

SCHEME UG A1: UNDERGRADUATE PROGRAMME (MULTIDISCIPLINARY)

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	Chemistry-I		3		2	3		1	4	25	50	5	20	100

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-A2	Chemistry-II		3		2	3		1	4	25	50	5	20	100

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-A3	Chemistry-III		3		2	3		1	4	25	50	5	20	100

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-A4	Chemistry-IV		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
Core Course(s)														
CC-A5	Chemistry-V		3		2	3		1	4	25	50	5	20	100

Internship is to be done during summer break after 4th Semester, Marks will be added in 5th Semester.

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-A6	Chemistry-VI		3		2	3		1	4	25	50	5	20	100

(To be effective from 2026-27)

SCHEME UG A2: UNDERGRADUATE PROGRAMME (SINGLE MAJOR)

Semester 1

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		3		2	3		1	4	25	50	5	20	100
CC-A2	Organic Chemistry-I		3		2	3		1	4	25	50	5	20	100
CC-A3	Physical Chemistry-I		3		2	3		1	4	25	50	5	20	100
Minor/ Vocational Course(s)														
MIC-1	One from Pool		2			2			2	15	35			50
Multidisciplinary Course(s)														
MDC-1	One from Pool		2		2	2		1	3	15	35	5	20	75
Ability Enhancement Course(s)														
AEC-1	One from Pool		2			2			2	15	35			50
Skill Enhancement Course(s)														
SEC-1	One from Pool		2		2	2		1	3	15	35	5	20	75
Value-added Course(s)														
VAC-1	One from Pool								2					50
Total Credits									24					600
Semester 2														

Semester 2

600														
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		3		2	3		1	4	25	50	5	20	100
CC-A5	Organic Chemistry-II		3		2	3		1	4	25	50	5	20	100
CC-A6	Physical Chemistry-II		3		2	3		1	4	25	50	5	20	100
Minor/ Vocational Course(s)														
MIC-2	One from Pool		2			2			2	15	35			50
Multidisciplinary Course(s)														
MDC-2	One from Pool		2		2	2		1	3	15	35	5	20	75
Ability Enhancement Course(s)														
AEC-2	One from Pool		2			2			2	15	35			50
Skill Enhancement Course(s)														
SEC-2	One from Pool		2		2	2		1	3	15	35	5	20	75
Value-added Course(s)														

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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		3		2	3		1	4	25	50	5	20	100
CC-A8	Organic Chemistry-III		3		2	3		1	4	25	50	5	20	100
CC-A9	Physical Chemistry-III		3		2	3		1	4	25	50	5	20	100
MIC-3	One from Pool		3		2	3		1	4	25	50	5	20	100
MDC-3	One from Pool		2		2	2		1	3	15	35	5	20	75
SEC-3	One from Pool		2		2	2		1	3	15	35	5	20	75
Total Credits									22					550

Semester 4

Course Code	Course Title	Course ID												550
			L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
CC-A10	Inorganic Chemistry-IV		3		2	3		1	4	25	50	5	20	100
CC-A11	Organic Chemistry-IV		3		2	3		1	4	25	50	5	20	100
CC-A12	Physical Chemistry-IV		3		2	3		1	4	25	50	5	20	100
MIC-4	One from Pool		3		2	3		1	4	25	50	5	20	100
AEC-4	One from Pool		2			2			2	15	35			50
VAC-3	One from Pool		2			2			2	15	35			50

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Total Credits									20					500
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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		3		2	3		1	4	25	50	5	20	100
CC-A14	Organic Chemistry-V		3		2	3		1	4	25	50	5	20	100
CC-A15	Physical Chemistry-V		3		2	3		1	4	25	50	5	20	100
Minor/ Vocational Course(s)														
VOC-1	One from Pool		3		2	3		1	4	25	50	5	20	100
Skill Enhancement Course(s)														
Internship									4					100
Total Credits									20					500

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		3		2	3		1	4	25	50	5	20	100	
CC-A17	Organic Chemistry-VI		3		2	3		1	4	25	50	5	20	100	
CC-A18	Physical Chemistry-VI		3		2	3		1	4	25	50	5	20	100	
Minor/ Vocational Course(s)															
VOC-2	One from Pool		3		2	3		1	4	25	50	5	20	100	
VOC-3	One from Pool		3		2	3		1	4	25	50	5	20	100	
Ability Enhancement Course(s)															
AEC-3	One from Pool		2			2			2	15	35			50	
Total Credits									22					550	

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MIC-1	Green Chemistry Or Molecules of Life-I Or Basic Chemistry-I		2			2			2	15	35			50
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Semester 2

Course Code	Course Title	Course ID	Semester 2						Credits	MARKS				
			L	T	P	L	T	P		TI	TE	PI	PE	Total
			(Hrs)			Credits								
MIC-2	Bioinorganic Chemistry Or Molecules of Life-II Or Basic Chemistry-II		2			2			2	15	35			50

Semester 3

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

Semester 4

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

Semester 5

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

Semester 6

Course Code	Course Title	Course ID	Semester 6											
			L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-2			3		2	3		1	4	25	50	5	20	100
VOC-3			3		2	3		1	4	25	50	5	20	100

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

MULTIDISCIPLINARY COURSE (MDC) 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	Semester I							Credits	MARKS				
			L	T (theory)	P (prac.)	L	T	P	TI		TE	PI	PE	Total	
			(Hrs)			Credits									
MDC-1	Introductory Chemistry-I Or Knowledge of Rasayan-I Or Chemistry for Competitive Exams-I		2		2	2		1	3	15	35	05	20	75	

Semester 2

Course Code	Course Title	Course ID	L	T	P	Semester 2			Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-2	Introductory Chemistry-II Or Knowledge of Rasayan-II Or Chemistry for Competitive Exams-II		2		2	2		1	3	15	35	05	20	75

Semester 3

Course Code	Course Title	Course ID	Semester 3						Credits	MARKS				
			L	T	P	L	T	P		TI	TE	PI	PE	Total
			(Hrs)			Credits								
MDC-3	Introductory Chemistry-III		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

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VALUE ADDED COURSE FROM THE DEPARTMENT FOR POOL OF THE COURSES IN THE UNIVERSITY
 (All the departments will offer value added course for semester 3 for the students of same or different departments. In the first year, students will study (i)

Human Values and Ethics and (ii) Environmental Studies as value added course)

(4) Environmental Studies as value added course)														
Course Code	Course Title	Course ID	Semester 1						Credits	MARKS				
			L	T	P	L	T	P		TI	TE	PI	PE	Total
			(Hrs)			Credits								
VAC-1	<u>Human Values and Ethics</u> Or <u>Environmental Studies</u>		2						2	15	35			50
Semester 2														

Course Code	Course Title	Course ID	Semester 2						Credits	MARKS				
			L	T	P	L	T	P		TI	TE	PI	PE	Total
			(Hrs)			Credits								
VAC-2	Human Values and Ethics OR Environmental Studies		2						2	15	35			50

Course Code	Course Title	Course ID	Semester 4						Credits	MARKS				
			L	T	P	L	T	P		TI	TE	PI	PE	Total
			(Hrs)			Credits								
VAC-3	Chemistry in everyday life-Soaps, detergents & dyes		2						2	15	35			50

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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

Semester I														
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 Or Food Safety and Quality Assurance Or Laboratory Skills for Chemist		2		2	2		1	3	15	35	05	20	75

Semester 2

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 Or Soil and Water Analysis Or Chemistry and its impact on daily life		2		2	2		1	3	15	35	05	20	75

Semester 3

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

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Semester 6

Semester 6														
Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
AEC-3	English Language and Communication: 3 OR हिंदी भाषा एव. सम्प्रेषण-3 OR संस्कृत भाषा एव. सम्प्रेषण-3								2					50

Semester 4

Semester 4														
Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
AEC-4	English Language and Communication: Level-4 OR हिंदी भाषा एव. सम्प्रेषण-4 OR संस्कृत भाषा एव. सम्प्रेषण-4								2					50

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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 5

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

Semester 6

Course Code	Course Title	Course ID	Semester 6											
			L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VOC-2			3		2	3		1	4	25	50	5	20	100
VOC-3			3		2	3		1	4	25	50	5	20	100

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Bachelor of Science with Major in Chemistry
Minor Course
(To be effective from Session 2026-27)

MINOR COURSE-CHEMISTRY

COURSE DETAILS:

Course Title	Molecules of Life – I
Semester	Semester-I
Course Code	MIC-1
Course ID	240/CHE/MI/103
Total Credits	02 (Lecture: 02, Tutorial: 0, Practical: 0)
Total Marks	50
Marks Distribution	Theory External: 35 Theory Internal: 15 Practical External: -- Practical Internal: --

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 2	
Lectures (L) Hours per Week: 02	Practical (P) Hours per Week: --

COURSE OBJECTIVES:

- To study the structure, classification, and chemical behavior of carbohydrates.
- To understand glycosidic linkages, stereochemistry, and structures of disaccharides, polysaccharides.
- To understand chemical nature of water, pH systems, buffers.
- To learn about the structure, classification, and properties of amino acids.
- To study peptide bond formation, methods of peptide synthesis, and structural organization of proteins.

COURSE OUTCOMES:

Upon completing this course, students will be able to:

- Classify carbohydrates, explain open chain and cyclic structures of important monosaccharides, and describe their reactions, interconversions, and qualitative tests.
- Explain α and β linkages and compare structures of sucrose, lactose, maltose, starch, and cellulose.
- Explain pH, pK_a , buffer action, and ionization of water.
- Classify amino acids and interpret zwitterion formation and isoelectric points.
- Describe peptide bond formation and determine terminal amino acids using analytical methods.

