 3	This CO develops practical laboratory skills through basic chemical experiments and measurements, enhancing technical competency and problem-solving ability (**PO2, PO3**).

Reading References:

1. Vogel, A. I.; Tatchell, A. R.; Furnis, B. S.; Hannaford, A. J.; Smith, P. W. G. *Vogel's Textbook of Practical Organic Chemistry*. Pearson Education, New Delhi, 2010, 5th Ed.
2. Svehla, G. *Vogel's Qualitative Inorganic Analysis*. Pearson Education, New Delhi, 2012, 7th Ed.

CH1 107: Chemistry in Daily Life (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** I
Course Code: CH1 107	**Course Name:** Chemistry in Daily Life

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives:

- To enlighten students about the practical use of chemistry in daily life.
- To make students learn how chemistry is involved in daily food products and how food quality can be ensured using Chemistry knowledge.
- To make students aware about applications of chemistry in synthesis of soaps, detergent, fertilizer, pesticides and other daily products.

Course Outcome: At the end of this course students will be able to

CO 1: Chemical composition of Dairy products.
CO 2: Chemical composition of different Food additives.
CO 3: Chemistry behind soaps, detergents and agro-products
CO 4: Applications of Chemistry in Electronic devices.

Syllabus

Units	Contents	Hours
Unit I: Food Chemistry	**Dairy Products:** Composition of milk and milk products. Analysis of major/minor components, Estimationofaddedwaterinmilk.Comparemilkfrom different sources. Milk adulteration.	**10**
Unit II: Additives and Nutrients	**Food additives, adulterants, and contaminants.** Introduction and history of food preservatives, classification of food preservatives, and real-life examples of food preservatives. **Sweetening agents**: Introduction, classification of sweetening agents, and some examples of sweetening agents. **Flavors:** Introduction, Vanillin, alkylesters (fruit flavors), and monosodium glutamate. Curcumins.	**10**
Unit III: Cosmetics and Pesticides	**Soap and Detergents:** Introduction and History of soap synthesis, manufacturing of soaps and detergents, compositions, and uses. **Chemistry of Cosmetics:** Ageneral study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams, antiperspirants, and artificial flavors. **Chemistry of Pesticides:** General introduction to pesticides (natural and synthetic), benefits and adverse effects, uses of representative pesticidesin the following classes: Organochlorines (DDT, gammaxene); Organophosphates (malathion, parathion); Carbamates (carbofuranand carbaryl); Hazards associated with the synthesis and use of pesticides. **Electronic Materials in Daily life:** Chemistry behingcells and batteries, Types of Batteries, Applications of batteries in mobile, laptop and daily electronic devices Liquid crytals and its application in designing LCDs of television.	**10**

CO-PO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5

CO 1	3	2	2	–	1
CO 2	3	2	3	1	2
CO 3	3	1	2	1	1
CO 4	3	2	2	1	3
Average	**3.00**	**1.75**	**2.25**	**0.75**	**1.75**

Correlation levels:
1 - Low, 2 - Moderate, 3 – High

Justification for CO-PO Mapping

CO	Justification
CO 1	This CO develops knowledge of the composition and analysis of dairy products and beverages, supporting scientific understanding (**PO1**) and analytical skills (**PO2**).
CO 2	This CO provides understanding of food additives, preservatives, and adulterants, helping in analysis and interpretation of food-related issues (**PO3**).
CO 3	This CO develops understanding of vitamins, their sources, functions, and deficiency diseases, contributing to scientific knowledge (**PO1**).
CO 4	This CO provides knowledge of soaps, detergents, cosmetics, perfumes, and pesticides, including their preparation and uses, with awareness of environmental effects (**PO5**).

Reading References:

1. B. K. Sharma. *Introduction to Industrial Chemistry.* Goel Publishing House, Meerut. 1998, 1st Ed.
2. Ashutosh Kar. *Medicinal Chemistry.* New Age International Publishers, New Delhi. 2010, 1st Ed.
3. Fred W. Billmeyer. *Textbook of Polymer Science.* Wiley, New York. 1984, 3rd Ed.
4. N. Shakuntala Manay; M. Shadaksharaswamy. *Foods: Facts and Principles.* New Age International Publishers, New Delhi. 1998, 4th Ed.
5. M. S. Swaminathan; S. K. Goswami. *Handbook on Fertilizer Technology.* Fertilizer Association of India, New Delhi. 2001, 6th Ed.

CH1 108: Chemistry in Daily Life Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 108	**Course name:** Chemistry in Daily Life Laboratory

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/ week	2	60	Practical	CCE, ESE	50	40

Course Objectives:

This is a practical course of physics which deals with physical quantity, error analysis. This course also explains the experimental learning of the crystal structure of a solid material. This course will also be helpful in learning of radius of curvature of an object.

Course Outcome: At the end of this course students will be able to

CO1: Perform experiments for the preparation, characterisation, and analysis of soaps, detergents, and organic compounds.

CO2: Apply chemical tests to identify functional groups, unsaturation, and adulterants in food samples.

CO3: Analyse chemical constituents, such as caffeine, in tea and coffee using appropriate laboratory methods.

CO4: Operate laboratory equipment and interpret experimental results using scientific principles and analytical techniques.

Syllabus

Sr. No.	Name of the Experiment	Hours
1	To prepare and characterize soaps	**8**
2	To prepare and characterize detergents	**8**
3	To synthesize aspirin from salicylic acid	**8**
4	Detection of glucose using Benedicts solution	**8**
5	To test unsaturation in ghee and oil using Bromine water	**8**
6	Determine adulteration of starch in paneer	
7	To analyze caffeine content in tea and coffee samples	**10**
8	To identify cotton seed oil by Halphen's Test	**10**

CO-PO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5
CO 1	3	3	2	–	1
CO 2	3	2	3	–	2
CO 3	2	3	2	1	–
CO 4	2	3	3	1	1
Average	**2.50**	**2.75**	**2.50**	**0.50**	**1.00**

Correlation levels:

1 - Low, 2 - Moderate, 3 – High

Justification for CO-PO Mapping

CO	Justification
CO 1	This CO develops practical knowledge of preparation and characterization of soaps, detergents, and organic compounds, supporting scientific knowledge (**PO1**) and laboratory

	skills (**PO2**).
CO 2	This CO helps students perform chemical tests for identification of compounds and food components, improving analytical and problem-solving skills (**PO3**).
CO 3	This CO develops the ability to analyze caffeine content in tea and coffee samples using laboratory methods, strengthening technical skills (**PO2**).
CO 4	This CO enables students to handle laboratory equipment and interpret results, contributing to analytical ability (**PO3**) and technical competency (**PO2**).

