CURRICULUM AND CREDIT FRAMEWORK
As per NEP 2020

For

Under Graduate Programme
(Subject: Chemistry)

(To be effective from the Academic Session 2024-25)

Department of Chemistry

Gurugram University, Gurugram

(A State Govt. University Established Under Haryana Act 17 of 2017)

Table of Contents

Background

- The Chemistry Department of Gurugram University, Gurugram, Haryana - India was established in 2020.
- The vision of the Department of Chemistry is to promote excellence and innovation in teaching and research.
- The Department believe to create an academically stimulating atmosphere for students.
- The Mission of the Department of Chemistry is to educate and train students to achieve excellence in science via chemistry, which will empower them to contribute to the development of the nation.
- The Department aims to encourage critical thinking and develop research skill.

Vision and Mission

Vision

1. To impart knowledge and skills in the area of Chemistry, to promote excellence and innovation, instill curiosity and ignite interest in relevant areas to inspire young minds to make significant contributions for the betterment of mankind.

2. To develop a department that can effectively harness its strength to create an academically inspiring atmosphere by inculcating students with cultural and ethical values.

Mission

1. To promote, inspire and nurture the fundamentals of chemistry through courses offered to the students.
2. To provide high quality and innovative education with emphasis on both theory and practical training for transformation of young budding chemists into productive scientists, excellent teachers, entrepreneurs and creative independent researchers.
3. To support inter disciplinary research with focus on solving problems of global significance by working jointly with other universities and research Institutes.

Programme Outcomes

On completing B.Sc Programme with the subject Chemistry, the students shall be able to realize following programme outcomes:

PO	Description
PO-1	Understand the advance concepts of organic, physical, and inorganic along their application.
PO-2	Execute innovative and critical thinking in chemical sciences, which they have developed from theory classrooms and practical labs.
PO-3	Identify the given chemical problems and analyse them using scientific tools.
PO-4	Interpret the data collected from an experiment.
PO-5	Communicate well with others, make effective presentations, and write scientific reports and documents.
PO-6	Handle analytical techniques such as UV-Vis spectrophotometer, FTIR, Polarimeter, Potentiometer, Colorimeter, Chromatography etc.
PO-7	Understand the major thrust areas in chemical sciences to do their future Masters and jobs in industries or academia.

Programme Specific Outcomes

On completing B. Sc Programme with the subject Chemistry, the students shall be able to realize following outcomes:

PSO	Description
PSO-1	The detailed functional knowledge of theoretical concepts and experimental aspects of Chemistry.
PSO-2	To integrate the knowledge gained with various contemporary and evolving areas in chemical sciences like analytical, synthetic, pharmaceutical, etc.
PSO-3	To understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in chemical sciences.
PSO-4	Provide opportunity to excel in academia, research or industry.

Undergraduate Attributes

An Undergraduate B.Sc. student with Chemistry Subject is envisaged to have the following attributes:

- Disciplinary Knowledge
- Creative and Critical Thinking
- Reflective Thinking
- Problem Solving
- Communication Skills
- Research Skills
- Life Skills
- Multidisciplinary Competence
- Moral and Ethical Values
- Inculcate the importance of Life-long Learning
- Global Competence

Qualification Descriptors

To be eligible for admission in B.Sc programme the candidate should have minimum 50% marks in their Senior secondary (10+2) from a recognized school education board with Physics, Chemistry and Biology/Mathematics as the main subject.

Scheme of Programme

(Scheme UG A2: Undergraduate Programmes (Single Major)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A1	**Inorganic Chemistry-I**	240/CHE/CC/101	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A2	**Organic Chemistry-I**	240/CHE/CC/102	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A3	**Physical Chemistry-I**	240/CHE/CC/103	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
Minor/ Vocational Course(s)														
MIC-1	One from Pool	240/CHE/MI/101							2					50
Multidisciplinary Course(s)														
MDC-1	One from Pool	240/CHE/MD/101							3					75
Ability Enhancement Course(s)														
AEC-1	One from Pool								2					50
Skill Enhancement Course(s)														
SEC-1	One from Pool	240/CHE/SE/101							3					75
Value-added Course(s)														
VAC-1	One from Pool	240/CHE/VA/101							2					50
Total Credits									**24**					**600**