DETAILED CONTENT OF COURSE:



Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Carbohydrates - 1 Introduction and classification – monosaccharides, oligosaccharides and polysaccharides, aldose and ketose, reducing and non-reducing sugars. Open chain and cyclic structure of D (+)-glucose, D (-)-fructose, D-(+)-ribose and D-2-deoxyribose. Reactions of glucose and fructose with HCN, hydroxylamine and phenylhydrazine (osazone). Analytical tests for glucose – effect of heating, conc. H_2SO_4 , Fehling's Test, Tollen's Test, Molisch's Test. Basic idea of epimers, anomers, and Erythro and Threo Diastereomer. Inter-conversion of glucose and fructose.	8
II	Carbohydrates - 2 Linkage between monosaccharides (α and β): D-L configuration of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) including their structure. Water Structure of water, weak interactions in aqueous systems, water as biological solvents. Ionization of water, dissociation constant, concept of pH, pK_a and pK_b and buffer. Buffer action – acidic and basic.	7
III	Amino Acids Definition and Classification of amino acids – Acidic, basic and neutral; aliphatic and aromatic; and essential and non essential, zwitterion structure, isoelectric point and amphoteric nature of Amino acids. Peptide Introduction and basic formation of peptide. Determination of primary structure of peptides, determination of N-terminal amino acid (by Sanger's method) and C-terminal amino acid (with carboxypeptidase enzyme).	8
IV	Proteins Definition, classification of proteins based on molecular structure, hydrolysis product. Structure of proteins- peptide bond, primary, secondary, tertiary and quaternary structure of proteins, forces that determine folding and conformation and structural organization, Physical properties: denaturation and renaturation. Detection of Protein – Millon's test, Xantho protein test, Ninhydrin test, and Biuret test.	7

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05Marks • Seminar/ Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Instructions 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.

RECOMMENDED BOOKS

1. Morrison, R. N. and Boyd, R. N., *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Nelson, D. L., and Cox, M. M. (2021), *Lehninger Principles of Biochemistry* (8th ed.). W. H. Freeman and Company.
3. Satyanarayan, U. and Chakrapani, U. (2013), *Biochemistry* (4th ed.) Elsevier.
4. Sheela, K. *et al.* (2021), *Textbook of Biomolecules* (1st ed.) AIB Saliha Publications, Tamil Nadu.
5. Saini, G and Khanna, G. (2024), *Textbook of Chemistry of Biomolecules* (1st ed.) Prestige Publishers.

Bachelor of Science with Major in Chemistry
Minor Course
(To be Effective from Session 2026-27)

MINOR COURSE-CHEMISTRY

COURSE DETAILS:

Course Title	Basic Chemistry I
Semester	Semester-1
Course Code	MIC-1
Course ID	240/CHE/MI/102
Total Credits	02 (Lecture: 02, Tutorial: 0, Practical: 0)
Total Marks	50
Marks Distribution	Theory External: 35 Theory Internal: 15 Practical External: -- Practical Internal: --

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 2	
Lectures (L) Hours per Week: 02	Practical (P) Hours per Week: --

COURSE OBJECTIVES:

- To develop a conceptual understanding of atomic structure including de Broglie waves, uncertainty principle, quantum numbers, and atomic orbitals.
- To study ionic and covalent bonding using Valence Bond Theory, Molecular Orbital Theory, VSEPR theory, and hybridization.
- To understand periodic properties such as atomic size, ionization energy, electron affinity and electronegativity.
- To introduce electronic effects, reactive intermediates, and types of organic reactions for understanding reactivity and mechanisms in organic chemistry.

COURSE OUTCOMES:

Upon completing this course, students will be able to:

- Explain atomic structure, describe orbital shapes and probability distributions, and apply quantum numbers to determine electronic structure of atoms.
- Predict molecular shapes, explain bonding using MO theory, calculate bond order, and analyze bonding in simple and complex molecules.
- Interpret periodic trends, compare properties of s and p block elements, and explain concepts such as inert pair effect and diagonal relationship.
- Explain reaction mechanisms using inductive, resonance, and hyperconjugation effects, identify nucleophiles and electrophiles, and classify organic reactions and intermediates.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Atomic Structure Idea of de Broglie matter waves, Heisenberg's uncertainty principle, atomic orbitals, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, and d orbitals, Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge and Slater's rules.	8
II	Covalent Bonding and Ionic Bonding Valence bond theory and its limitations, hybridization and shapes of simple inorganic molecules (BeF_2 , BF_3 , CH_4 , PF_5 , SF_6 , IF_7); VSEPR theory (NH_3 , SF_4 , ClF_3 , and H_2O); Molecular orbital treatment of homonuclear and heteronuclear (CO & NO) diatomic molecules; HOMO, LUMO, Bond order. General characteristics of ionic compounds: ionization energy, electron affinity, sizes of ions, radius ratio rule and its limitation, lattice energy; Born-Haber cycle.	8
III	Periodic Properties and Trends Atomic and ionic radii, ionization energy, electron affinity and electronegativity – trends in periodic table (in s & p block elements). Comparative study of physical and chemical properties of s and p-block elements - Group trends in electronic configuration, common oxidation states, inert pair effect and diagonal relationship.	7
IV	Fundamentals of Organic Chemistry Electronic displacements: inductive effect, resonance and hyperconjugation; nucleophiles and electrophiles; reactive intermediates: carbocations (S_N1 and S_N2), carbanions, free radicals, carbene and nitrene.	7

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/ Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Instructions for End Term Theory Exam:

Bachelor of Science with Major in Chemistry
Minor Course
(To be Effective from Session 2026-27)

MINOR COURSE-CHEMISTRY

COURSE DETAILS:

Course Title	Molecules of Life – II
Semester	Semester-2
Course Code	MIC-2
Course ID	240/CHE/MI/203
Total Credits	02 (Lecture: 02, Tutorial: 0, Practical: 0)
Total Marks	50
Marks Distribution	Theory External: 35 Theory Internal: 15 Practical External: -- Practical Internal: --

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 2	
Lectures (L) Hours per Week: 02	Practical (P) Hours per Week: --

COURSE OBJECTIVES:

- To study the chemical components, structure, and organization of nucleic acids including nucleosides, nucleotides, DNA, and RNA.
- To understand classification, structure, and chemical behavior of lipids including fatty acids, phospholipids, and cholesterol.
- To understand the importance and role of chemistry in enzyme action.
- To study classification, sources, physiological roles, and deficiency/toxicity effects of vitamins and minerals in biological systems.

COURSE OUTCOMES:

Upon completing this course, students will be able to:

- Identify nitrogenous bases, explain the structure of nucleosides, nucleotides, DNA and RNA
- To classify lipids, explain properties of fatty acids, and describe their chemical reactions.
- Explain enzyme specificity, describe catalytic mechanisms, and analyze factors affecting enzyme activity.
- Have better understanding of vitamins and minerals for human body and implications of its deficiency and toxicity.

DETAILED CONTENT OF COURSE:



Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Chemistry of Nucleic Acids Components of Nucleic acids: Adenine, guanine, thymine, cytosine and uracil (structure only), other components of nucleic acids, nucleosides and nucleotides (nomenclature), structure of polynucleotides; structure of DNA (Watson-Crick model) and RNA (types of RNA - tRNA, mRNA and rRNA), difference between DNA and RNA.	8
II	Chemistry of Lipids Introduction, definition and classification of lipids- simple, compound (phospholipids) and derived lipids (cholesterol). Classification of fatty acids – saturated fatty acids, unsaturated fatty acids. Physical property-emulsification. Chemical properties- hydrogenation of fats and oil, saponification number, Rancidity, acid number, and Iodine number.	8
III	Enzymes Classification of enzymes and their uses (mention Ribozymes). Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive and non-competitive inhibition including allosteric inhibition).	7
IV	Vitamins & Minerals Vitamins: Introduction and classification - fat-soluble vitamins (Vitamin A, D, E, K) & water-soluble vitamins (B and C). Minerals: Introduction, classification and their sources: macro-minerals (Ca, P, Mg) & micro-minerals (Se, Fe, I, Co, Zn, Cu, Se, Cr). Deficiency and toxicity; physiological importance of vitamins and minerals, effect of food processing on vitamins and minerals.	7

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/ Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Instructions 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.

RECOMMENDED BOOKS

1. Morrison, R. N. and Boyd, R. N., *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Nelson, D. L., and Cox, M. M. (2021), *Lehninger Principles of Biochemistry* (8th ed.). W. H. Freeman and Company.
3. Satyanarayan, U. and Chakrapani, U. (2013), *Biochemistry* (4th ed.) Elsevier.
4. Sheela, K. *et al.* (2021), *Textbook of Biomolecules* (1st ed.) AIB Saliha Publications, Tamil Nadu.
5. Saini, G and Khanna, G. (2024), *Textbook of Chemistry of Biomolecules* (1st ed.) Prestige Publishers.



Bachelor of Science with Major in Chemistry
Core Course
(To be effective from Session 2026-27)

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: 01)	
Total Marks	100	
Marks Distribution	Theory External: 50 Practical External: 20	Theory Internal: 25 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 develop a fundamental understanding of the rates of chemical reactions, including rate laws, order, and half-life of reactions.
- To introduce the foundational theories of reaction rates and their role in explaining reaction mechanisms.
- To develop mathematical skills for determining the order and rate constants of chemical reactions.
- To provide comprehensive knowledge of electrolytic conductance and the theories governing ionic conduction.
- To develop experimental and analytical skills in conductivity measurements, including the application of Kohlrausch's Law and determination of degree of dissociation.

COURSE OUTCOMES

- Apply concepts of reaction rates to derive rate laws, determine order of reactions, and evaluate half-life for different reaction systems.
- Explain and critically analyze theories of reaction rates in the context of reaction mechanisms.
- Solve numerical problems to determine order and rate constants using appropriate mathematical methods.
- Analyze electrolytic conductance and explain ionic mobility using theories such as Arrhenius theory and Ostwald's dilution law.



- Perform conductivity measurements and apply Kohlrausch's Law to determine degree of dissociation and related parameters (e.g., pK_a).

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	Chemical Kinetics-I Rate of reaction, rate equation, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst. Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction, Difference between molecularity and order of reaction, Half-life period of reaction, Methods of determination of order of reaction (Graphical, half-life period, Vant Hoff method, integrated rate expression method).	11
II	Chemical Kinetics-II Effect of temperature on the rate of reaction – Arrhenius equation, Theories of reaction rate Simple collision theory for unimolecular and bimolecular collision, Transition state theory of Bimolecular reactions, Steady state approximation, Comparison between collision theory and Arrhenius theory, Comparative study of Activated complex theory and collision theory, Theory for unimolecular reactions (Lindemann Hypothesis).	12
III	Electrochemistry-I Electrolytic conduction, factors affecting electrolytic conduction, specific, conductance, molar conductance, equivalent conductance and relation among them, their variation with concentration Arrhenius theory of ionization, Ostwald's Dilution Law, Debye- Huckel – Onsager's equation for strong electrolytes, Transport number, definition and determination by Hittorf's method.	11
IV	Electrochemistry-II Kohlrausch's Law, calculation of molar ionic conductance and effect of viscosity, temperature & pressure on it, Application of Kohlrausch's Law in calculation of conductance of weak electrolytes at infinite dilution, Applications of conductivity measurements: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of sparingly soluble salts, conductometric titrations, Definition of pH and pK_a , Buffer solution, Buffer action, Henderson – Hazel equation, Buffer mechanism of buffer action.	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
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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 (02 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

Instructions 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

Theory

1. Atkins, P., & de Paula, J. (2018). *Physical chemistry* (11th ed.). Oxford University Press.
2. Levine, I. N. (2014). *Physical chemistry* (6th ed.). McGraw-Hill Education.
3. Laidler, K. J. (1987). *Chemical kinetics* (3rd ed.). Harper & Row.
4. Frost, A. A., & Pearson, R. G. (1961). *Kinetics and mechanism* (2nd ed.). Wiley.
5. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2017). *Principles of physical chemistry* (47th ed.). Vishal Publishing Co.
6. Glasstone, S. (1946). *An introduction to electrochemistry*. D. Van Nostrand Company.
7. Bard, A. J., & Faulkner, L. R. (2001). *Electrochemical methods: Fundamentals and applications* (2nd ed.). Wiley.
8. Bahl, B. S., Tuli, G. D., & Bahl, A. (2016). *Essentials of physical chemistry*. S. Chand Publishing.