Reading References:

1. Elias Anil J. *A Collection of Interesting General Chemistry Experiments.* University Press, Hyderabad. 2012, 1st Ed.

CH1 109: Communication Skills-I (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 109	Course name: Communication Skills-I

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objective: This course develops fundamental communication skills required for academic and professional success. It introduces the principles of effective verbal, non-verbal, and digital communication while strengthening listening, grammar, speaking, and reading skills. The course also enhances students' confidence through presentations, debates, role plays, and group discussions, enabling them to communicate effectively in academic and everyday situations.

Course Outcomes (COs): This course is designed to
CO 1: Develop effective communication skills across verbal, non-verbal and digital platforms for academic and professional use.
CO 2: Strengthen active listening and note-taking abilities to enhance understanding and engagement.
CO 3: Improve grammatical accuracy and language proficiency for clear and error-free communication.
CO 4: Build confidence in public speaking through structured activities like debates, presentations and role plays.
CO 5: Enhance reading strategies such as skimming, scanning, and contextual word interpretation for better comprehension.

Detailed Syllabus

Units	Content	Hours
I Effective Communication in the Digital Age	**Communication Skills**: Importance of communication skills, communication cycle, types, flows, barriers, nonverbal communication, Formal vs. Informal communication, Digital communication basics (email, chat, video calls) **Listening skills:** Types of listening, barriers to effective listening, tips to improve listening Skills, Active listening and note-taking, listening to short scientific/academic talks.	**15**
II Communicative English: Grammar to Group Talk	**Grammar**: Articles, prepositions, tenses, concord, adjectives & degrees of comparison, adverbs, Common grammatical errors and corrections **Speaking Skills**: Impromptu, short situational dialogues/conversation, short speeches, presentations, Debate and group discussion practice, role plays based on academic and laboratory situations. **Reading Skills**: Difference between skimming & scanning, identifying main idea and topic, guessing the meanings of words	**15**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	2	1	1	3	-
CO 2	1	2	1	3	-
CO 3	2	1	2	3	-
CO 4	1	1	2	3	-
CO 5	2	2	3	2	-
Average	**1.6**	**1.4**	**1.8**	**2.8**	**-**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	This CO focuses on developing effective communication across verbal, non-verbal and digital platforms, fostering **PO 4** (communication skills) and building foundational knowledge **PO 1**).
CO 2	This CO strengthens active listening and note-taking abilities which supports effective communication and teamwork (**PO 4**) and promotes technical and analytical skills through information processing (**PO 2**).
CO 3	This CO improves grammatical accuracy and language proficiency, which supports clear written and verbal communication (**PO 4**) and contributes to critical thinking and problem-solving through analytical use of language (**PO 3**).
CO 4	This CO builds confidence in public speaking through debates, presentations, and role plays, directly enhancing communication and leadership qualities (**PO 4**) and developing critical thinking abilities (**PO 3**).
CO 5	This CO enhances reading strategies such as skimming, scanning, and contextual interpretation, contributing to scientific knowledge and understanding (**PO 1**) and fostering analytical skills (**PO 2**) and critical thinking (**PO 3**).

Reference References:

1. Dr. Sanjay Kumar and Dr. Pushp Lata Communication Skills, Oxford University Press 2011 2nd Edition
2. Meenakshi Raman & Sangeeta Sharma Technical Communication; Principles and Practice Oxford University Press. 2015 Edition 3
3. M Ashraf Rizvi Effective Technical Communication – McGraw Hills Education, 2017, Second Edition
4. Vitthal Patel &Unnat Patel Text Book of Communication Skills Ria Publishing House 2013

Wren & Martin Key to High School English Grammar and Composition S Chand Publishing 2017

CH1 110: Quantitative Skills in Chemistry (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 110	**Course name:** Quantitative Skills in Chemistry

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives: This course is designed to provide students with fundamental computer skills required for scientific and academic applications in chemistry. It introduces the basic concepts of computer hardware, software, computer organization, generations of computers, and data processing systems. The course also develops an understanding of various number systems and their interconversions, which form the basis of digital computing. Further, students gain knowledge of input/output devices, storage technologies, memory systems, and computer peripherals, enabling them to effectively use computer resources for data handling, analysis, documentation, and technology-assisted learning in chemistry and related disciplines.

Course Outcomes: At the end of this course students will be able to
CO 1: Apply basic mathematical concepts and quantitative methods to solve chemistry-related numerical problems.
CO 2: Use digital tools and computer applications for scientific documentation, information retrieval, and data processing.
CO 3: Analyze, interpret, and present experimental data using statistical methods, graphs, and spreadsheet software.
CO 4: Demonstrate quantitative reasoning and digital competency for effective problem-solving and communication in chemistry.

Detailed Syllabus

Units	Content	Hours
Unit I: Introduction to Computers	Computer system: characteristics and capabilities. Computer Hardware and Software: Block Diagram of a Computer, Data Processing System, Storing Data, Processing Data. Types of Computers, Generation of Computers. Number systems: Decimal Number system, Binary number system, Octal, Hexadecimal number system, their mutual conversion and illustrated examples.	**12**
Unit II: Digital Tools for Chemistry	Storage Introduction to Input Devices: Categorizing Input Hardware, Keyboard, Direct Entry - Card Readers, Scanning Devices - O.M.R., Character Readers, Thumb Scanner, MICR, Smart Cards, Voice Input Devices, Pointing Devices Central Processing Unit: The Microprocessor, control unit, Buses, Main Memory, Main Memory (RAM) for microcomputers, Read Only Memory (ROM). Storage Devices: Storage Fundamentals, Primary and Secondary Storage, Hard Disks, Disk Cartridges, Optical Disks, CD ROM.	**08**
Unit III: Basic Mathematical Skills	Significant figures, rounding off, precision, accuracy, and types of experimental errors; basic algebraic operations including rearrangement of chemical equations, ratios and proportions, percentage calculations, and simple linear equations; application of mathematical concepts to solve numerical problems related to measurements, laboratory calculations, and chemical data.	**10**

CO-PO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5
CO 1	3	2	3	-	1
CO 2	2	3	2	2	2
CO 3	2	3	3	1	2
CO 4	2	2	3	3	2
Average	**2.25**	**2.5**	**2.75**	**1.5**	**1.75**

Justification for CO-PO Mapping Table

CO	Justification
CO1	Application of basic mathematical concepts, unit conversions, dimensional analysis, and algebraic methods develops quantitative reasoning and problem-solving skills essential for chemistry. **(PO1, PO2, PO3).**
CO2	Knowledge and application of digital tools, computer applications, and online scientific resources enhance technical competency, information management, and ethical use of digital technologies in chemistry. **(PO1, PO2, PO4, PO5).**
CO3	Collection, statistical analysis, graphical representation, and interpretation of experimental data strengthen analytical skills, experimental competency, and multidisciplinary problem-solving abilities. **(PO2, PO3, PO5, PO6).**
CO4	Integration of quantitative reasoning, spreadsheet applications, and scientific communication develops critical thinking, professional competency, and responsible scientific practices for solving chemistry-related problems. **(PO1, PO2, PO3, PO4).**

Reading References:

1. P. K. Sinha. *Computer Fundamentals.* BPB Publications, New Delhi. 2012, 6th Ed.
2. V. Rajaraman. *Introduction to Information Technology.* PHI Learning Pvt. Ltd., New Delhi. 2008, 2nd Ed.
3. Suresh K. Basandra. *Computers Today.* Galgotia Publications, New Delhi. 2018, Revised Ed.
4. Peter Norton. *Computing Fundamentals.* McGraw Hill-Osborne, New York. 2010, 6th Ed.

