Department of Chemistry
B.Sc Physical Sciences
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

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

Department of Chemistry
B.Sc Physical Sciences
SCHEME UG A2: UNDERGRADUATE PROGRAMME (SINGLE MAJOR)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Total Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A1	**Inorganic Chemistry-I**		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

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)														
VAC-2	One from Pool								2					50

Department of Chemistry
B.Sc Physical Sciences

Total Credits									24					600

Semester 3

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A7	**Inorganic Chemistry-III**		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
Minor/ Vocational Course(s)														
MIC-3	One from Pool		3		2	3		1	4	25	50	5	20	100
Multidisciplinary Course(s)														
MDC-3	One from Pool		2		2	2		1	3	15	35	5	20	75
Ability Enhancement Course(s)														
AEC-3	One from Pool		2			2			2	15	35			50
Skill Enhancement Course(s)														
SEC-3	One from Pool		2		2	2		1	3	15	35	5	20	75
Total Credits									24					600

Semester 4

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A10	**Inorganic Chemistry-IV**		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
Minor/ Vocational Course(s)														
MIC-4	One from Pool		3		2	3		1	4	25	50	5	20	100
Ability Enhancement Course(s)														
AEC-4	One from Pool		2			2			2	15	35			50
Value-added Course(s)														
VAC-3	One from Pool		2			2			2	15	35			50

Department of Chemistry
B.Sc Physical Sciences

Total Credits									20					500

Semester 5

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
Core Course(s)														
CC-A13	Inorganic Chemistry-V		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)														
MIC-5	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)														
MIC-6	One from Pool		3		2	3		1	4	25	50	5	20	100
MIC-7	One from Pool		3		2	3		1	4	25	50	5	20	100
Total Credits									20					500

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

Department of Chemistry
B.Sc Physical Sciences
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	L	T (theory)	P (prac.)	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MDC-1	Introductory Chemistry-I		2		2	2		1	3	15	35	05	20	75

Semester 2

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

Semester 3

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

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

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

Semester 1

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

Semester 2

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

Semester 3

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

Department of Chemistry
B.Sc Physical Sciences

	biomolecules-II													

Semester 5

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

Semester 6

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
MIC-6	Agriculture Chemistry		3		2	3		1	4	25	50	5	20	100
MIC-7	Green Laboratory Practices Or Maintenance of laboratory instruments		3		2	3		1	4	25	50	5	20	100

Department of Chemistry
B.Sc Physical Sciences
SKILL ENHANCEMENT COURSE FROM THE DEPARTMENT FOR POOL OF THE COURSES IN THE UNIVERSITY

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

Semester 1

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

Semester 2

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

Semester 3

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

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) Envioronmental Studies as value added course)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
VAC-1	Human Values and Ethics Or Environmental Studies		2						2	15	35			50

Semester 2

Department of Chemistry
B.Sc Physical Sciences

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

Semester 4

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

Department of Chemistry
B.Sc Physical Sciences

ABILITY ENHANCEMENT COURSE FROM THE DEPARTMENT FOR POOL OF THE COURSES IN THE UNIVERSITY

(These courses are offered by department of Indian and Foreign Languages for students of other departments/same department and leads to enhancement in the ability of learn Regional and foreign languages)

Semester 1

Course Code	Course Title	Course ID	L	T	P	L	T	P	Credits	MARKS				
			(Hrs)			Credits				TI	TE	PI	PE	Total
AEC-1	English Language and Communication: Level-1 OR हिंदी भाषा एव. सम्प्रेषण-1 OR संस्कृत भाषा एव. सम्प्रेषण-1								2					50

Semester 2

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

Department of Chemistry
B.Sc Physical Sciences
Semester 3

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

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

VOCATION COURSE FROM THE DEPARTMENT FOR POOL OF THE COURSES IN THE UNIVERSITY

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

Semester 4

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

Department of Chemistry
B.Sc Physical Sciences

	Cosmetics and Perfumes													

Semester 5

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

Semester 6

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

UG chemistry 240|CHE|CC301

COURSE DETAILS:

Course Title	**Inorganic Chemistry-III**
Semester	**Semester-3**
Course Code	**CC-A7**
Course ID	
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 study the physical properties, chemical reactions, and applications of non-aqueous solvents.
- 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 introduce bioinorganic chemistry, focusing on trace metals, toxicity, and the biological role of essential metal ions.
- To develop analytical skills in gravimetric estimation of metal ions.
- To synthesize and characterize inorganic coordination complexes in the laboratory.

COURSE OUTCOMES

After completing this course, students will be able to

- Analyze the physical properties, self-ionization, and chemical reactions of non-aqueous solvents like NH_3, H_2SO_4, and SO_2.
- 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.
- Evaluate the biological role and toxicity of essential and trace elements, including the structure-function relationship of metalloporphyrins like hemoglobin.

- Perform gravimetric analysis and prepare coordination complexes demonstrating experimental precision and analytical reasoning.