Practical

1. Kumari, R., & Anand, A. (2018). *Physical chemistry laboratory manual: An interdisciplinary approach*. I.K. International Publishing House.
2. Vogel, A. I., Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1989). *Vogel's textbook of quantitative chemical analysis* (5th ed.). Longman.
3. Yadav, J. B. (2013). *Advanced practical physical chemistry*. Krishna Prakashan Media.
4. Rao, C. N. R., & Agarwala, U. C. (1988). *Experiments in physical chemistry*. Wiley Eastern.
5. Gupta, S. V. (2014). *Viscometry for liquids: Calibration of viscometers*. Springer.
6. Bartell, F. E. (1944). *Laboratory manual of colloid and surface chemistry* (2nd ed.). Edwards Brothers.

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B.Sc. Physical Science (Multidisciplinary)
Subject- Chemistry
(To be Effective from Session 2026-27)

Core Course (Multidisciplinary)

COURSE DETAILS:

Course Title	Chemistry-I
Semester	Semester-I
Course Code	240/CHEP/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

- To develop a fundamental understanding of atomic structure, quantum numbers, electronic configuration, and periodic properties of elements.
- To explain the principles of chemical bonding, including valence bond theory, hybridization, VSEPR theory, and molecular orbital theory.
- To introduce the basic concepts of organic chemistry, including classification, nomenclature, electronic effects, and reaction intermediates.
- To develop an understanding of stereochemistry and conformational analysis, including isomerism, chirality, and molecular configurations.
- To provide knowledge of chemical kinetics, including rate laws, order of reactions, and the effect of temperature on reaction rates.

COURSE OUTCOMES

- Apply quantum mechanical concepts and periodic trends to explain electronic configurations, effective nuclear charge, and properties of elements.
- Analyze molecular structure and bonding using valence bond theory, hybridization, VSEPR, and molecular orbital theory, and predict molecular geometry and properties.



- Classify and name organic compounds, and interpret the role of electronic effects and reaction intermediates in determining reactivity and stability.
- Analyze stereochemical features of organic molecules, including optical and geometrical isomerism, and evaluate conformational stability of different molecular systems.
- Apply principles of chemical kinetics to determine rate laws, order of reactions, half-life, and evaluate the effect of temperature using the Arrhenius equation.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	Atomic Structure & 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).	11
II	Chemical Bonding - Part I Valence bond theory and its limitations, directional characteristics of covalent bond, various types 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-} , and ClO_4^-). Valence shell electron pair repulsion (VSEPR) theory to NH_3 , H_3O^+ , SF_4 , ClF_3 , H_2O , SnCl_2 , ClO_3^- and ICl_2^- . Molecular orbital theory of homonuclear and heteronuclear diatomic molecules (N_2 , O_2 , C_2 , CO , and NO), bond order, bond length and bond energy.	11
III	Basic Concepts in Organic Chemistry Classification and Nomenclature of organic compounds. Electronic Displacements: Inductive, electrometric, resonance and mesomeric effects, hyperconjugation and their comparison & applications. Reaction intermediates: Carbocations, Carbanions, Free radicals, Carbenes, arynes and nitrenes (Types, shape, structure, Mechanistic study and relative stability) Stereochemistry and Conformational Analysis Isomerism: Types of isomerism, Optical isomerism: elements of symmetry, Optical Activity, Molecular chirality/asymmetry, Enantiomers, Diastereoisomers, Meso compounds, Racemic mixture and resolution. Relative and absolute configuration: D/L designation, Geometric isomerism: 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).	12

IV Chemical Kinetics	11
Rate of reaction, rate equation, factors influencing the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst, Order of a reaction, integrated rate expression for zero order, first order, second and third order reaction, Half-life period of reaction, Methods of determination of order of reaction, Difference between molecularity and order of reaction, Effect of temperature on the rate of reaction – Arrhenius equation	

V	Practicals:	30
1. Titrimetric Analysis: (i) Calibration and use of apparatus (ii) Preparation of solutions of different Molarity/Normality. 2. Paper chromatographic separation of Cu^{2+} and Cd^{2+} ions. 3. To study the process of sublimation of camphor and phthalic acid. 4. To prepare a pure sample p-Bromoacetanilide from acetanilide. 5. To estimate Zn^{2+} and Mg^{2+} ions using standardized EDTA solution by Complexometric titrations. 6. Determination of surface tension of a liquid using the drop number method. 7. Determination of surface tension of a liquid using the drop weight method. 8. Determination of the viscosity of a liquid using Ostwald's viscometer.		

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 (02 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

Instructions 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.

RECOMMENDED BOOKS

1. Atkins, P., & de Paula, J. (2018). *Physical chemistry* (11th ed.). Oxford University Press.
2. Lee, J. D. (2010). *Concise inorganic chemistry* (5th ed.). Wiley India.
3. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (2006). *Inorganic chemistry: Principles of structure and reactivity* (4th ed.). Pearson Education.
4. Morrison, R. T., & Boyd, R. N. (2011). *Organic chemistry* (7th ed.). Pearson Education.
5. Solomons, T. W. G., Fryhle, C. B., & Snyder, S. A. (2016). *Organic chemistry* (12th ed.). Wiley.
6. Clayden, J., Greeves, N., & Warren, S. (2012). *Organic chemistry* (2nd ed.). Oxford University Press.
7. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2017). *Principles of physical chemistry* (47th ed.). Vishal Publishing Co.
8. Laidler, K. J. (1987). *Chemical kinetics* (3rd ed.). Harper & Row.
9. McQuarrie, D. A., & Simon, J. D. (1997). *Physical chemistry: A molecular approach*. University Science Books.
10. Vogel, A. I., Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1989). *Vogel's textbook of quantitative chemical analysis* (5th ed.). Longman.
11. Yadav, J. B. (2013). *Advanced practical physical chemistry*. Krishna Prakashan Media.
12. Rao, C. N. R., & Agarwala, U. C. (1988). *Experiments in physical chemistry*. Wiley Eastern.
13. Kumari, R., & Anand, A. (2018). *Physical chemistry laboratory manual: An interdisciplinary approach*. I.K. International Publishing House.



SKILL COURSES- CHEMISTRY

COURSE DETAILS:

Course Title	Laboratory Skills for Chemist	
Semester	Semester-I	
Course Code	SEC-1	
Course ID	240/CHE/SE/102	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

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

COURSE OBJECTIVES:

- To develop a fundamental understanding of chemistry laboratory organization, safety rules, precautions, and maintenance practices.
- To understand the classification and chemical behavior of reagents, solvents, and their role in various chemical reactions.
- To learn different concentration terms and acquire skills for accurate preparation of chemical solutions.
- To gain knowledge of principles and methodologies involved in titrimetric analysis including acid-base, redox, complexometric, and precipitation titrations.
- To build competence in quantitative analysis techniques applicable to chemical and pharmaceutical systems.

COURSE OUTCOMES:

- Demonstrate safe laboratory practices, proper handling of chemicals, and effective use and

- maintenance of laboratory apparatus.
- Classify reagents based on their chemical properties and explain their functions in different types of reactions.
- Prepare standard solutions and perform calculations using various concentration units such as molarity, normality, molality, ppm, and percentage compositions.
- Perform titrimetric analyses including acid-base, redox (permanganometry and dichrometry), and complexometric (EDTA) titrations with appropriate indicators.
- Apply quantitative analytical methods for estimation of substances, including reducing agents in pharmaceutical preparations.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Chemistry Laboratory and Laboratory Apparatus: General introduction to chemistry lab, safety rules and precautions in the chemistry laboratory, storage, ventilation, lighting, fumes, cupboard, hazards, precautions, maintenance of laboratory, cleaning of laboratory. Basic idea about equipment/apparatus, (glass apparatus, Heating apparatus, Stirrer, Oven, Melting point apparatus, Kipp's apparatus).	8
II	Laboratory Reagents and Solvents: Reagents-classification of reagents according to their action (i) acids (ii) bases (iii) salts (iv) complexing agents (v) oxidizing and reducing agents (vi) precipitating agents (vii) chelating agents. Chemical reactions, Quantification of Reducing Agents in Pharmaceuticals.	7
III	Concentration Terms and Solution Preparation: Percentage (Mass, Volume, Mass-Volume), Mole percent, Mole fraction, Mass ppm, ppb, g/L, molarity, normality, molality; Solution Preparation: Solutions, components of a solution, types of solution, solubility, calculation of masses and volumes for preparation of solutions.	8
IV	Introduction to Titrimetry: Definition of titrant, tetrad, analyte, indicator, equivalent point and end point, Primary and Secondary Standards, Types of Titrations, Acid-Base Titrations with titration curves, indicators, Redox Titration : Permanganometry and dichrometry, Complexometric Titration: Formation of metal ion complex, EDTA titration, A basic idea of	8

	Precipitation titrations.	
V	Practical: 1. Preparation of standard solutions: Preparing molar (M), molal (m) and normal (N) solutions of primary and secondary standards (e.g. Sodium Hydroxide, Sodium Carbonate, Oxalic Acid) 2. Standardization of HCl solution using Sodium Carbonate as primary standard 3. To determine the melting point of given solid compound. 4. To determine the boiling point of the liquid components. 5. Calibration of laboratory apparatus. 6. Test the solubility of compounds like (NaCl, Sugar, Napthalene) in polar solvent(water) and organic solvent (ethanol, ether). 7. Effect of impurities on melting point- mixed melting point of two unknown organic compound. 8. Purification of organic compounds by crystallization using the following solvents (water, alcohol, alcohol-water).	30

COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

Bachelor of Science with Major in Chemistry
Skill Enhancement Course
(To be effective from Session 2026-27)

SKILL COURSES- CHEMISTRY

COURSE DETAILS:

Course Title	Food Safety and Quality Assurance	
Semester	Semester-I	
Course Code	SEC-1	
Course ID	240/CHE/SE/103	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

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

COURSE OBJECTIVES:

- To understand the principles, techniques, and importance of food preservation, processing, and packaging.
- To gain knowledge of food analysis, nutritional value of foods, and their relationship with human health.
- To study food additives, their chemical nature, functions, safety aspects, and applications in food systems.
- To understand food adulteration, its types, methods, and impact on food quality and human health.
- To develop skills for detection of common food adulterants and understand regulatory policies and quality control measures.