CH1 111: Yoga for Wellness (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** I
Course code: CH1 111	**Course name:** Yoga for Wellness

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	2/week	2	30	Lecture	CEE, ESE	50	40

Course Objectives:
This course deals with an understanding of mind and body through various types of physical postures, commonly known as Asanas. This course also teaches techniques of meditation, and breathing to keep a balance in everyone's daily life and maintain physical and mental health, flexibility, and endurance.

Course outcome: Through this course, the students will be able to
CO 1: Define the basic skills associated with yoga activities
CO 2: Discuss the ability to perform yoga movements in various combinations and forms.
CO 3: Understand the theoretical parts of yoga
CO 4: Apply yoga activities to citizens for their wellness

Syllabus

Units	Content	Hours
Unit I	Different terminologies and meaning of yoga, types of yoga, illusions of yoga, benefits of yoga. Details about Ashtanga Yoga, and it's types. Understanding of complementary asanas with examples. Pranayama, types and it's forms, benefits of pranayama. Understanding of Pratyahar and examples.	**10**
Unit II	Practicing Suryanamaskar, Padmasana, Gomukhasan, Dhanurasan, Tadasan, Padahastasan, Bhadrasan, Shavasan, Utthanpadasan, Purnatitli asan.	**10**
Unit III	Health meaning of health, Definition, Health Education, policy, Effect of health health spectrum, physical health, social health, Mental health, Health test program	**10**

CO-PO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5
CO 1	2	2	1	2	2
CO 2	2	3	2	2	3
CO 3	3	1	2	2	2
CO 4	2	2	2	3	3
Average	**2.25**	**2.00**	**1.75**	**2.25**	**2.50**

Correlation levels:
1 - Low, 2 - Moderate, 3 – High

Justification for CO-PO Mapping

CO	Justification
CO 1	This CO develops basic knowledge and skills related to yoga practices, supporting personal wellness and health awareness (**PO1**, **PO5**).

CO 2	This CO helps students perform yoga postures and movements, improving practical skills and physical coordination (**PO2**).
CO 3	This CO provides understanding of the theoretical aspects of yoga, contributing to knowledge development and self-awareness (**PO1**).
CO 4	This CO encourages the application of yoga practices for health and wellness, promoting social responsibility ar healthy living (**PO4**, **PO5**).

Reading References:

1. Swami Vivekananda. *Complete Book of Yoga: Karma Yoga, Bhakti Yoga, Raja Yoga, Jnana Yoga.* Arushi Book Enterprises, New Delhi. 2023, 1st Ed.

B. Sc. Chemistry Semester II
Syllabus

CH1 201: Organic Chemistry-II: Chemistry of Oxygenated Hydrocarbons (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 201	**Course name:** Organic Chemistry-II: Chemistry of Oxygenated Hydrocarbons

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/ week	--	2	30	Lecture	CEE, ESE	50	40

Course Objective:

- To introduce the fundamental concepts of aromaticity and the factors governing aromatic character in organic compounds.
- Course provides a clear understanding of the chemistry of alkyl and aryl halides, along with oxygenated hydrocarbons.
- To focuses on their preparation methods, physical and chemical properties, and overall reactivity.
- Students will learn the mechanisms of important named reactions associated with these classes of compounds.

Course Learning Outcomes: At the end of this course, students will be able to
CO 1: Remember the concept of aromaticity and preparation and related name reaction of oxygenated, alky, and aryl halide compounds
CO 2: Understand the difference between substitution and elimination reactions.
CO 3: Applying knowledge of reaction mechanisms and aromaticity concepts in multi-step synthesis.
CO 4: Explaining the reaction mechanism and reactivity of oxygenated, alkyl, and aryl halide compounds

Syllabus

Unit	Content	Hours
Unit I: Aromaticity	**Aromaticity**: Concept of aromaticity, Hückel's rule, aromatic character of arenes, non-aromaticity, anti-aromaticity, homoaromaticity, Aromaticity in Heterocycles, Benzanoid and Non-Benzanoid, Aromatic ions (Cyclopropenyl cation, Cyclopentadienyl anion, Tropylium ion). Methods to Determine Aromaticity,	**05**
Unit II: Alkyl and Aryl Halides	**Alkyl Halides:** Nomenclature and classes of alkyl halides, methods of synthesis and chemical reactions. Different types of nucleophilic substitution reactions and their stereochemistry, SN_1 and SN_2, E_1 and E_2 reactions with energy profile diagrams. **Aryl Halides:** Methods of synthesis and chemical reactions of aryl halides, the addition-elimination and the elimination-addition of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides, allyl, vinyl and aryl halides.	**10**
Unit III: Chemistry of Oxygenated Hydrocarbons	**Alcohols:** Classification and nomenclature, preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, **Oxidation and Reduction Reaction**: Oxidation of alcohol, oxidation of diols by periodic acid and lead tetraacetate, Bouvaelt Blanc Reaction **Rearrangement**: Pinacol Pinacolone rearrangement **Phenols**: Preparation and properties; Acidity and factors affecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism. **Ethers:**Classification and nomenclature, Preparation and properties: Williamson ether synthesis, Acid and base-catalysed ring opening of epoxides (cyclic ether), orientation of epoxide ring opening, reagents with epoxides.	**15**

Reading references:

1. S. M. Mukherji; S. P. Singh. *Mechanism and Structure in Organic Chemistry.* New Age International Publishers, New Delhi. 2017, 1st Ed.
2. R. T. Morrison; R. N. Boyd; S. K. Bhattacharjee. *Organic Chemistry.* Pearson Education India, New Delhi. 2010, 7th Ed.
3. L. Finar. *Organic Chemistry (Volume I).* Dorling Kindersley (India) Pvt. Ltd., Pearson Education, New Delhi. 1963, 4th Ed.
4. V. K. Ahluwalia; P. Bhagat; R. Aggarwal; R. Chandra. *Intermediate for Organic Synthesis.* I. K. International Publishing House, New Delhi. 2005, 1st Ed.
5. T. W. Graham Solomons; C. B. Fryhle; S. A. Snyder. *Organic Chemistry.* Wiley, Hoboken. 2016, 12th Ed.
6. R. Chandra; S. Singh; A. Singh. *Organic Reactions and Their Nomenclature.* Arcler Education Inc., New York. 2019, 1st Ed.
7. Bhupinder Mehta; Manju Mehta. *Organic Chemistry.* PHI Learning Pvt. Ltd., New Delhi. 2015, 2nd Ed.