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A4	**Inorganic Chemistry-II**	240/CHE/CC/201	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A5	**Organic Chemistry-II**	240/CHE/CC/202	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A6	**Physical Chemistry-II**	240/CHE/CC/203	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
Minor/ Vocational Course(s)														
MIC-2	One from Pool	240/CHE/MI/201							2					50
Multidisciplinary Course(s)														
MDC-2	One from Pool	240/CHE/MD/201							3					75
Ability Enhancement Course(s)														
AEC-2	One from Pool								2					50
Skill Enhancement Course(s)														
SEC-2	One from Pool	240/CHE/SE/201							3					75
Value-added Course(s)														
VAC-2	One from Pool	240/CHE/VA/201							**2**					**50**
Total Credits									**24**					**600**

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A7	**Inorganic Chemistry-III**	240/CHE/CC/301	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A8	**Organic**	240/CHE/C	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100

	Chemistry-III	C/302												
CC-A9	**Physical Chemistry-III**	240/CHE/CC/303	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
Minor/ Vocational Course(s)														
MIC-3	One from Pool	240/CHE/MI/301							4					100
Multidisciplinary Course(s)														
MDC-3	One from Pool	240/CHE/MD/301							3					75
Ability Enhancement Course(s)														
AEC-3	One from Pool								2					50
Total Credits									**20**					**50**

Semester 4

Course Code	**Course Title**	**Course ID**	**L**	**T**	**P**	**L**	**T**	**P**	**Credits**	**MARKS**				
			(Hrs)			**Credits**				**TI**	**TE**	**PI**	**PE**	**Total**
Core Course(s)														
CC-A10	**Inorganic Chemistry-IV**	240/CHE/CC/401	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A11	**Organic Chemistry-IV**	240/CHE/CC/402	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A12	**Physical Chemistry-IV**	240/CHE/CC/403	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
Minor/ Vocational Course(s)														
MIC/VOC-4	One from Pool	240/CHE/MI/401 OR 240/CHE/VO/401							4					100
Ability Enhancement Course(s)														
AEC-4	One from Pool								2					50
Value-added Course(s)														
VAC-3	One from Pool	240/CHE/V							**2**					**50**

		A/401												
Total Credits									**20**					**500**

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A13	**Inorganic Chemistry-V**	240/CHE/CC/501	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A14	**Organic Chemistry-V**	240/CHE/CC/502	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A15	**Physical Chemistry-V**	240/CHE/CC/503	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
Minor/ Vocational Course(s)														
MIC-5	One from Pool	240/CHE/MI/501							4					100
Skill Enhancement Course(s)														
Internship									4					100
Total Credits									**20**					

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A16	**Inorganic Chemistry-VI**	240/CHE/CC/601	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A17	**Organic Chemistry-VI**	240/CHE/CC/602	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100
CC-A18	**Physical Chemistry-VI**	240/CHE/CC/603	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100

Minor/ Vocational Course(s)													
MIC-6	One from Pool	240/CHE/MI/601							4				100
MIC-7	One from Pool	240/CHE/MI/602							4				100
Skill Enhancement Course(s)													
SEC-3	One from Pool	240/CHE/SE/601							3				75
Total Credits									**22**				**550**

1. ***The curriculum of semester 7 and 8 will is provided in due course of time.***

Multidisciplinary Course from the department for pool of the Courses in the University (These courses are to be offered to students of different discipline/Subject)

Semester 1

Course Code	Course Title	Course ID	L	T (theory)	P (prac.)	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-1	**Introductory Chemistry-I**	240/CHE/MD/101	**2**		**2**	**2**		**1**	3	**15**	**35**	**05**	**20**	75

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-2	**Introductory Chemistry-II**	240/CHE/MD/201	**2**		**2**	**2**		**1**	3	**15**	**35**	**05**	**20**	75

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-3	**Introductory Chemistry-III**	240/CHE/MD/301	**2**		**2**	**2**		**1**	3	**15**	**35**	**05**	**20**	75

Minor Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department to gain a broader understanding beyond the major discipline)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-1	**Green Chemistry**	240/CHE/MI/101	**2**			**2**			2	**15**	**35**			50

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-2	**Bioinorganic Chemistry**	240/CHE/MI/201	**2**			**2**			2	**15**	**35**			50

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-3	**Chemistry of biomolecules-I**	240/CHE/MI/301	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-6	**Chemistry of biomolecules-II**	240/CHE/MI/601	**3**		**2**	**3**		**1**	**4**	**25**	**50**	**5**	**20**	100

Vocation Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is focused on practical work, preparing students for a particular skilled profession.