COURSE OUTCOMES:

- Explain various methods of food preservation, processing, and packaging, and evaluate their significance in extending shelf life.
- Analyze the nutritional composition of food and explain its relationship with health and food safety principles.
- Describe different food additives, their chemical nature, functions, and assess their safety in food applications.
- Identify types and methods of food adulteration and evaluate their adverse effects on food quality and human health.
- Detect common adulterants in food products such as milk, oils, spices, and pulses using standard techniques and interpret their health impacts.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Food Preservation: Introduction, techniques of food preservation, physical and chemical methods, the importance of food preservation, type of food preservatives and food packing. , idea about food processing. Food analysis-Need and its importance, Nutritional value of foods, relationship between Nutrition and health, Principle of food safety and quality assurance.	8
II	Food Additive: Introduction, Need and safety aspects, chemical nature and its function. Application of chemical and Instrumental methods in food analysis. Adulterants in Food Products: Introduction, definition, types of food adulteration, methods of food adulteration, effect of food adulteration	8
III	Adulterants, Detection and their impact on health: Adulterants in milk and milk products, oil, fats, mustard oil and, sweetening agents (natural and artificial), Common Adulterants and their impact on health, Detection and their testing techniques, Policy and control measures. Case Study : A study on status of milk adulterants.	7

IV	Adulteration in spices and pulses: Turmeric powder, coriander powder, Chili Powder, food grains and their products, (gram flour etc.) Common Adulterants and their impact on health, Detection and their testing techniques, Policy and control measures. Case Study : Adulteration in Indian spices: An alarming concern and silent health hazard.	7
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V	Practical: 1. To Analyze the acidity of milk and milk products by using pH strip. 2. To determine the total solids content in given milk sample. 3. To determine total nitrogen (Kjeldahl method) content in given milk sample. 4. To determine urea, starch and Detergent adulteration in given milk sample. 5. To analyze the protein in given milk sample (Biuret test). 6. To determine the saponification value and iodine value of given oil sample. 7. Identification of adulterants in some common food items: Edible oil, Ghee, Milk, Coffee powder, Chili powder, Turmeric powder, Coriander powder, Asafoetida and Pulses. 8. To measure the thermal decomposition of baking soda.	30
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COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

Internal Assessment: 05 Marks	• Class Participation: 2.5 • Seminar/Lab record/Demonstration: 2.5 marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instructions 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.

RECOMMENDED BOOKS

1. J. Scott Smith & Y. H. Hui, 2004, *Food Processing : Principles and Applications*, Blackwell Publishing, 1st Edition.
2. William H. Butz and Henry J. Noebels, 1961, *Instrumental Methods for the Analysis of Food Additives*, Interscience Publishers.
3. M. Kalia and S. Sood, 1996, *Food Preservation and Processing*, Kalyani Publishers.
4. F.D. Snell & F.M. Biffen, 1964, *Commercial methods of analysis*, chemical publishing.
5. S. K. Sharma, 2012, *Food Preservation: Physical and Chemical Methods*, New India Publishing Agency.
6. A. L. Branen, P.M. Davidson, 2001, *Food Additives*, CRC press, 2nd Edition.
7. Titus A. M., 2012, *The Chemistry of Food Additives and Preservatives*, Wiley Blackwell.
8. V. Khader, 2001, *Textbook of Food Science and Technology*, Indian Council of Agricultural Research New Delhi.
9. S. Ghodke, 2023, *Food Adulteration and Hygiene*, AG Publishing House.
10. D.D. Patange, D.K. Kamble and R.C. Ranveer, 2018, *A Text Book on Milk and Milk Products*, Narendra Publishing House.
11. R. Sharma, Y.S. Rajput, A.K. Barui, L. Naik, 2012, *Detection of Adulterants in Milk - A Laboratory Manual*, ICAR - NDRI.
12. M.L. Nollé, J. Ahmad, 2023, *Analysis of Food Spices: Identification and Authentication*, CRC Press.

Case Study:

1. Kumar, A., Goyal, S.K., Pradhan, R.C. and Goyal, R.K. (2015). *A study on status of milk adulterants using in Milk of District Varanasi*. South Asian J. Food Technol. Environ. 1(2): 140-143.
2. Sahoo, J. P., & Samal, K. C. (2024). Adulteration in Indian spices: An alarming concern and a silent health hazard. *Int. J. Adulteration*, 8, e4ijad3043.

Bachelor of Science with Major in Chemistry
MDC Course
(To be effective from Session 2026-27)

Course Title	Knowledge of Rasayan-I	
Semester	Semester-I	
Course Code	MDC-I	
Course ID	240/CHE/MD/103	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 4	
Lectures (L) Hours per Week: 2	Practicals (P) Hours per Week: 2

COURSE OBJECTIVES:

- Learn about the blocks, columns, periods of periodic table and variations in properties along them.
- Understand the atomic structure and subatomic particles.
- Learn about the different shapes of orbitals and rules for filling of electrons in different orbitals.
- Explore the different types of chemical bonding and their effects on properties of chemical compounds.
- Enhance the knowledge of essential elements for life and about the basics of Physical Chemistry.

COURSE OUTCOMES:

- Students will learn the periodic table and trends of different properties along periods and columns.
- Students will understand the structure of atoms and their sub-atomic particles.
- Students will gain knowledge about shapes of orbitals and different rules of electron filling.
- Students will have idea to recognize the different types of chemical bonds and their effects on properties of compounds.
- Students will have understanding of essential Inorganic elements and also basics of Physical Chemistry.

DETAILED CONTENT OF COURSE:



Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Periodic properties: Significance of periods and groups. Introduction of s, p, d and f blocks. Study of different periodic trends: Atomic radii, Ionisation energy, electron affinity, electronegativity, oxidation state. Elementary introduction of atomic structure, Quantum numbers, shapes of orbitals (s,p,d,f) and electron filling rules.	8
II	Chemical bonding: Definition, types of chemical bonds: Ionic bond, Covalent bond, Coordinate bond, Metallic bond, Hydrogen bond and types, Vander Waals interactions.	7
III	Everyday Inorganic compounds: Study of essential elements to life Carbon (C), Hydrogen (H), Nitrogen (N), Oxygen (O), Phosphorus (P), Sulfur (S). Importance of water (H ₂ O), table salt (NaCl), baking soda (NaHCO ₃), cleaning agent like ammonia (NH ₃), CaCO ₃ , gypsum, plaster of Paris.	8
IV	General of Physical Chemistry: States of matter: Solid (Crystalline and Amorphous), liquid (Polar and non-polar), gas (Ideal and non-ideal) (physical properties only), definition of different types of concentrations: molarity, molality, mole fraction, normality. Introduction of electrolytes and their types.	7
V	Practicals 1. To prepare 1 molar and 1 normal standard solutions of NaCl/Na ₂ CO ₃ . 2. To prepare a sample of calcium carbonate by double displacement reaction of CaCl ₂ and Na ₂ CO ₃ . 3. To demonstrate Hydrogen bonding between filter paper and water vs alcohol through paper chromatography of ink. 4. To study simple tests (wet paper tearing) to see Hydrogen bonding interact with solid structure like Cellulose. 5. To study the conversion of gypsum into Plaster of Paris and hardening of POP. 6. To study the process of sublimation of Camphor and Phthalic acid.	30

COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

Internal Assessment: 05 Marks	• Class Participation: 2.5 Marks • Seminar/Lab record/Demonstration: 2.5 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.

RECOMMENDED BOOKS

1. Johnson, W.R.; (2007), **Atomic Structure Theory**, (1st ed.)Springer.
2. Kumar, A.; Rathore, V.S.; Chauhan, S.; (2024), **Atomic Structure & Bonding**, S. Dinesh & Co.
3. Greenwood, N.N.; Earnshaw, A.; (1997), **Chemistry of the Elements**, (2nd ed.) Elsevier.

4. Sharma, R.K.; (2007), **Chemistry of Chemical Bonding**, (1st ed.) Discovery Publishing House.
5. Kumar, J.; Sethi, S.; Shewate, V.T.; Mohan, V.; (2025), **Inorganic Chemistry: Structure, Bonding and Applications**, A.G. Publishing house.
6. Huheey, J.E.; Keiter, E.A.; Keiter, R.L.; Medhi, O.K.; (2022) **Inorganic Chemistry: Principles of Structure and Reactivity**, (4th ed.) Pearson Education.
7. Atkins, P.; Paula, J.D.; Keeler, J.; (2018), **Atkins Physical Chemistry**, (11th ed.) Oxford University Press.
8. Puri, B.R.; Sharma, L.R.; Pathania, M.S.; (2024), **Principles of Physical Chemistry**, Vishal Publishing Co.

H

Bachelor of Science with Major in Chemistry
MDC Course
(To be Effective from Session 2026-27)

Course Title	Chemistry for Competitive Exams- I
Semester	Semester-1
Course Code	MDC-1
Course ID	240/CHE/MD/102
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)
Total Marks	75
Marks Distribution	Theory External: 35 Theory Internal: 15 Practical External: 20 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 4	
Lectures (L) Hours per Week: 2	Practicals (P) Hours per Week: 2

COURSE OBJECTIVES:

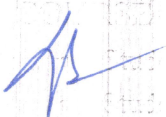
- Understand the atomic structure and subatomic particles.
- Explore trends in periodic table using different properties.
- Explore different types of chemical bonding and their effects on properties of chemical compounds.
- Learn about acids, bases, and the importance of pH in biological and industrial processes.
- Enhance practical laboratory skills through hands-on experiments.