CH1 202: Physical Chemistry-I: States of Matter (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 202	**Course name:** Physical Chemistry-I: States of Matter

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	--	2	30	Lecture	CCE, ESE	50	40

Course Objectives:
The course aims to provide fundamental knowledge of the gaseous, liquid, and solid states of matter and their physical properties. It develops an understanding of kinetic theory, real gas behavior, crystal structures, intermolecular forces, and related laws governing different states of matter. The course also enables students to analyze structural arrangements, molecular interactions, and physicochemical properties such as viscosity, surface tension, and diffraction phenomena.

Course Outcomes: At the end of this course students will be able to
CO1: Understand the kinetic theory of gases, behavior of ideal and real gases, and the structural features of solids and liquids.
CO2: Apply the concepts of gas laws, crystal structures, intermolecular forces, and related physical chemistry principles to solve numerical and theoretical problems.
CO3: Analyze the behavior of gases, solids, and liquids using equations of state, crystal geometry, and molecular interactions.
CO4: Relate the physical properties of matter such as viscosity, surface tension, heat capacities, and critical phenomena with molecular structure and intermolecular forces.

Syllabus

Units	Content	Hours
Unit I: Gas Laws and Real Gas Behavior	**Gaseous State: Derivation of gas laws:** Boyle's law, Charles law, Avogadro's law, Gay-Lussac's law and Dalton's law, Combined gas law or formulation of ideal gas equation, Kinetic theory of gases, Qualitative explanation of gas laws using kinetic theory, kinetic gas equation, Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy. Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behavior. van der Waals equation of state, its derivation, and application in explaining real gas behavior, introduction to virial equation of state, significance of Van der Waal's constant and calculation their units, concept of Boyle temperature.–Isotherms of real gases and their comparison with van der Waals isotherms.	**15**
Unit II: Structure of Solids	**Solid State:** Types of solids, differences between crystalline and amorphous solids. Seven crystal systems and introduction to Bravais lattices. Space lattice and unit cell of a crystal, close packing and packing efficiency, structures of sodium chloride, cesium chloride, zinc blende. Application of solid-state chemistry.	**8**
Unit III: Physicochemical Properties of Liquids	**Liquid State:** Intermolecular forces in liquid, vapor pressure, boiling point, surface tension, relationship between surface tension and surface energy, capillary action, viscosity of liquid. Effect of addition of solutes on vapor pressure, boiling point,	**7**

	viscosity, and surface tension (qualitative treatment). Optical properties of liquid: refractive index, and Snell's law. Application and real-world relevance.	

CO-PO Mapping Table

	PO1:	PO2:	PO3:	PO4:	PO5:
CO1	3	1	1	-	-
CO2	3	2	2	-	-
CO3	2	3	3	-	-
CO4	2	2	3	-	1
Average	**2.50**	**2.00**	**2.25**	**-**	**0.25**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

CO	Justification
CO 1	This CO focuses on building the foundational scientific knowledge (**PO1**) of the fundamental states of matter (gases, liquids, solids). It introduces basic conceptual frameworks that lay the groundwork for baseline data interpretation (**PO2**) and rudimentary problem-solving frameworks (**PO3**).
CO 2	Students transition into utilizing mathematical formulations like gas laws and crystal lattice systems to solve theoretical and quantitative numeric problems. This strengthens calculation competency (**PO2**) and builds core scientific problem-solving abilities (**PO3**) based on deep principles (**PO1**).
CO 3	Dissecting non-ideal parameters via equations of state (e.g., Van der Waals equation) and checking crystal geometry transformations requires advanced analytical skills (**PO2**). It builds critical thinking aptitude (**PO3**) to diagnose structural variations from quantitative analytical datasets.
CO 4	Relating bulk macroscopic physical properties (like viscosity, surface tension, and critical parameters) back to microscopic structural forces demands high-level logical reasoning and integration abilities (**PO3**). Evaluating how surface forces or thermal capacities apply to fluids and materials handles aspects of safety or operational parameters relating loosely to environmental material management (**PO5**).

Reading References:

1. Dr. R. L. Madan. *Chemistry for Degree Students.* S. Chand Publications, New Delhi. 2022, 1st Ed.
2. B. R. Puri; Madan S. Pathania; L. R. Sharma. *Principles of Physical Chemistry.* Vishal Publishing Co., Jalandhar. 2011, Revised Ed.
3. Gurdeep Raj. *Advanced Physical Chemistry.* Krishna Prakashan Media, Meerut. 2018, 4th Ed.
4. B. R. Puri; L. R. Sharma. *Principles of Physical Chemistry.* Vishal Publishing Co., Jalandhar. 2018, 1st Ed.
5. P. L. Soni. *Textbook of Physical Chemistry.* Sultan Chand & Sons, New Delhi. 2016, Revised Ed.
6. Charles Kittel. *Introduction to Solid State Physics.* John Wiley & Sons, New York. 2018, 8th Ed.
7. C. F. Prutton; H. A. Marron. *Principles of Physical Chemistry.* Oxford & IBH Publishing Co., New Delhi. 2017, 4th Ed.
8. B. R. Puri; L. R. Sharma. *Textbook of Physical Chemistry.* Vishal Publishing Co., Jalandhar. 2020, 1st Ed.
9. K. L. Kapoor. *Textbook of Physical Chemistry.* McGraw Hill Education, New Delhi. 2020, 4th Ed.

CH1 203: Organic Chemistry-II Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 203	**Course name:** Organic Chemistry-II Laboratory

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/week	2	60	Lab	CCE, ESE	50	40

Course Objectives:

- The practical course in organic chemistry focuses on developing laboratory skills Students will learn to determine the melting points of organic compounds as a means of assessing purity and identification.
- The course also includes solubility tests of organic compounds in various solvents to aid in their characterisation.
- Students will carry out the synthesis of important aromatic compounds, including alkylbenzene, bromobenzene, and nitrobenzene.