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-1	**Chemistry of Fertilizers and Pesticides or Chemistry of Cosmetics and Perfumes**		**3**		**2**	**3**		**1**	4	**25**	**50**	**5**	**20**	100

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-2	**Agriculture Chemistry**		**3**		**2**	**3**		**1**	4	**25**	**50**	**5**	**20**	100

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-3	**Green Laboratory Practices Or Maintenance of laboratory instruments**		**3**		**2**	**3**		**1**	4	**25**	**50**	**5**	**20**	100

Skill Enhancement Course from the department for pool of the Courses in the University

(These courses are offered by each department for students of other departments/same department and is designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work.)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-1	Chemistry lab operation and safety measures	240/CHE/SE/101	2		2	2		1	3	15	35	05	20	75

Semester 2

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-2	Analytical Chemistry	240/CHE/SE/201	2		2	2		1	3	15	35	05	20	75

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-3	Food Adulteration Testing		2		2	2		1	3	15	35	05	20	75

Semester 8

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
SEC-4/ Field Training	Chemistry of food, flavor & colorants		2		2	2		1	3	15	35	05	20	75

Core Course: Single major

COURSE DETAILS:

Course Title	**Inorganic Chemistry-I**
Semester	**Semester-1**
Course Code	**240/CHE/CC/101**
Course ID	**CC-A1**
Level of Course	**100-199**
Total Credits	**04 (Lecture: 03, Tutorial: 0, Practical: 01)**
Total Marks	**100**
Marks Distribution	**Theory External: 50 Theory Internal: 25** **Practical External: 20 Practical Internal: 05**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 5	
Lectures (L) Hours per Week: 3	**Practical (P) Hours per Week: 2**

COURSE OBJECTIVES:

- Develop a fundamental understanding of periodic properties, chemical bonding theories and extraction methods of metals.
- Acquire skills in quantitative analysis through practical experiments in titrimetric analysis and acid-base titrations.
- Foster analytical thinking in understanding the relationship between electronic structure, chemical bonding, and physical properties of elements and compounds.
- Apply theoretical knowledge to practical scenarios such as metal extraction methods and chemical bonding predictions.
- Critically analyze experimental data and theoretical concepts to draw conclusions and solve problems in chemistry.

COURSE OUTCOMES:

- Students will be able to Explain and predict trends in atomic and ionic radii, ionization enthalpy, electron gain enthalpy, and electronegativity using various scales.
- Understand the principles of ionic bonding, metallic bonding, and weak forces.

- Apply valence bond theory and VSEPR theory to predict shapes and hybridization in simple inorganic molecules and ions.
- Analyze and compare different methods of metal extraction including Ellingham diagrams, electrolytic reduction, and hydrometallurgy.
- Perform and interpret results from titrimetric experiments including acid-base titrations and quantitative analysis of solutions.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	**Periodic Properties** Quantum numbers, Aufbau and Pauli exclusion principles, Hund's rules of maximum multiplicity. Periodic classification of elements into s, p d & f block elements and electronic configuration, screening effect, effective nuclear charge and Slater's rules, discussion and trends of the following properties of representative elements (s & p block): atomic and ionic radii, ionization enthalpy, electron gain enthalpy and electronegativity (Pauling's/ Mulliken's/ Allred Rachow's scale).	**12**
II	**Chemical Bonding-I** Ionic Bonding: Lattice energy, Born-Haber cycle, solvation energy, and ionic radii; Metallic Bonding: Band theory, conductors, semiconductors, and insulators; Weak forces: Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, instantaneous dipole-induced dipole interactions, hydrogen bonding.	**11**
III	**Chemical Bonding-II** Covalent Bonding: Valence bond theory (Heitler-London approach) and its limitation, directional characteristics of covalent bond, type of hybridization and shapes of simple inorganic molecules and ions (BeF_2, BF_3, CH_4, PF_5, SF_6, IF_7, SO_4^{-2}, ClO_4^{-1}, NO_3^{-1}) valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, H_2O, $SnCl_2$, ClO_3^{-1} and ICl_2^{-1}.	**11**
IV	**Extractions of Metals** General modes of occurrence of metals. Ellingham diagrams for the reduction of metal oxides using carbon and carbon monoxide as reducing agents. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel-de Boer process and Mond's process, Zone refining.	**11**
V	**Practical**	**30**

	1. **Titrimetric Analysis:** (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality. 2. **Acid-Base Titrations**: Principles of acid-base titrations to be discussed. (i) Estimation of oxalic acid using standardized NaOH solution (ii) Estimation of sodium carbonate using standardized HCl. (iii) Estimation of carbonate and hydroxide present together in a mixture. (iv) Estimation of carbonate and bicarbonate present together in a mixture.	