COURSE OUTCOMES:

- Students will understand the structure of atoms and their sub-atomic particles.
- Students will get knowledge about the periodic table and different properties of elements.
- Students will have idea to recognize the different types of chemical bonds and their effects on properties of compounds.
- Learn about the importance of acids, bases, and pH in various biological and industrial processes.
- Personal experience of students will rise by doing experiments with their own hands.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30



Unit	Topics	Contact Hours
I	Atomic structure: Elementary introduction of atomic structure, subatomic particles (electron, proton, neutron), Historical atomic models: Thomson's model, Rutherford model, Bohr's model, Quantum numbers, shapes of orbitals (s,p,d,f), electron filling rules. Isotopes, Isobars and Isotones (definitions).	8
II	Periodic properties and laws: Periodic table, Introduction of s, p, d and f blocks, periodic trends and properties: atomic and ionic radii, ionisation energy, electron gain enthalpy, electronegativity, oxidation state, colour, metallic character, magnetic and catalytic properties, ability to form complexes.	8
III	Chemical bonding: Definition, types of chemical bonds: Ionic bond, Covalent bond, Coordinate bond, Metallic bond, Hydrogen bond and types, Vander Waals' interactions Factors affecting the bonding, Comparison between covalent and ionic bond.	7
IV	Acids and Bases: Definition, types and properties of acids and bases. Different theories: Arrhenius theory, Bronsted-Lowry concept, Lewis theory. Concept of pH, Common daily life examples.	7
V	Practicals 1. Determine the nature of common household substances (e.g., vinegar, baking soda solution, lemon juice, milk, soap solution) whether acidic or alkaline using different indicators/ pH paper. 2. To study the neutralization reaction between a strong acid and a strong base through titration and determine the concentration of an acid solution. 3. Find the normality of an unknown HCl solution by titrating it against a 0.1 N NaOH solution. 4. Prepare 1 molar and 1 normal standard solution of NaCl/ Na_2CO_3. 5. To study the process of sublimation of camphor and phthalic acid. 6. To determine the pH of given acid and base using pH meter.	30

COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

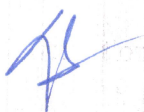
Internal Assessment: 05 Marks	• Class Participation: 2.5 Marks • Seminar/Lab record/Demonstration: 2.5 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instructions for End Term Theory Exam:

The Examiner is required to set nine questions in total, selecting two questions from each section. Question-I will be a compulsory question consisting short answer type questions covering all the units of the syllabus. All questions should carry equal marks.

RECOMMENDED BOOKS

1. Johnson, W.R.; (2007), **Atomic Structure Theory**, (1st ed.) Springer.
2. Kumar, A.; Rathore, V.S.; Chauhan, S.; (2024), **Atomic Structure & Bonding**, S. Dinesh & Co.
3. Greenwood, N.N.; Earnshaw, A.; (1997), **Chemistry of the Elements**, (2nd ed.) Elsevier.



4. Sharma, R.K.; (2007), **Chemistry of Chemical Bonding**, Discovery Publishing House.
5. Kumar, J.; Sethi, S.; Shewate, V.T.; Mohan, V.; (2025), **Inorganic Chemistry: Structure, Bonding and Applications**, A.G. Publishing house.
6. Lew, K.; (2008), **Acids and Bases**, (1st ed.) Chelsea House Publications.
7. Cox, B.G.; (2013), **Acids and Bases: Solvent Effects on Acid-Base Strength**, (1st ed.) Oxford University Press.
8. Huheey, J.E.; Keiter, E.A.; Keiter, R.L.; Medhi, O.K.; (2022) **Inorganic Chemistry: Principles of Structure and Reactivity**, (4th ed.) Pearson Education.

h

Bachelor of Science with Major in Chemistry
Minor Course
(To be effective from Session 2026-27)
MINOR COURSE-CHEMISTRY

COURSE DETAILS:

Course Title	Basic Chemistry II
Semester	Semester-2
Course Code	MIC-2
Course ID	240/CHE/MI/202
Total Credits	02 (Lecture: 02, Tutorial: 0, Practical: 0)
Total Marks	50
Marks Distribution	Theory External: 35 Theory Internal: 15 Practical External: -- Practical Internal: --

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 2	
Lectures (L) Hours per Week: 02	Practical (P) Hours per Week: --

COURSE OBJECTIVES:

- Introduce students to the fundamentals of alkanes, alkenes, and aromatic hydrocarbons.
- To study kinetic theory of gases, real gas behavior.
- To study properties of liquids such as surface tension and viscosity.
- To understand the concept of chemical kinetics with emphasis on rate constant and order of reaction.

COURSE OUTCOMES:

Upon completing this course, students will be able to:

- Understand nomenclature, classification and chemical reactions of hydrocarbons.
- Learn about role of temperature and pressure to establish the state of gases and describe the concept of critical constants of real gases.
- To determine and interpret properties like surface tension and viscosity along with their temperature dependence.
- Get the knowledge of concepts of rates of chemical reactions and its application in determination of order up to 2nd order reaction.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Hydrocarbons Alkanes - IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, methods of formation (with special reference to Wurtz reaction and Kolbe reaction). Alkenes Nomenclature of alkenes, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, Saytzeff rule, electrophilic and free radical additions, Markownikoff's and anti- Markownikoff's rule. Aromaticity: Aromaticity and Huckel rule – aromatic, non-aromatic and anti-aromatic. A general concept of molecular orbital picture of benzene.	8
II	Gaseous State Kinetic theory of gases, ideal gas laws based on kinetic theory, collision in a gas: mean free path, collision diameter, collision number. Behavior of real gases - the Van der Waal's equation. Critical phenomena - critical constants of a gas and their determination, the Van der Waal's equation and critical state.	8
III	Liquid State Surface tension of liquids - capillary action, experimental determination of surface tension, temperature effect on surface tension. Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.	7
IV	Chemical Kinetics Rate of reaction, factors affecting the rate of a reaction – concentration, temperature, pressure, solvent, light, catalyst, law of mass action and rate law. Order of a reaction, integrated rate expression for zero order, first order, pseudo first order and second order. Half Life period of a reaction. Difference between "Order and Molecularity" of chemical reactions. Determination of the rate constant and order of reaction from kinetic data. Effect of temperature on rate of reaction: Arrhenius equation.	7

COURSE EVALUATION METHODS

Theory Exams: Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/ Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Instructions 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.

RECOMMENDED BOOKS

1. Morrison, R. N. and Boyd, R. N. (2010), *Organic Chemistry*, (7th ed.) Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Puri, B. R.; Sharma, L. R. and Pathania, M. S. (2020) *Principles of Physical Chemistry*, (49th ed.) Vishal Publishing Co.
3. Kheterpal, S. C. (2019), *Physical Chemistry*, Vol 1, (18th ed.) Pradeep Publications.
4. Dhawan S. N. (2019), *Organic Chemistry*, Vol 1, (18th ed.) Pradeep Publications.
5. Kapoor, K. L. (2015), *A Textbook of Physical Chemistry*, Vol 1, (6th ed.), McGraw Hill Education.
6. Atkins, P.W. and Paula, J.de. (2014), *Atkin's Physical Chemistry*, (10th ed.), Oxford University Press.
7. Kapoor, K. L. (2015), *A Textbook of Physical Chemistry*, Vol 1, (6th ed.), McGraw Hill Education.



Bachelor of Science with Major in Chemistry
MDC Course
(To be effective from Session 2026-27)

Course Title	Knowledge of Rasayan-II	
Semester	Semester-II	
Course Code	MDC-2	
Course ID	240/CHE/MD/203	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 4	
Lectures (L) Hours per Week: 2	Practicals (P) Hours per Week: 2

COURSE OBJECTIVES:

- Understand the chemical processes involved in food processing and preservation.
- Explore the types and side effects of adulteration of different foods in everyday life.
- Study about the different types of pollutions and their impact on human health.
- Enhance the knowledge of students about the soil factors, BOD and COD.
- Enhance the laboratory skills through observation and hands-on experiments.

COURSE OUTCOMES:

- Students will understand the different types of chemical processes involved in food processing and preservation.
- Students will come to know the different types and side effects of adulteration of foods in daily life.
- Knowledge about the different types of pollutions and their impact on human health and environment.
- Students will get knowledge about the different factors of soil, contamination of water, BOD and COD.
- Laboratory skills of the students will improve through the observations and hands-on experiments.

DETAILED CONTENT OF COURSE:



• **Theory Syllabus: Total Contact Hours: 30**

Unit	Topics	Contact Hours
I	Food processing and adulteration: Introduction of food processing, Food processing techniques (pasteurization, sterilization, blanching, freezing, drying and irradiation), definition and types of food adulteration, adulteration in common foods.	8
II	Food preservatives: Types: natural and synthetic preservatives, Properties of food preservatives, preservation process of pickles and jams, artificial sweeteners.	8
III	Environmental Chemistry: Cause and effects of air pollution, water pollution, soil pollution and industrial pollution, greenhouse effect and global warming.	7
IV	Factors of Chemical Science in Geographical Components: Acid mine drainage (AMD), cause, consequences and remedial solution, role of pH measurement in soil, Contamination factors of water: Biological oxygen demand (BOD), Chemical oxygen demand (COD).	7
V	Practicals 1. To purify the impure sample of benzoic acid by recrystallization. 2. To synthesize an ester by reacting a carboxylic acid with an alcohol in the presence of acid catalyst. 3. To prepare 1 molar and 1 normal standard solutions of NaCl. 4. To find the normality of an unknown HCl solution by titrating it against a 0.1 N NaOH solution. 5. To determine the BOD of given water sample. 6. Determine the dissolved oxygen in the given sample of water.	30

COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

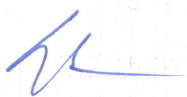
Internal Assessment: 05 Marks	• Class Participation: 2.5 Marks • Seminar/Lab record/Demonstration: 2.5 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

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.

RECOMMENDED BOOKS

1. Sinha, S.P.; (2012), **Principles of Food Processing**, (1st ed.) Adhyayan Publishers and Distributors.
2. Sivasankar, B.; (2002), **Food Processing and Preservation**, (1st ed.) Prentice Hall India Learning Private Limited.
3. Ram, P.M.; Ram, V.R.; (2023), **Food Adulteration**, Lap Lambert Academic Publishing.
4. Sharma, G.K.; Xavier, J.R.; Singh, A.; (2024), **Food Adulterants and Contaminants**, New India Publishing Agency.
5. Subramanian, V.; (2020), **Environmental Chemistry**, Dreamtech Press.