Course Outcomes: At the end of this course, students will be able to
C0 1: Identify a suitable test for the separation of functional groups
C0 2: Understand the alkylation, nitration, and diazotization of organic molecules
C0 3: Demonstrate the functional group analysis and related reaction
C0 4: Analyze the different functional groups of the given groups

Syllabus

Sr. No.	Name of the Experiment	Hours
1	To perform functional group analysis: characteristic tests for aromatic amine group	**5**
2	To perform functional group analysis: characteristic tests for ketone group	**5**
3	To perform characteristic tests for aldehydes (Tollen's test, Fehling's test, Schiff's test).	**10**
4	To perform characteristic tests for alcohols (Lucas test, Ceric ammonium nitrate test, Iodoform test).	**10**
5	To perform functional group analysis: characteristic tests for carboxylic acid group	**10**
6	To prepare nitrobenzene via nitration of benzene.	**10**
7	To synthesize bromobenzene from aniline via diazotization followed by Sandmeyer reaction.	**10**

Reading references:

1. B. S. Furniss. *Vogel's Textbook of Practical Organic Chemistry.* Pearson Education, New Delhi. 2011, Revised Ed.
2. A. I. Vogel; A. R. Tatchell; B. S. Furniss; A. J. Hannaford; P. W. G. Smith. *Textbook of Practical Organic Chemistry.* Prentice-Hall, New Delhi. 1996, 5th Ed.
3. A. K. Nad; B. Mahapatra. *An Advanced Course in Practical Chemistry.* New Central Book Agency, Kolkata. 2022, 3rd Ed.
4. V. K. Ahluwalia; Sunita Dhingra. *Practical Organic Chemistry.* New Central Book Agency, Kolkata. 2017, 1st Ed.
5. N. K. Vishnoi. *Advanced Practical Organic Chemistry.* Vikas Publishing House, New Delhi. 2009, 3rd Ed.

CH1 204: Physical Chemistry - I Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 204	**Course name:** Physical Chemistry - I Laboratory

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/week	2	60	Practical	CCE, ESE	50	40

Course Objectives:
The course aims to develop a fundamental understanding of gases, liquids, surface phenomena, viscosity, and refractive properties through laboratory experiments. It emphasizes the application of experimental and analytical techniques for determining various physical properties of liquid systems. The course also enables students to analyze the influence of temperature, concentration, and intermolecular interactions and relate experimental observations with the theoretical concepts of physical chemistry.

Course Outcomes: At the end of this course students will be able to
CO 1: Understand the fundamental principles of gases, liquids, surface phenomena, viscosity, and refractive properties through laboratory experiments.
CO 2: Apply experimental techniques and analytical methods for the determination of surface tension, viscosity, refractivity, and composition of liquid systems.
CO 3: Analyze the effect of temperature, concentration, and intermolecular interactions on the physical properties of matter.
CO 4: Relate the experimental observations and measured physical parameters with the theoretical concepts of physical chemistry and states of matter.

Syllabus

Sr. No.	Name of the Experiment	Hours
1	To demonstrate the Kinetic Theory of Gas at different temperatures. (https://sciencing.com/how-8211482-convert-atm-pressure-celsius.html)	**4**
2	To perform a comparative analysis of the physical properties of different liquids. (https://www.youtube.com/watch?v=jFWjjUKwCAk)	**8**
3	To determine the surface tension of a liquid using various analytica samples	**8**
4	To study the variation of surface tension of a detergent solution with concentration.	**8**
5	To estimate the viscosity coefficient of various analytical liquid samples by Ostwald's viscometry.	**8**
6	To determine the percent composition of a binary mixture by using surface tension	**8**
7	To separate two or more components by Paper Chromatography	**8**
8	To compare the conductivity of different electrolytes	**8**

CO-PO Mapping Table

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	-	-

CO2	3	3	2	-	-
CO3	2	3	3	-	-
CO4	2	2	3	1	1
Average	**2.50**	**2.50**	**2.25**	**0.25**	**0.25**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

CO	Justification
CO1	This CO establishes the foundational scientific knowledge (**PO1**) linking state-of-matter theories to hands-on laboratory instrumentation. It introduces basic technical skills (**PO2**) needed to handle instrumentation safely.
CO2	Operating specialized laboratory tools like stalagmometers, viscometers, and refractometers directly develops practical skillsets and technical competence (**PO2**). Calculating properties like the composition of binary liquid mixtures involves structural mathematical problem-solving (**PO3**).
CO3	Investigating how varying physical parameters (temperature and solute concentration) shift fluid behavior requires advanced analytical data interpretation (**PO2**). It builds critical thinking (**PO3**) by forcing students to deduce the underlying changes in intermolecular forces from macroscopic data trends.
CO4	Correlating real-world, error-prone experimental observations back to idealized physical chemistry laws demands strong scientific reasoning and deductive logic (**PO3**). Documenting these relationships in structured lab reports builds early professional communication habits (**PO4**), while managing temperature-dependent fluids introduces basic chemical safety awareness (**PO5**).

Reading References

1. B. D. Khosla; V. C. Garg; Adarsh Gulati. *Senior Practical Physical Chemistry.* R. Chand & Co., New Delhi. 2018, Revised Ed.
2. B. Viswanathan; P. S. Raghavan. *Practical Physical Chemistry.* Viva Books Private Limited, Navi Mumbai. 2017, 1st Ed.
3. K. Nad; B. Mahapatra; A. Ghoshal. *An Advanced Course in Practical Chemistry (Paperback).* New Central Book Agency Pvt. Ltd., Kolkata. 2022, 3rd Ed.
4. Viswanathan; P. S. Raghavan. *Practical Physical Chemistry.* Viva Books, New Delhi. 2012, Revised Ed.

CH1 205PC/IC: Chemical Analysis and Quality Systems **(L-T-P-C: 2-0-0-2)**

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 205PC/IC	**Course name:** Chemical Analysis and Quality Systems

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objective: To introduce students to the principles of chemical analysis, quality systems, and environmental monitoring, while developing an understanding of analytical techniques, quality assurance practices, green analytical chemistry, and sustainable approaches used in pharmaceutical, industrial, and environmental sectors.

Course Outcomes: At the end of this course students will be able to
CO1: Explain the fundamental concepts of chemical measurements, analytical techniques, and sample analysis used in chemical and pharmaceutical sciences.
CO2: Describe the concepts of quality assurance, quality control, Good Laboratory Practices (GLP), standards, and documentation systems used in chemical industries.
CO3: Apply basic concepts of environmental monitoring, green analytical chemistry, and resource conservation to evaluate sustainable chemical practices.