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 75 (External: 50 + Internal: 25)

Internal Assessment: 25 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 15 Marks
External Assessment: 50 Marks (03 Hours)	• End Term Exam: 50 Marks

Practical Exam: Total Marks: 25 (External: 20 + Internal: 05)

Internal Assessment: 05 Marks	• Class Participation: 05 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End-Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

SUGGESTED BOOKS

1. "Concise Inorganic Chemistry" by J.D. Lee, Sudarshan Guha (Indian Adaptation)
2. "Inorganic Chemistry" by Puri, Sharma, and Kalia

3. "Principles of Inorganic Chemistry" by B.R. Puri, L.R. Sharma, and K.C. Kalia
4. "Extractive Metallurgy" by T. Rosenqvist, Terkel Rosenqvist (Indian Edition)
5. "Quantitative Chemical Analysis" by Daniel C. Harris
6. "Vogel's Textbook of Quantitative Chemical Analysis" by J. Mendham, R.C. Denney, J.D. Barnes, and M. Thomas
7. "Fundamentals of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch
8. "Quantitative Inorganic Analysis" by A. I. Vogel

COURSE DETAILS:

Course Title	**Organic Chemistry-I**
Semester	**Semester-1**
Course Code	**240/CHE/CC/102**
Course ID	**CC-A2**
Level of Course	**100-199**
Total Credits	**04 (Lecture: 03, Tutorial: 0, Practical: 01)**
Total Marks	**100**
Marks Distribution	**Theory External: 50** **Theory Internal: 25** **Practical External: 20** **Practical Internal: 05**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 5	
Lectures (L) Hours per Week: 3	**Practicals (P) Hours per Week: 2**

COURSE OBJECTIVES:

- Fundamental understanding of basic concepts in organic chemistry.
- Equip students with detailed knowledge of organic reaction mechanisms.
- Develop a comprehensive understanding of 2D and 3D structure of compounds including isomerism, conformational and configurations analysis,
- Enhance laboratory skills through practical experiments.

COURSE OUTCOMES:

- Students will be able to classify and name organic compounds, understand hybridization and electronic displacements, and apply these concepts to predict bond properties and reactivity.
- Capable of analysing and explaining organic reaction mechanisms, identifying reaction intermediates, and assessing the relative stability of these intermediates.
- Demonstrate proficiency in identifying and distinguishing between different types of isomerism, understanding chiral and achiral molecules, and applying CIP rules for configuration.
- Gain a thorough understanding of the properties, preparation methods, and reactivity patterns of alkanes, alkenes, and alkynes, including detailed mechanisms of key reactions.

- Students will develop practical skills in organic chemistry laboratory techniques, including purification, melting and boiling point determination, distillation, sublimation, and organic synthesis.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	**Basic Concepts in Organic Chemistry** Classification, and Nomenclature of organic compounds, Hybridization: Shapes of molecules, influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their comparison & applications. Mechanism of Organic Reactions: Curly arrow rules, formal charges, Electrophiles and Nucleophiles, Homolytic and Heterolytic fission with suitable examples. Reaction intermediates: Carbocations, Carbanions, Free radicals, Carbenes, arynes and nitrenes (Types, shape, structure, Mechanistic study and relative stability) Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.	11
II	**Stereochemistry and Conformational Analysis** Isomerism: Types of isomerism, Optical isomerism: elements of symmetry, Optical Activity, Specific Rotation, Molecular chirality/asymmetry, Enantiomers, chiral and achiral molecules with two stereogeniccentres, Diastereoisomers, Meso compounds, Racemic mixture and resolution. Relative and absolute configuration: CIP rules, D/L and R/S designations. Geometric isomerism: Configuration of geometric isomers. Cis-Trans and E & Z nomenclature, Conformational isomerism: Conformational analysis of ethane and n-butane; chair, boat, half chair and twist boat conformations of cyclohexane (interconversions and energy level diagram). Interconversions of Newman projection and Sawhorse formulae, Wedge Formula and Fischer representations (Erythrose, Threose and Tartaric acid), Difference between configuration and conformation.	12
III	**Hydrocarbons (Alkanes and Alkenes-1)** **Alkanes**: Physical (Boiling point, melting point, solubility) and chemical properties (Combustion, cracking, and reforming) of alkanes, general methods of preparation: Wurtz reaction, Kolbe reaction, Corey-House	11