6. Girard, J.; (2013), **Principles of Environmental Chemistry**, (2nd ed.) Jones & Bartlett Learning.

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Bachelor of Science with Major in Chemistry
MDC Course
(To be effective from Session 2026-27)

Course Title	Chemistry for Competitive Exams-II	
Semester	Semester-II	
Course Code	MDC-2	
Course ID	240/CHE/MD/202	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 4	
Lectures (L) Hours per Week: 2	Practicals (P) Hours per Week: 2

COURSE OBJECTIVES:

- Investigate the different types of states of matter and factors affecting.
- Learn about metals, non-metals, different types of alloys and their applications.
- Understand the basics of carbon compounds and oxygen containing functional groups.
- Learn about the different types of metallurgical process and corrosion.
- Enhance the knowledge about handling of chemicals, glass apparatus and instruments in labs through experiments.

COURSE OUTCOMES:

- Students will be able to describe the properties of solid, liquid and gases.
- Students will have knowledge of different metals, non-metals, alloys and their applications.
- Students will understand the basics of carbon compounds and important functional groups.
- Students will understand the process of extraction of metal and prevention of corrosion.
- Importance of safety and careful handling of chemicals, instruments in labs will be well understood.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30



Unit	Topics	Contact Hours
I	States of matter: Introduction of different states of matter. Gas: Introduction to ideal and real gases. Difference between ideal and real gases. Introduction of different laws: Boyle's law, Charles' law, Gay Lussac's law, Avogadro's law (no derivations). Liquid: Introduction and effect of temperature and pressure on surface tension, viscosity, vapour pressure (no derivations), Polar and non-polar liquids. Solid: Types of solids: Amorphous solid and Crystalline solid (Brief description and differences).	8
II	Metals, non-metals and alloys: Definition and physical properties of metals, non-metals and alloys. Discuss different types of alloys and common examples (Steel, Stainless Steel, Brass, Bronze, Duralumin, Alnico).	7
III	Metallurgy and corrosion: General modes of occurrence of metals in nature, Extraction of metals- Crushing and grinding, Concentration of ores (gravity separation and froth flotation), Conversion to metal oxide (calcination and roasting), Reduction of metal oxide, Refining of metal (brief description) Corrosion: Definition, Cause of corrosion, Effect and factors of corrosion, Electrochemical mechanism of rusting of iron, Prevention of corrosion	8
IV	Carbon and its compounds: Introduction and types of hydrocarbons, study of carbon compounds and catenation, Introduction of important Oxygen containing functional groups: alcohol, aldehyde, ketone, carboxylic acid, ester, ether (only physical properties, exclude chemical properties).	7

V	Practicals	30
	1. To synthesize an ester by reacting a carboxylic acid with an alcohol in the presence of acid catalyst. 2. To purify the impure sample of benzoic acid by recrystallization. 3. To detect the presence of starch in a sample (potato/rice/bread) by using a potassium iodide-iodine solution as an indicator. 4. To compare the viscosity of various liquids (honey, dish soap, milk, water) by pouring race method. 5. To observe the existence of surface tension and demonstrate how soap reduce it (By needle floating method). 6. To study the effect of air, moisture and electrolytes (NaCl) on rusting of iron.	

COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

Internal Assessment: 05 Marks	• Class Participation: 2.5 Marks • Seminar/Lab record/Demonstration: 2.5 Marks
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External Assessment: 20 Marks (03 Hours)	● End Term Practical Exam: 10 Marks ● Lab record: 05 Marks ● Viva Voce: 05 Marks
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Instructions for End Term Theory Exam:

The Examiner is required 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.

RECOMMENDED BOOKS

1. Goodstein, D.L.; (2014), **States of Matter**, Dover Publications.
2. Powell, P.; Timms, P.L.; (1974), **The Chemistry of the Non-metals**, Chapman & Hall.
3. Walker, D.; (2007), **Metals and Non-metals (Core Chemistry)**, Evans Brothers Ltd.
4. Schweitzer, P.A.; (2009), **Fundamentals of Corrosion**, (2nd ed.) CRC Press.
5. Dieter, G.E.; (1986), **Mechanical Metallurgy**, (3rd ed.) McGraw-Hill.
6. Atkins, P.; Paula, J.D.; Keeler, J.; (2018), **Atkins Physical Chemistry**, (11th ed.) Oxford University Press.
7. Puri, B.R.; Sharma, L.R.; Pathania, M.S.; (2024), **Principles of Physical Chemistry**, Vishal Publishing Co.
8. Morrison, R.T.; Boyd, R.N.; (2010), **Organic Chemistry**, (7th ed.) Pearson Education.
9. Patai, S.; (2010), **Chemistry of Functional Groups**, Wiley Online Library.

Bachelor of Science with Major in Chemistry
Skill Enhancement Course
(To be effective from Session 2026-27)

SKILL COURSES- CHEMISTRY

COURSE DETAILS:

Course Title	Soil and Water Analysis	
Semester	Semester-II	
Course Code	SEC-2	
Course ID	240/CHE/SE/202	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

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

COURSE OBJECTIVES:

- To impart fundamental knowledge of environmental pollution, types of chemical pollutants including e-waste, their toxic effects on ecosystems, and global environmental issues.
- To explain the concept of water quality, physical and chemical properties of water, sources of water for domestic use, and conventional treatment methods.
- To train students in standard analytical methods for determination of key water quality parameters as per BIS and WHO specifications, including BOD, COD, DO, hardness, alkalinity, TDS, and industrial water treatment techniques.
- To develop understanding of soil composition, physico-chemical properties, soil profile, ion exchange phenomena, essential nutrients, and standard analytical techniques for soil testing relevant to fertility and environmental assessment.

COURSE OUTCOMES:

- Students will be able to classify different types of pollutants and chemical pollutants, assess toxic effects of e-waste, and chemistry behind global warming, greenhouse effect, acid rain, water footprint.
- Students will be able to evaluate properties of water, differentiate municipal and drinking water sources, and describe chemical principles of water treatment processes for domestic purposes.
- Students will be able to perform quantitative determination of water quality parameters, drinking water standards, and softening techniques.
- Students will be able to describe soil texture, structure, inorganic and organic components, soil profile and soil organisms, and estimate essential macronutrients and micronutrients.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Pollution: Climate change: The study of chemical processes that contribute to climate processes, contribute to climate change such as the release of green house gases and the change in the carbon cycle. Environmental toxicology: The study of the effects of chemical pollutants on living organism, including humans. Environmental fate and transport: The study of how chemical pollutants move through the environment and how they are transformed by chemical and biological processes. Environmental remediation: the study of methods for cleaning up contaminated environments. Concept of carbon foot print and water footprint.	8
II	Water Analysis: Source of water (surface, ground, sea water). Introduction to water quality, its parameters, physical and chemical properties, chemical analysis of water (principal of volumetric and instrumental methods), water for domestic purpose: Municipal water/ Drinking water standards, water treatment (primary, secondary, tertiary), Disinfection method (chlorination, UV, ozonation).	7
III	Important water quality parameters as per BIS and WHO and methods for their determination: turbidity, color, taste, pH, acidity, alkalinity, metals, hardness of water (Temporary and permanent), dissolved oxygen, standard for drinking water as per WHO specifications. Determination of BOD, COD, DO, alkalinity, total hardness of drinking water, TDS, Boiler feed water, Desalination of Brackish water, Water softening technique (ion exchange, reverse osmosis, lime softening, zeolite process).	8
IV	Soil Analysis: Introduction, soil sampling technique, characteristics (soil texture and structure), composition (inorganic, organic components, water and air in soil), soil organisms, soil profile, soil reactions (cation and anion exchange reactions), essential elements (macronutrients and micronutrients) only qualitative description.	7

V	Practicals: 1. To determine the pH and electrical conductivity of water. 2. To determine the pH of given soil sample. 3. To determine the Biochemical Oxygen Demand (BOD) of given water sample. 4. To determine the Chemical Oxygen Demand (COD) of given water sample. 5. To determine the Dissolved oxygen (DO) of given water sample. 6. To analyze the soil nutrients (N, P, K) content in given soil sample. 7. To determine the residual chlorine in a given water sample. 8. Determination of hardness of water by complexometric titration. 9. To analyze the turbidity and color of a given water sample.	30
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COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/ Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (03 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

Internal Assessment: 05 Marks	• Class Participation: 2.5 Marks • Seminar/Lab record/Demonstration: 2.5 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.

RECOMMENDED BOOKS

1. Jain, P. C., & Jain, M. (2022). *Engineering chemistry* (17th ed.). Dhanpat Rai Publishing Co.
2. Baird, C., & Cann, M. (2022). *Environmental chemistry* (6th ed.). W.H. Freeman and Company.
3. Essington, M. E. (2015). *Soil and water chemistry: An integrative approach* (2nd ed.). CRC Press.
4. Das, D. K. (2020). *Soil science* (4th ed.). Kalyani Publishers.
5. American Water Works Association. (2021). *Water quality and treatment: A handbook on drinking water* (7th ed.). McGraw Hill.
6. Goel, P. K. (2019). *Water and wastewater analysis* (1st ed.). Kalyani Publishers.
7. Baruah, T. C., & Barthakur, H. P. (2017). *A textbook of soil analysis* (1st ed.). Vikas Publishing House.
8. Sparks, D. L. (Ed.). (2020). *Methods of soil analysis, part 3: Chemical methods* (2nd ed.). Soil Science Society of America.

SKILL COURSES- CHEMISTRY

COURSE DETAILS:

Course Title	Chemistry and its impact on daily life	
Semester	Semester-II	
Course Code	SEC-2	
Course ID	240/CHE/SE/203	
Total Credits	03 (Lecture: 02, Tutorial: 0, Practical: 01)	
Total Marks	75	
Marks Distribution	Theory External: 35 Practical External: 20	Theory Internal: 15 Practical Internal: 05

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

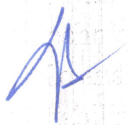
Total Hours per Week: 4		
Lectures (L) Hours per Week: 2	Practical (P) Hours per Week: 2	

COURSE OBJECTIVES:

- To understand the chemical composition, function, and regulatory aspects of cosmetics and analyze hazards associated with cosmetic ingredients.
- To understand the chemistry of soaps, detergents, bleaching agents and dry cleaning, including surfactant action and environmental impact.
- To describe nutritional aspects of food and the role of food additives, preservatives and processing techniques in food chemistry.
- To analyze the chemistry of swimming pool sanitation, including chlorination, pH control, stabilizers and safe handling of chlorine.