Syllabus

Units	Content	Hours
Unit I: Chemical Measurements and Analysis	Importance of analytical chemistry, Sampling and sample preparation, Basic concepts of accuracy and precision, Introduction to pH measurement, Introduction to spectroscopic and chromatographic techniques.	**10**
Unit II: Quality Systems and Standards	Concepts of quality assurance and quality control, Good Laboratory Practices (GLP), Introduction to ISO standards, Specifications and standards of chemical products, Documentation and record keeping	**10**
Unit III: Environmental Monitoring and Green Practices	Water quality parameters, Air quality indicators, Introduction to green analytical chemistry, Resource conservation and recycling, Case studies from pharmaceutical, industrial, and green sectors.	**10**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	**3**	**3**	**1**	**-**	**-**
CO 2	**3**	**2**	**1**	**2**	**-**
CO 3	**2**	**2**	**2**	**1**	**3**
Average	**2.66**	**2.33**	**1.33**	**1**	**1**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification

CO 1	This CO develops understanding of analytical chemistry principles and measurement techniques, strengthening scientific knowledge (**PO1**) and technical competency in chemical analysis (**PO2**).
CO 2	This CO enhances knowledge of quality systems, standards, and documentation practices while introducing analytical and professional aspects of chemical industries (**PO1, PO2, PO4**).
CO 3	This CO promotes the application of environmental monitoring, green analytical chemistry, and sustainable practices, contributing to analytical reasoning (**PO3**) and sustainability awareness (**PO5**).

Reading References:

1. T. L. Brown; H. E. LeMay; B. E. Bursten; C. J. Murphy; P. M. Woodward. *Chemistry: The Central Science*. Pearson Education, New Delhi, 2018, 14th Ed.
2. D. Ganderton; T. Jones. *An Introduction to Pharmaceutical Sciences*. Pharmaceutical Press, London, 2007, 1st Ed.
3. B. K. Sharma. *Industrial Chemistry*. Goel Publishing House, Meerut, 2014, 16th Ed.

CH1 206PC/IC: Industrial Analysis and Quality Control Laboratory **(L-T-P-C: 0-0-4-2)**

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 206PC/IC	**Course name:** Industrial Analysis and Quality Control Laboratory

Lecture (Hours)	**Practical (Hours)**	**Credits**	**Total Hours**	**Evaluation Scheme**			
				Component	**Exam**	**Max. Marks**	**Passing %**
-	4/week	2	60	Lab	CCE, ESE	50	40

Course Objective: To develop fundamental analytical, quality assessment, and environmental monitoring skills through laboratory experiments involving chemical measurements, quality systems, and sustainable laboratory practices

Course Outcomes: At the end of this course students will be able to
CO1: Identify and use basic analytical instruments, laboratory documentation practices, and quality control procedures.
CO2: Perform simple analytical experiments involving sampling, pH measurement, titrimetric analysis, spectroscopic measurements, and water quality assessment.
CO3: Apply principles of quality systems, environmental monitoring, and green laboratory practices in chemical analysis.

Syllabus

Sr. No.	**Name of the Experiment**	**Hours**
1.	Determination of accuracy and precision using replicate measurements	**4**
2.	Calibration and use of analytical balances and volumetric glassware	**4**
3.	Measurement of pH of pharmaceutical, industrial, and environmental samples	**8**
4.	Spectrophotometric estimation of a colored solution using Beer-Lambert law	**8**
5.	Demonstration/interpretation of chromatographic separation using paper or thin-layer chromatography (TLC)	**8**
6.	Study of packaging, batch numbers, manufacturing date, expiry date, and certification marks (ISI, ISO, GMP, etc.)	**8**
7.	Determination of water quality parameters such as hardness, chloride, or dissolved oxygen	**8**
8.	Preparation and maintenance of analytical records, worksheets, and laboratory reports	**4**
9.	Quality assessment of commercial industrial products based on label claims and specifications.	**8**

CO-PO Mapping Table

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	**2**	**3**	**1**	**2**	**-**
CO 2	**2**	**3**	**2**	**-**	**1**
CO 3	**1**	**2**	**2**	**2**	**3**
Average	**1.67**	**2.66**	**1.66**	**1.33**	**1.33**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	This CO develops basic analytical and laboratory competencies through the use of instruments, documentation, and quality control practices, contributing to scientific knowledge and technical skills (**PO1, PO2, PO4**).
CO 2	This CO enhances practical analytical skills through hands-on experiments and measurements, strengthening technical competency and problem-solving ability (**PO2, PO3**).
CO 3	This CO promotes the application of quality systems, environmental monitoring, and sustainable laboratory practices, contributing to ethical responsibility and sustainability awareness (**PO4, PO5**).

Reading References:

1. Vogel, A. I.; Tatchell, A. R.; Furnis, B. S.; Hannaford, A. J.; Smith, P. W. G. Vogel's Textbook of Practical Organic Chemistry. Pearson Education, New Delhi, 2010, 5th Ed.
2. Svehla, G. Vogel's Qualitative Inorganic Analysis. Pearson Education, New Delhi, 2012, 7th Ed.

CH1 207: Chemistry of Materials (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 207	**Course name:** Chemistry of Materials

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives:
This course provides a comprehensive understanding of the chemistry of materials, with a particular emphasis on solid-state materials and their structure–property relationships. It covers both amorphous and crystalline materials, including their fundamental characteristics, synthesis, and applications. The course also explores polymeric materials, dielectric materials, and silicates, highlighting their chemical composition, properties, and technological significance. In addition, it introduces nanoporous materials and the fundamentals of nanomaterials, focusing on their unique structural features and emerging applications. Through these topics, students will develop a strong foundation in materials chemistry and gain insight into the role of advanced materials in modern science and technology.

Course Outcomes: At the end of this course students will be able to
CO 1: Learn the basics of crystal lattice, structure of complex solid.
CO 2: Learn basics of porous materials and their types.
CO 3: Learn basics of polymeric materials, Dielectric materials, Silicates, .
CO 4: Understand the fundamentals of Nanomaterial and their characterization techniques.

Syllabus

Units	Content	Hours
Unit I: Inorganic Solids	**Solid State Materials:** Basic concept, Lattice energy, size effects, covalent character in ionic bonds, structures of complex solids, conductivity in ionic solids, and solids held together by different interactions. **Synthesis and Applications of Inorganic Solids:** ***Conventional solid-state synthesis methods,*** Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. Inorganic solids of technological importance. Microwave-assisted synthesis of inorganic materials. Combustion synthesis and sonochemical methods. Applications of inorganic solids in energy storage and catalysis.	15
Unit II: Polymeric and Silicate Materials	**Polymeric Materials:** Different schemes of classification of polymers, polymer nomenclature, molecular forces, chemical bonding in polymers, and texture of polymers. Synthesis, characterization techniques, properties, and applications of any well-known polymer. Conducting polymers, porous polymers. Biodegradable and bio-based polymers. Polymer nanocomposites and their applications. Smart and stimuli-responsive polymers. **Modern glass materials and applications:** Glassy state and its properties, classification (silicate and nonsilicate glasses). Composition and properties of the following types of glasses: Soda lime glass, safety glass, borosilicate glass, fluorosilicate, colored glass, and photosensitive glass.	15
Unit III: Nanoporous materials	**Nanomaterials:** Basics of nanomaterial, Synthesis and Properties of nanomaterials, Role of size and shape, Characterization techniques and application of Nanomaterial. Carbon nanomaterials (fullerenes, carbon nanotubes, graphene, Green synthesis of nanomaterials, Biomedical and environmental applications of nanomaterials. **Crystalline vs. amorphous porous solids:** Chemistry of microporous materials,	15

	mesoporous materials, macroporous materials, zeolite and zeolite-like materials. Metal-Organic Frameworks (MOFs). Covalent Organic Frameworks (COFs). Gas adsorption and separation using porous materials.	