	reaction and decarboxylation of carboxylic acids, Reactivity and Mechanisms: Free radical substitutions, halogenation: relative reactivity and selectivity. **Alkenes**: Structure and isomerism, physical (Boiling point, melting point, solubility) and chemical properties (Stability, reactivity).	
IV	**Hydrocarbons (Alkenes-1I and Alkynes)** **Alkenes**: Formation, Mechanism of elimination reactions (E1, E2, E1cb), Saytzeff and Hoffmann elimination, Reactions of alkenes: Electrophilic additions their mechanisms (Markownikov/ Anti Markownikov addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). **Alkynes**: General methods of preparation, reactions of alkynes: acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds, alkylation of terminal alkynes.	**11**
V	**Practical** 1. Calibration of a thermometer. 2. Purification of organic compounds by crystallization using the following solvents: a. Water b. Alcohol c. Alcohol-Water 3. Determination of the melting points of prepared organic compounds (Kjeldahl method and electrically heated melting point apparatus). 4. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method). 5. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds. 6. Simple Distillation of Organic Mixtures. 7. Fractional Distillation of Alcohols 8. To study the process of sublimation of camphor and phthalic acid. 9. Organic Preparation: a. Bromination of acetanilide/aniline/phenol, b. Nitration of nitrobenzene/toluene	**30**

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 75 (External: 50 + Internal: 25)

Internal Assessment: 25 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks

	• Mid Term Exam: 15 Marks
External Assessment: 50 Marks (03 Hours)	• End Term Exam: 50 Marks

Practical Exam: Total Marks: 25 (External: 20 + Internal: 05)

Internal Assessment: 05 Marks	• Class Participation: 05 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

SUGGESTED BOOKS

1. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. J. E. McMurry, Fundamentals of Organic Chemistry, 7thEdition, Cengage Learning India, 2013.
3. R. N. Boyd, R. T. Morrison and S. K. Bhattcharjee, Organic Chemistry, 7thEdition, Pearson, 2014.
4. P. S. Kalsi, Stereochemistry Conformation and Mechanism, New Age International, 2005.
5. J. Singh, L.D.S. Yadav, Organic Chemistry (Volume I), 14th Edition, Pragati Prakashan, 2019.
6. E. L. Eliel & S. H. Wilen, Stereochemistry of Organic Compounds, Wiley: London, 1994.
7. S. M. Mukerji, S. P. Singh, K.P.Kapoor and R. Das, Organic Chemistry (Volume I), 2nd Edition, New Age International Publishers, 2010.
8. S. M. Mukerji, S. P. Singh, K.P. Kapoor and R. Das, Organic Chemistry (Volume II), 2nd Edition, New Age International Publishers, 2012.
9. B.S. Furniss ; A. J. Hannaford ; P.W.G. Smith ; A. R. Tatchell, Practical Organic Chemistry, 5th Edition., Pearson, 2012.
10. F.G. Mann & B.C. Saunders, Practical Organic Chemistry, Pearson, 2009.
11. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),Vogel's textbook of Practical Organic Chemistry, Pearson.

COURSE DETAILS:

Course Title	**Physical Chemistry-I**
Semester	**Semester-I**
Course Code	**240/CHE/CC/103**
Course ID	**CC-A3**
Level of Course	**100-199**
Total Credits	**04 (Lecture: 03, Tutorial: 0, Practical: 02)**
Total Marks	**100**
Marks Distribution	**Theory External: 50 Theory Internal: 25** **Practical External: 20 Practical Internal: 05**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 4	
Lectures (L) Hours per Week: 3	**Practical (P) Hours per Week: 2**

COURSE OBJECTIVES:

- To provide a comprehensive understanding of fundamental concepts in atomic and molecular structure.
- To introduce students to the foundational principles and postulates of quantum mechanics.
- To develop the mathematical skills required to solve quantum mechanical problems.
- To explore the shapes, energy levels, and electron distributions of atomic orbitals.
- To apply quantum mechanical concepts to real-world problems.