COURSE OUTCOMES:

- After completing this course, students will be able to identify major and minor constituents of cosmetics and assess their safety.
- Students will be able to differentiate between soaps and synthetic detergents, and explain the mechanism of bleaching agents and enzymatic cleaners.
- Students will be able to classify food additives by function and detect common preservatives, colors, and adulterants using chemical tests.
- Students will be able to maintain swimming pool water quality by testing free chlorine, pH and apply chlorine handling guidelines safely.



DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	Chemistry in Cosmetics: Analysis of cosmetics- Major and minor constituents and their functions. Composition of skin creams, hand lotions, nail paints, lip balm, conditioners, sunscreen. Different kinds of Shampoos- antidandruff, anti-lice, herbal and baby shampoos. Hazards of cosmetics (skin allergies, banned ingredients, BIS standards) Perfumes- Requirement of a good perfume, composition, classification of perfumery materials. Regulatory aspects- FSSAI CDSCO guidelines for cosmetics in India.	8
II	Chemistry in Laundry: Soaps (bathing and washing) - Formulation, Ingredient, saponification process, synthetic surfactants and their mode of action. Bleaching agents - chlorine, sodium perborate, hydrogen peroxide- composition and their mode of action. Detergents- Anionic, Cationic and Non-ionic classification, surfactants action. Dry cleaning- solvent used, environment impact, green alternative. Stain remover-Enzymatic cleaner and their action on protein/oil stain.	8
III	Chemistry in Kitchen: Nutritional value of food (carbohydrate, protein, fat, vitamin, mineral). Food processing (canning, freezing, dehydration, pasteurization) and food preservations (physical method). Food additives –Define sweeteners (saccharin, aspartame, sucralose, stevia), preservatives (Sodium carbonate, Sodium benzoate, Sorbic acid), Flavoring agents, Emulsifiers, Acidulants (citric acid, tartaric acid), Coloring matter (Natural vs synthetic -brilliant blue FCF, fast green FCF).	7
IV	Chemistry in Swimming pool: Purpose and importance of chlorination, effect of pH, chlorine stabilizers, super chlorination, effect of sunlight on chlorine, side effects of chlorine on skin and preventive measures, water quality testing and monitoring, alternative of chlorine, guideline of chlorine handling.	7

V	Practical: 1. Preparation of Cold cream. 2. Prepare cosmetic formulations: for Talcum powder. 3. Prepare cosmetic formulations: for Lip balm. 4. Prepare cosmetic formulations: for Nail polish remover. 5. Prepare cosmetic formulations: for Shampoo. 6. Preparation of Hand Wash and soap by Saponification process. 7. Quality testing of soap: assess pH, alkalinity. 8. Determine chlorine content in swimming pool water via titration. 9. To study the effect of sunlight on pH of chlorinated water of swimming pool 10. pH testing of common kitchen items (lemon juice, baking soda solution, vinegar, milk etc.) 11. Identification of synthetic food colors by Paper chromatography. 12. Qualitative analysis of Food preservatives – Test for benzoic acid in soft drinks, sulphites in dried fruits	30
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COURSE EVALUATION METHODS

Theory Exams:

Total Marks: 50 (External: 35 + Internal: 15)

Internal Assessment: 15 Marks	• Class Participation: 05 Marks • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 05 Marks
External Assessment: 35 Marks (03 Hours)	• End Term Exam: 35 Marks

Practical Exam:

Total Marks: 25 (External: 20 + Internal: 5)

Internal Assessment: 05 Marks	• Class Participation: 2.5 Marks • Seminar/Lab record/Demonstration: 2.5 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.

RECOMMENDED BOOKS

1. Jain, P. C., & Jain, M. (2022). *Engineering chemistry* (17th ed.). Dhanpat Rai Publishing Co.
2. Rao, C. V. (2021). *Applied chemistry* (2nd ed.). New Age International Publishers.
3. Srilakshmi, B. (2023). *Food science* (8th ed.). New Age International Publishers.
4. Panda, H. (2020). *Textbook of cosmetic formulations* (3rd ed.). Asia Pacific Business Press Inc.
5. Brown, T. L., LeMay, H. E., & Bursten, B. E. (2023). *Chemistry: The central science* (15th ed.). Pearson Education.
6. Rosen, M. R. (2021). *Harry's cosmetology* (9th ed.). Chemical Publishing Company.
7. Fennema, O. R., Damodaran, S., & Parkin, K. L. (2017). *Food chemistry* (5th ed.). CRC Press.
8. Lowry, R. W. (2022). *Pool & spa operator handbook* (3rd ed.). Lowry Consulting Group.
9. Sharma, B. K. (2020). *Industrial chemistry* (19th ed.). Krishna Prakashan Media Pvt. Ltd.
10. Goyal, R. K. (2019). *Food chemistry and nutrition* (1st ed.). S. Chand Publishing.



Core Course (Multidisciplinary)

COURSE DETAILS:

Course Title	Chemistry-II
Semester	Semester-II
Course Code	240/CHEP/CC/201
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	Practical (P) Hours per Week: 2

COURSE OBJECTIVES

- To develop an understanding of advanced chemical bonding concepts, including metallic bonding, intermolecular forces, and ionic bonding with polarization effects.
- To introduce the preparation, properties, and reaction mechanisms of hydrocarbons (alkanes, alkenes, and alkynes).
- To explain the kinetic theory of gases and the behavior of ideal and real gases, along with the physical properties of liquids.
- To provide fundamental knowledge of solid-state chemistry, including crystal structures, X-ray diffraction, and defects in solids.
- To develop practical skills in organic synthesis, qualitative analysis, and quantitative volumetric analysis using standard laboratory techniques.

COURSE OUTCOMES

- Analyze different types of chemical bonding, including metallic bonding, intermolecular forces, and ionic bonding, and explain polarization effects using Fajan's rules.
- Apply concepts of organic chemistry to explain the preparation, mechanisms, and reactivity of alkanes, alkenes, and alkynes.
- Apply kinetic theory to evaluate gaseous behavior and analyze physical properties of liquids such as surface tension and viscosity under varying conditions.

- Interpret crystal structures and solid-state properties using concepts of unit cells, X-ray diffraction, lattice energy, and crystal defects.
- Perform laboratory experiments involving organic synthesis, detection of elements, and redox titrations, and analyze results to determine composition and purity of chemical substances.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	Chemical Bonding: II Metallic Bonding: 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. Ionic Bonding: Lattice energy, Born-Haber cycle, solvation energy, and ionic radii Covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules and consequences of polarization.	11
II	Hydrocarbons: Alkanes: General introduction alkanes, general methods of preparation: Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids, Reactivity and Mechanisms: Free radical substitutions, halogenation: relative reactivity and selectivity. Alkenes: Synthesis, 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.	12
III	Gaseous and Liquid State Kinetic molecular model of a gas; collision frequency; collision diameter; mean free path and viscosity of gases; Maxwell-Boltzmann distribution: molecular velocities, law of equipartition of energy, molecular basis of heat capacities; Ideal gases, and deviations from ideal gas behaviour, van der Waals equation of state. critical state, law of corresponding states. Physical properties of Liquid, vapour pressure, surface tension and viscosity and their applications; effect of concentration of solutes on surface tension and viscosity; effect of temperature on viscosity and surface tension of liquid	11

IV	Solid State Unit Cells, Miller indices, crystal systems and Bravais Lattices, elementary applications of vectors to crystal systems; X-ray diffraction, Bragg's Law, Structure of NaCl, CsCl, and KCl ; Close packing in metals and metal compounds, semiconductors, insulators; Defects in crystals, stoichiometric defects; Non stoichiometric defects; lattice energy; isomorphism.	11
V	Practical's: 1. Preparation of Iodoform from Acetone. 2. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements). 3. Preparation of Dibenzalacetone from acetone and benzaldehyde. 4. To prepare 2,4-DNP derivative of Benzophenone/Acetophenone. 5. To determine the percentage purity of the given sample of Mohr's salt, 22 gm of which are dissolved per litre of the given solution. Provided N/20 Potassium permanganate solution. 6. To determine the percentage of the Ferrous ions in a given sample of Mohr's salt, 20 gm of which are dissolved per litre of the given solution. Provided N/20 Potassium permanganate solution. 7. To determine the number of molecules of water of crystallization in the given sample of Oxalic Acid. Provided N/20 Potassium permanganate solution. 8. To determine the percentage of Fe (II) ions in the given sample of Mohr's salt by titrating it with $K_2Cr_2O_7$ using (diphenylamine/ N-phenyl anthranilic acid) as indicator. 9. To determine the value of x in the given sample of Mohr's salt, 19.5 gm of which have been dissolved per litre of the water, by titrating it with N/20 $K_2Cr_2O_7$	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 (02 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.

RECOMMENDED BOOKS

1. Atkins, P., & de Paula, J. (2018). *Physical chemistry* (11th ed.). Oxford University Press.
2. Levine, I. N. (2014). *Physical chemistry* (6th ed.). McGraw-Hill Education.
3. Lee, J. D. (2010). *Concise inorganic chemistry* (5th ed.). Wiley India.
4. Huheey, J. E., Keiter, E. A., & Keiter, R. L. (2006). *Inorganic chemistry: Principles of structure and reactivity* (4th ed.). Pearson Education.
5. Morrison, R. T., & Boyd, R. N. (2011). *Organic chemistry* (7th ed.). Pearson Education.
6. Clayden, J., Greeves, N., & Warren, S. (2012). *Organic chemistry* (2nd ed.). Oxford University Press.
7. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2017). *Principles of physical chemistry* (47th ed.). Vishal Publishing Co.
8. Bahl, B. S., Tuli, G. D., & Bahl, A. (2016). *Essentials of physical chemistry*. S. Chand Publishing.
9. Madan, R. L. (2014). *Physical chemistry*. S. Chand Publishing.
10. Gurdeep, R. (2014). *Advanced physical chemistry*. Pragati Prakashan.
11. Singh, J. (2013). *Organic chemistry*. Pragati Prakashan.
12. Finar, I. L. (2011). *Organic chemistry* (Vols. 1–2). Pearson Education.
13. Vogel, A. I., Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1989). *Vogel's textbook of quantitative chemical analysis* (5th ed.). Longman.
14. Yadav, J. B. (2013). *Advanced practical physical chemistry*. Krishna Prakashan Media.
15. Rao, C. N. R., & Agarwala, U. C. (1988). *Experiments in physical chemistry*. Wiley Eastern.