Reference Textbooks

1. **General Chemistry: Principles, Patterns, and Applications**. Saylor Foundation, 2011.
2. A.R. West, Solid State Chemistry and its applications
3. Shackelford, J. **Introduction to Materials Science for Engineers**. 6th edition. Upper Saddle River, NJ: Pearson, 2004. ISBN: 9780131424869.
4. Cullity, B. D., and S. R. Stock. **Elements of X-Ray Diffraction**. 3rd edition. Upper Saddle River NJ: Pearson, 2001. ISBN: 9780201610918.
5. Averill, B., and P. Eldredge. **Chemistry: Principles, Patterns, and Applications**. Upper Saddle River, NJ: Pearson, 2007. ISBN: 9780805337990.

Reference books

1. A.K. Cheetham and P. Day, Solid State Chemistry: 1. Techniques and 2. Applications
2. P.A. Cox, The electronic structure and chemistry of solids
3. Klabunde, K. J., Ed. *Nanoscale Materials in Chemistry*, Wiley Interscience (2001)
4. N.N. Greenwood, Ionic crystal, lattice defect and non-stoichiometry
5. C.N.R. Rao and J. Gopalakrishnan, New directions in solid state chemistry

Web reference

*https://ocw.mit.edu/courses/3-091sc-introduction-to-solid-state-chemistry-fall-*2010/pages/syllabus/

CH1 208: Chemistry of Materials Laboratory (L-T-P-C: 0-0-4-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 208	**Course name:** Chemistry of Materials Laboratory

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
-	4/week	1	60	Lecture	CCE, ESE	50	40

Course objectives: This course provides practical knowledge of the synthesis, characterization, and properties of important classes of materials, including amorphous and crystalline materials, polymeric materials, silicates, nanoporous materials, and nanomaterials. Emphasis is placed on understanding their structural features, preparation methods, characterization techniques, and applications in modern materials science and technology.

Course Outcomes: At the end of this course students will be able to
CO 1: Learn the basics of matter.
CO 2: Material synthesis techniques.
CO 3: Material characterization techniques.
CO 4: Analysis skill to correlate the synthesized material and their respective characterization data.

Syllabus

Sl. No.	Name of Experiment	Hours
1	Analysis of the Crystal Structure of a Given Sample	10
2	Study of the Thermosetting Behavior of Polymeric Materials	10
3	Synthesis and Characterization of Nanoparticles by the Sol–Gel Method	10
4	Synthesis and Characterization of Nanoparticles by the Hydrothermal Method	10
5	Synthesis and Characterization of Porous Materials	10
6	Synthesis and Characterization of Metal/Metaloxide Nanoparticles	10

Reading References:

1. A. K. Cheetham and P. Day. *Solid State Chemistry: Techniques and Applications*. Oxford University Press, Oxford. 1987, 1st Ed.
2. P. A. Cox. *The Electronic Structure and Chemistry of Solids*. Oxford University Press, Oxford. 1987, 1st Ed.
3. K. J. Klabunde (Ed.). *Nanoscale Materials in Chemistry*. Wiley Interscience, New York. 2001, 1st Ed.
4. N. N. Greenwood. *Ionic Crystal, Lattice Defect and Non-Stoichiometry*. Butterworths, London. 1968, 1st Ed.
5. C. N. R. Rao and J. Gopalakrishnan. *New Directions in Solid State Chemistry*. Cambridge University Press, Cambridge. 1997, 2nd Ed.

CH1 209: Communication Skills-II (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 209	**Course name:** Communication Skills-II

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives: This This course develops effective communication skills for academic and professional environments. It strengthens oral communication, presentation, reading, writing, grammar, and vocabulary skills while enhancing workplace communication through reports, resumes, email and telephone etiquette, group discussions, and meeting documentation.

Course Outcomes: At the end of this course students will be able to
CO1: Develop advanced oral communication and presentation skills through structured speaking activities and real-life simulations.
CO2: Enhance understanding and application of advanced grammar and vocabulary for professional and academic communication.
CO3: Apply reading strategies to comprehend technical and general texts, including case studies and media content.
CO4: Strengthen formal writing skills by drafting reports, resumes, précis, advertisements and meeting documents.
CO5: Demonstrate proper communication etiquette in telephonic, email and group discussion scenarios for workplace readiness.

Syllabus

Units	Content	Hours
I Advanced English Usage & Presentation Skills	**Communication Skills, Speaking & Grammar Communication & Speaking Skills** Oral Communication: 6 C's of Communication, conversation in pairs with the help of Cue-cards and effective presentation strategy, P's of presentation preparing outline of the presentation. Explaining their ideas and feelings in simple English. Situations will be drawn from their everyday experiences, group discussion dynamics, group discussion on scientific and environmental topics. Role plays based on formal and informal situations, Listening comprehension, Telephone and email communication etiquette. **Advance Grammar and Vocabulary** Voice –Active/Passive, Use of Adjective and Adverb, Difference between Simple, Compound and Complex sentences, confusables, affixes, idioms and one-word, substitutes, Synonyms, antonyms, and vocabulary expansion tools.	**15**
II Effective Reading & Writing Skills	**Reading Skills & Writing Skills Reading Skills** Reading comprehension of general passages, Reading Technical passages, Reading scientific articles from newspapers/magazines, advertisements from newspapers/magazines. **Writing Skills** Defining report, the purpose of report writing & its significance, explaining various characteristics, types, and elements of report writing Discussing the difference between reference and bibliography, preparing resume, Explaining Précis writing and its significance and practice, Preparing Advertisement, Notice, agenda, and minutes of meeting writing.	**15**

CO-PO Mapping Table

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	**1**	**2**	**2**	**3**	**-**

CO 2	**2**	**1**	**2**	**3**	**-**
CO 3	**2**	**2**	**3**	**2**	**-**
CO 4	**1**	**1**	**2**	**3**	**-**
CO 5	**1**	**1**	**2**	**3**	**-**
Average	**1.4**	**1.4**	**2.2**	**2.8**	**-**

Correlation levels:
1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	This CO develops advanced oral communication and presentation skills, directly addressing communication competence and professional readiness (**PO 4**) and fostering technical and analytical skills through structured speaking activities (**PO 2**).
CO 2	This CO enhances advanced grammar and vocabulary for professional communication, building scientific knowledge and language foundations (**PO 1**) and supporting effective professional communication (**PO 4**).
CO 3	This CO applies reading strategies to technical and general texts, cultivating critical thinking and comprehension abilities (**PO 3**) and enhancing scientific knowledge through engagement with technical content (**PO 1**).
CO 4	This CO strengthens formal writing skills for reports, resumes, and meeting documents, supporting professional communication and lifelong learning (**PO 4**) and developing critical thinking through structured writing (**PO 3**).
CO 5	This CO demonstrates workplace communication etiquette in telephonic, email, and group discussion contexts, directly strengthening professional communication and ethical conduct (**PO 4**) and developing problem-solving ability in real-life scenarios (**PO 3**).