COURSE OUTCOMES:

- Students will be able to explain the quantization of energy and its implications for various phenomena.
- Demonstrate a clear understanding of the postulates of quantum mechanics.
- Solve quantum mechanical problems using the Schrödinger equation.
- Describe the shapes, energy levels, and electron configurations of various atomic orbitals.
- Through practical experiments, students will develop hands-on skills in measuring surface tension and viscosity, and analyzing the effects of temperature and concentration on these properties.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	**Atomic and Molecular Structure - I** Planck's black body radiation: Understanding the quantization of energy and its implications for the emission of radiation from black bodies. Compton effect: Understanding the scattering of X-rays by electrons and its significance in demonstrating the particle nature of light. Photoelectric effect: Explaining the emission of electrons from metal surfaces when exposed to light and its experimental observations. Bohr's theory of the hydrogen atom: Describing the quantized nature of electron orbits and energy levels. de Broglie postulate: Introducing wave-particle duality and the de Broglie wavelength for matter waves. Heisenberg's Uncertainty Principle: Explaining the fundamental limits on the precision of simultaneous measurements of position and momentum.	11
II	**Quantum Mechanics - I** Postulates of quantum mechanics: Providing the foundational principles and axioms underlying the theory. State function (wave function) postulate: Describing the state of a quantum system. Observable postulate: Introduction to operators and measurable quantities. Measurement postulate: Collapse of the wave function and eigenvalue equations. Normalized and orthogonal wave functions: Explaining their significance in quantum systems and the properties of orthogonality and normalization. Normalization condition: Ensuring total probability equals one. Orthogonality of wave functions: Importance in quantum mechanics. Complex conjugate: Role in normalization and orthogonality.	12
III	**Quantum Mechanics - II** Probability density function (Ψ^2): Describing the probability interpretation of the wave function and its use in predicting measurement outcomes. Radial probability distribution: For hydrogen-like atoms. Operators in quantum mechanics: Including their mathematical properties and physical significance. Radial and angular wave functions for the hydrogen atom: Explaining their derivation and significance in describing the atom's electron distribution. Radial probability distribution: Analyzing the probability of finding an electron at various distances from the nucleus. Schrödinger's wave equation: Including its derivation and applications to simple systems. Time-independent Schrödinger equation: Focusing on stationary states. Particle in a one-dimensional box: Solutions and energy quantization. Harmonic oscillator: Basic concepts and applications	11

IV	**Atomic and Molecular Structure - II** Energy spectrum of the hydrogen atom: Including the derivation and significance of energy levels and spectral lines. Shapes of s, p, d, and f orbitals: Describing the spatial distribution and nodal structures of these atomic orbitals. Pauli's Exclusion Principle: Discussing its role in determining the electronic configuration of atoms. Hund's rule of maximum multiplicity: Explaining its application in filling electron orbitals in multi-electron atoms.	**11**
V	**Practical** 1. Determination of surface tension of a liquid using the drop number method. 2. Determination of surface tension of a liquid using the drop weight method. 3. Determination of surface tension of different mixtures and solutions. 4. Study of the effect of temperature on the surface tension of a liquid. 5. Determination of the viscosity of a liquid using Ostwald's viscometer. 6. Determination of the viscosity of a liquid using a falling sphere viscometer. 7. Study of the effect of temperature on the viscosity of a liquid. 8. Study of the effect of concentration on the viscosity of a solution. 9. Determination of the viscosity of polymer solutions.	**30**

COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 75 (External: 50 + Internal: 25)

Internal Assessment: 25 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 15 Marks
External Assessment: 50 Marks (03 Hours)	• End Term Exam: 50 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 05)

Internal Assessment: 05 Marks	• Class Participation: 05 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks

	• Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

SUGGESTED BOOKS

1. "Physical Chemistry" by P. Bahadur
2. "Principles of Physical Chemistry" by Puri, Sharma, and Pathania
3. "Physical Chemistry" by A.K. Nag
4. "Advanced Practical Physical Chemistry" by J.B. Yadav
5. "Experiments in Physical Chemistry" by C. N. R. Rao and U. C. Agarwala
6. "Vogel's Textbook of Quantitative Chemical Analysis" by G. H. Jeffery, J. Bassett, J. Mendham, and R.C. Denney