Bachelor of Science with Major in Chemistry
Core Course
(To be effective from Session 2026-27)

COURSE DETAILS:

Course Title	Inorganic Chemistry-II
Semester	Semester-2
Course Code	240/CHE/CC/201
Course ID	CC-A4
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 comprehensive understanding of advanced topics in chemical bonding.
- To study different properties of s block elements and noble gases.
- To explore the chemistry of boron and carbon families, including their structures, properties, and reactivity.
- To understand the electronic configuration, periodic properties, and oxides/oxyacids of nitrogen family elements.
- To study the oxoacids and properties of oxygen and halogen families.
- Foster critical thinking skills to evaluate and apply chemical principles in various contexts such as inorganic synthesis, analysis, and materials science.
- Communicate scientific concepts effectively through written reports and oral presentations based on experimental findings and theoretical knowledge.

COURSE OUTCOMES:

- Students will be able to apply molecular orbital theory to predict bond order, bond length, and bond energy in homonuclear and heteronuclear diatomic molecules.
- Analyze multiple bonding (σ and π bond approach), covalent character in ionic compounds, and the consequences of polarization using Fajan's rules.
- Understand the inert pair effect, diagonal relationship, and complex formation tendencies of s-

block elements. Describe the structure, bonding, and synthesis of fluorides, oxides, and oxyfluorides of noble gases

- Explain the chemistry of the boron family, including diborane's electron-deficient bonding, borazine's structure, and Lewis acidity of boron trihalides.
- Describe the catenation, allotropes of carbon (diamond, graphite, fullerenes), and the structure of silicates and silicones.
- Compare the structure and acidic strength of oxides and oxyacids of nitrogen and phosphorus and explain allotropes of phosphorus.
- Explain the structure and properties of oxoacids, hydrogen peroxides and interhalogen compounds.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	Chemical Bonding-III Molecular orbital theory of homonuclear and heteronuclear diatomic molecules (N_2 , O_2 , C_2 , CO , and NO), bond order, bond length and bond energy. Multiple bonding (σ and π bond approach) and bond lengths, Covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules and consequences of polarization.	10
II	Chemistry of s-block elements and Noble gases Comparative study, Diagonal relationship and anomalous behaviour of the first member of each group. Solvation and Complex formation tendency of s-block elements, crown ethers and cryptates. Silent features of hydrides. Occurrence, inertness and use of noble gases, structure, bonding, synthesis and properties of fluorides, oxides and oxyfluorides of Xe.	11
III	Chemistry of Boron family Brief comparative study of group 13 to 17, Boron family (13th group): Electronic configuration, periodic properties, inert pair effect and diagonal relationship. Diborane: Preparation, properties and structure (as an example of electron-deficient compound and multicenter bonding), Borazine chemical properties and structure, relative strength of trihalide of Boron as Lewis acids, the structure of aluminium (III) chloride. Chemistry of Carbon family Electronic configuration and periodic properties, Catenation and allotropes of carbon (diamond, graphite and fullerenes), Carbides, structural aspects of fluorocarbons, silicates and silicones, preparation, properties and uses.	12

IV	Chemistry of Nitrogen family Electronic configuration and periodic properties, allotropes of phosphorus (white, red and black P), Oxides: Structure of oxides of nitrogen and phosphorus, Oxyacids: Structure and relative acidic strength of oxy acids of nitrogen and phosphorus. Chemistry of oxygen family and halogens Oxygen family (16th group): Oxy acids of sulphur — structure and acidic strength, Hydrogen Peroxide properties and uses. Halogen family (17th group): Interhalogen compounds (their properties and structures), Hydra and oxy acids of chlorine — structure and comparison of acid strength, cationic nature of Iodine.	12
V	Practical Redox Titrations: - To determine the percentage purity of the given sample of Mohr's salt, 22 gm of which are dissolved per liter of the given solution. Provided N/20 Potassium permanganate solution. - To determine the percentage of the Ferrous ions in a given sample of Mohr's salt, 20 gm of which are dissolved per litre of the given solution. Provided N/20 Potassium permanganate solution. - To determine the number of molecules of water of crystallization in the given sample of Oxalic Acid. Provided N/20 Potassium permanganate solution. - To determine the percentage of Fe (II) ions in the given sample of Mohr's salt by titrating it with $K_2Cr_2O_7$ using (diphenylamine/ <i>N</i>-phenyl anthranilic acid) as indicator. - To determine the value of x in the given sample of Mohr's salt, 19.5 gm of which have been dissolved per litre of the water, by titrating it with N/20 $K_2Cr_2O_7$ 2. Paper Chromatography of following metal ions - Cu (II) and Cd (II) metal ions - Ni (II) and Co (II) metal ions	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
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External Assessment: 50 Marks (02 Hours)	• End Term Exam: 50 Marks
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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

Instructions 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.

SUGGESTED BOOKS:

- Kumar, A.; (2021), **Chemistry of the Main Group Elements**, Aaryush Education.
- Patania, V.B.; (2007), **Periodic Classification of Elements**, Campus Books International.
- Johnson, W.R.; (2007), **Atomic Structure Theory**, Springer.
- Kumar, A.; Rathore, V.S.; Chauhan, S.; (2024), **Atomic Structure & Bonding**, S. Dinesh & Co.
- Greenwood, N.N.; Earnshaw, A.; (1997), **Chemistry of the Elements**, Elsevier.
- Sharma, R.K.; (2007), **Chemistry of Chemical Bonding**, Discovery Publishing House.
- Kumar, J.; Sethi, S.; Shewate, V.T.; Mohan, V.; (2025), **Inorganic Chemistry: Structure, Bonding and Applications**, A.G. Publishing house.
- Huheey, J.E.; Keiter, E.A.; Keiter, R.L.; Medhi, O.K.; (2022) **Inorganic Chemistry: Principles of Structure and Reactivity**, Pearson Education.

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Bachelor of Science with Major Chemistry
Core Course
To be Effective from Session 2026-27

Course Title	Physical Chemistry-II	
Semester	Semester-II	
Course Code	240/CHE/CC/203	
Course ID	CC-A6	
Level of Course		
Total Credits	04 (Lecture: 03, Tutorial: 0, Practical: 01)	
Total Marks	100	
Marks Distribution	Theory External: 50 Practical External: 20	Theory Internal: 25 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 develop a fundamental understanding of the behavior of gases, including gas laws, kinetic theory, and deviations from ideal behavior.
- To explain molecular motion and statistical distribution in gases and relate them to macroscopic properties such as viscosity and collision phenomena.
- To introduce the structural and physical properties of liquids and liquid crystals along with their measurement techniques.
- To impart knowledge of solid-state chemistry, crystallography, and methods for determination of crystal structures.
- To develop analytical and experimental skills using pH-metric and conductometric techniques for quantitative chemical analysis.

COURSE OUTCOMES

- Apply gas laws, kinetic theory, and equations of state to analyze and predict the behavior of ideal and real gaseous systems.
- Analyze molecular motion and statistical distribution in gases and correlate them with macroscopic properties such as viscosity, diffusion, and collision phenomena.
- Evaluate the physical properties of liquids and explain the structure, classification, and applications of liquid crystals using appropriate measurement techniques.
- Interpret crystal structures and explain solid-state properties using crystallographic principles and X-ray diffraction methods.
- Perform quantitative chemical analysis using pH-metric and conductometric techniques to determine dissociation constants (pKa) and composition of mixtures.



DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	Gaseous State-I Elementary treatment of gas laws, Real and ideal gases, Boyle's temperature, gas constant R and its numerical values critical constants and their determination, Kinetic gas equation and its derivation, cause of deviation of gases from ideal behaviour, Vander waal's equation and its deviation under different PV isotherms of real gases, isotherms of carbon dioxide, continuity of states, Relationship between critical constants and vander waal's constants, law of corresponding states, Reduced equation of state, Law of corresponding states, liquification of gases (based on Joule- Thomson effect), Degree of freedom of motion and principle of equipartition of energy.	11
II	Gaseous State-II: Kinetic Molecular theory of gases, Maxwell's distribution law of velocities and energies, Root mean square velocity, average velocity and most probable velocity and their relationship, Mean free path and its derivation, Collision diameter, Collision number and collision frequency, viscosity of gases. Relationship between mean free path and coefficient of viscosity, calculation of molecular diameter from coefficient of viscosity.	12
III	Liquid State and liquid Crystals: Structure of liquids, Properties of liquids-surface tension, refractive index, viscosity, vapour pressure and optical rotation and their measurement. Liquid crystals: Difference between solids, liquids and liquid crystals, types of liquid crystals, Applications of liquid crystals.	11
IV	Solid State: Crystalline and amorphous solids, Type of unit cells, Laws of crystallography law of constancy of interfacial angles, law of rational indices, law of symmetry, Symmetry of elements in crystals, Seven crystal system, Bravais Lattice Bragg's equation and its derivation, X-ray diffraction of crystals. Determination of crystal structure of NaCl, KCl, CsCl.	11

V	Practical 1. pH metric titration of strong acid vs. strong base. 2. pH metric titration of weak acid vs. weak base. 3. pH metric titration of weak acid vs. strong base. 4. pH metric titration of a mixture of acids vs. base. 5. Determination of pKa of weak acids using pH metric titration. 6. Conductometric titration of strong acid vs. strong base. 7. Conductometric titration of weak acid vs. weak base. 8. Conductometric titration of weak acid vs. strong base. 9. Conductometric titration of mixture of acids vs. base. 10. Conductometric titration of a salt solution with silver nitrate.	30
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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 (02 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

Instructions 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.

Recommended Textbooks:

Theory:

1. Atkins, P., & de Paula, J. (2018). *Physical chemistry* (11th ed.). Oxford University Press.
2. Pauling, L. (1988). *General chemistry* (3rd ed.). Dover Publications.
3. Puri, B. R., Sharma, L. R., & Pathania, M. S. (2017). *Principles of physical chemistry* (47th ed.). Vishal Publishing Co.
4. Levine, I. N. (2014). *Physical chemistry* (6th ed.). McGraw-Hill Education.
5. Bahl, B. S., Tuli, G. D., & Bahl, A. (2016). *Essentials of physical chemistry* (S. Chand ed.). S. Chand Publishing.
6. Rajaram, J., & Kuriacose, J. C. (2014). *Modern physical chemistry*. S. Chand Publishing.

Practical:

1. Yadav, J. B. (2013). *Advanced practical physical chemistry*. Krishna Prakashan Media.
2. Rao, C. N. R., & Agarwala, U. C. (1988). *Experiments in physical chemistry*. Wiley Eastern.
3. Jeffery, G. H., Bassett, J., Mendham, J., & Denney, R. C. (1989). *Vogel's textbook of quantitative chemical analysis* (5th ed.). Longman.