Reading References:

1. Dr. Sanjay Kumar and Dr. Pushp Lata. *Communication Skills: A Workbook*. Oxford University Press, New Delhi. 2018, 1st Ed.
2. Meenakshi Raman and Sangeeta Sharma. *Technical Communication: Principles and Practice*. Oxford University Press, New Delhi. 2015, 3rd Ed.
3. R. C. Sharma and Krishna Mohan. *Business Correspondence and Report Writing*. Tata McGraw-Hill, New Delhi. 2015, 8th Ed.
4. M. Ashraf Rizvi. *Effective Technical Communication*. SIA Publishers, Hyderabad. 2022, Latest Ed.

CH1 210: Techniques of Chemical Analysis (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 210	**Course name:** Techniques of Chemical Analysis

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objective:

- Understanding of different chromatographic separation method, principles, and their advantages.
- To solve the Rf value of any unknown compound.
- Get idea about different concentration terms used for qualitative analysis with numerical.
- Develop the concept of conducting material and electrolysis.

Course Outcomes: At the end of this course students will be able to
CO 1: Describe the principles of different chromatographic techniques.
CO 2: Calculate the Rf value for unknown compound
CO 3: Classify different concentration term, m and their correlation.
CO 4: Illustrate the concept of conductivity and electrolysis.

Syllabus

Units	Content	Hours
Unit I: Chromatographic separation	Principles of chromatographic separation, Rf factor, details study of paper and thin layer chromatography, different types of paper used in paper chromatography, normal and modified paper, advantages of paper chromatography, solvent system, concept of eluents and eluate, chromatography as qualitative analysis, applications, importance of staining reagent (SR) in chromatography, types of SR and their application, consideration for selecting and using SR.	**15**
Unit II: Concentration of solution, Conductivity	Types of solutions: homogenous, heterogenous and other category with example, components of solution, concentration term: Mass percentage, Volume percentage, m/v percentage, Molarity (M), Molality, Normality (N), concept of Mole, mole fraction, ppm, relation between N and M, effect of Temperature on M, N, m and PPM. numerical, electrolysis and electrolytes, conductance in electrolytic solutions, metallic and ionic conductor, types of electrodes, mechanism of electrolysis, faraday's law, electrochemical equivalent weight, numerical, Concept of Transport number and validation for Gr-I metals	**15**

CO-PO Mapping Table 2

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	**3**	**2**	**1**	**-**	**1**
CO 2	**2**	**3**	**2**	**-**	**1**
CO 3	**3**	**3**	**2**	**-**	**1**
CO 4	**3**	**2**	**3**	**1**	**1**
Average	**2.75**	**2.50**	**2.00**	**0.25**	**1.00**

Correlation levels:

1 - Low, 2 - Moderate, 3 - High

Justification for CO-PO Mapping

COs	Justification
CO 1	Develops fundamental knowledge of chromatographic principles and separation techniques (PO1) and basic analytical understanding (PO2).
CO 2	Enhances practical and analytical skills through calculation and interpretation of Rf values (PO2, PO3).
CO 3	Strengthens understanding of concentration terms and numerical problem-solving abilities (PO1, PO2, PO3).
CO 4	Develops understanding of conductivity and electrolysis (PO1) and improves analytical reasoning and problem-solving skills (PO2, PO3, PO4).

Reading references:

1. Anna P. G. Nikalje. *A Handbook of Chromatography*. Scholar's Press Verlag Omniscriptam, Deutschland, Germany. ISBN: 978-3-330-65032-9.
2. Vogel, G. H. Jeffery Longman Scientific & Technical, 1989. Edition 5, illustrated, reprint Publisher Longman Scientific & Technical, 1989 ISBN 0582446937

CH1 211: Health and Nutrition (L-T-P-C: 2-0-0-2)

Program: B. Sc. Chemistry	**Semester:** II
Course code: CH1 211	**Course name:** Health and Nutrition

Lecture (Hours)	Practical (Hours)	Credits	Total Hours	Evaluation Scheme			
				Component	Exam	Max. Marks	Passing %
2/week	-	2	30	Lecture	CCE, ESE	50	40

Course Objectives:

- To understand the nutritional aspects of food materials of human health.
- To differentiate different types of diseases caused by food infection and water contamination
- To study various control measures of water-borne disease.
- To analyze the role of food in disease progression.

Course Outcome: At the end of the course, the student will be able to
CO 1: Understand the classification of various types of food items
CO 2: Explain the calorific value of food materials and balance diet
CO 3: Illustrate food and water-borne diseases
CO 4: Analyze impact of food and water on human health

Syllabus

Units	Content	Hours
Unit I: Food and Nutrition	**Food:** Basic concept of food, Types of plant and animal foods, Nutritional value. Balance diet, Calorific values of different food items, Cereals, Millets, Pulses, Fats & Oils, Fruits & vegetables, milk and milk products. **Nutrition:** Basics of nutrients, Macro and micro-nutrients, Essential nutrients, Food guide pyramid, Source and digestion of Carbohydrates, Proteins, Fats, Vitamins, and Minerals. Diseases related to food deficiency. Health and fitness.	**10**
Unit II: Food-borne Diseases	**Food Infections and Poisoning:** Types and control measures, Food poisoning of bacterial and Non-bacterial origin, Staphylococcus food poisoning, Botulism, Ergotism, Afflatoxicosis, Signs, symptoms, and safety measures, Probiotics-Nutritional and therapeutic aspects	**10**
Unit III: Waterborne Diseases	**Waterborne Infections:** Classification, Types and preventive measures, Amoebiasis, Cholera, *E. coli* infection, Dysentery, Typhoid fever, Hepatitis A, Poliomyelitis, Safety measures and primary treatment, Local water-borne diseases	**10**

Reading references:

1. B. Srilakshmi. *Food Science*. New Age International Pvt. Ltd., 2018, 7th Ed.
2. L. H. Meyer. *Food Chemistry*. CBS Publishers and Distributors, 2006, New Ed.
3. B. Poornima. *Fundamentals of Food Science, Technology and Processing and Preservation*. Centrum Press, 2012.

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