DETAILED CONTENT OF COURSE:

Theory & Practical Syllabus:

Total Contact Hours: 45 (Theory) + 30 (Practical)

Unit	Topics	Contact Hours
I	**Non-aqueous solvents** Physical properties of solvents, Properties and uses of non-aqueous solvents, Self ionization, physical properties and chemical reactions in non-aqueous solvents (liquid NH_3, liquid H_2SO_4, liquid SO_2, liquid BrF_5).	11
II	**Chemistry of Boron family** 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.	11
III	**Chemistry of Carbon family** Electronic configuration and periodic properties, Catenation and allotropes of carbon (diamond, graphite and fullerenes), Carbides, structural aspects of silicates and silicones, preparation, properties and uses. **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.	12
IV	**Bioinorganic Chemistry** Essentials and trace elements present in biological systems, Excess and deficiency of some trace metals (Fe, Cu and Zn). Toxicity of metal ions (Hg, Pb, Cd and As), Use of chelating agents in medicine, platinum metal complexes as anticancer agents and their probable mechanism, Biological role of Na^+, K^+, Ca^{+2}, Mg^{+2}, Fe^{+2} ions. Metalloporphyrins with special reference to hemoglobin and myoglobin. Cooperative effect, Bohr effect; photosynthesis, nitrogen fixation.	11
V	Practical Gravimetric Analysis: 1. Estimation of nickel (II) using Dimethylglyoxime (DMG). 2. Estimation of copper as CuSCN 3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$. 4. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminiumoxinate). Inorganic Preparations: 1. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$	30

	2. Cis and trans $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate (III) 3. Tetraamminecarbonatocobalt (III) ion 4. Potassium tris(oxalate)ferrate(III)	

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 (02 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 of short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

SUGGESTED BOOKS

1. "Non-Aqueous Solvents" by J.J. Lagowski
2. "Inorganic Chemistry: Principles of Structure and Reactivity" by James E. Huheey, Ellen A. Keiter, and Richard L. Keiter
3. "Inorganic Chemistry" by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr
4. "Concise Inorganic Chemistry" by J.D. Lee
5. "Inorganic Chemistry" by Catherine Housecroft and Alan G. Sharpe
6. "Bioinorganic Chemistry" by Ajai Kumar
7. "Quantitative Inorganic Analysis" by A. I. Vogel
8. "Advanced Practical Inorganic Chemistry" by R.D. Madan
9. "Experimental Inorganic Chemistry" by A.K. Srivastava and C.P. Sharma

UG chemistry 240/CHE/CC302

COURSE DETAILS:

Course Title	**Organic Chemistry-III**	
Semester	**Semester-3**	
Course Code	**CC-A8**	
Course ID		
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: 5	
Lectures (L) Hours per Week: 3	**Practicals (P) Hours per Week: 2**

COURSE OBJECTIVES:

- Develop a thorough understanding of the structure, properties, and reactions of organic compounds studied in the course, UV absorption spectroscopy, and IR absorption spectroscopy in organic chemistry.
- Gain proficiency in explaining reaction mechanisms involved in the preparation and transformations of carboxylic acids, acid derivatives, amines, diazonium salts, and reactions studied under UV and IR spectroscopy.
- Acquire practical skills in the analysis and interpretation of UV and IR spectra for structure elucidation of organic compounds.
- Learn practical synthetic methods for preparing various organic compounds studied in the course.
- Understand the applications of these organic compounds and spectroscopic techniques in research and industrial settings.

COURSE OUTCOMES:

- Students will be able to define and apply concepts related to carboxylic acids, their derivatives, amines, diazonium salts, and spectroscopic methods (UV and IR spectroscopy) in organic chemistry.
- Analyze and differentiate between mechanisms involved in the preparation and reactions of carboxylic acids, acid derivatives, amines, diazonium salts, and spectroscopic transitions (UV and IR absorption).
- Perform and explain synthetic transformations including preparation methods and reactions of carboxylic acids, acid derivatives, amines, and diazonium salts as studied in the course.

- Interpret UV and IR spectra to determine structural features and functional groups in organic compounds, applying principles like Woodward-Fieser rules and effect of conjugation.
- Apply acquired knowledge to solve problems related to synthesis, reaction mechanisms, and spectroscopic analysis of organic compounds in a variety of contexts, including practical laboratory settings.

DETAILED CONTENT OF COURSE:

Theory & Practical Syllabus:
Total Contact Hours: 45 (Theory) + 30 (Practical)

Unit	Topics	Contact Hours
I	**Carboxylic acids and their derivatives** General methods, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids. Preparation and reactions of acid chlorides, anhydrides, esters and amides. Comparative study of nucleophilic substitution at acyl group, interconversion of acid derivatives by nucleophilic acyl substitution. Mechanism of acidic and basic hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hoffmann-bromamide degradation and Curtius rearrangement.	11
II	**Nitrogen Containing Functional Groups-I** **Amines**: Introduction, classification, chirality in amines (pyramidal inversion), importance and general methods of preparation. Properties: Physical properties, Basicity of amines: Effect of substituents, solvent and steric effects. Distinction between Primary, secondary and tertiary amines using Hinsberg's method and nitrous acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Gabriel Phthalimide synthesis, Hoffmann-Bromamide reaction, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction and Cope elimination. **Diazonium Salts**: Preparation and synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds. Coupling reactions of diazonium salts (preparation of azo dyes).	12
III	**Ultraviolet (UV) absorption spectroscopy** Absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones, Woodward-Fieser rules, calculation of λmax of simple conjugated dienes and α,β-unsaturated ketones (upto one DB extension). Application of Woodward Rules for calculation of λ_{max} for the following systems: α, β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular, Extended	11

	conjugated systems (aldehydes, ketones and dienes), distinction between cis and trans isomers by UV.	
IV	**Infrared (IR) absorption spectroscopy** Fundamental and non-fundamental molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, IR absorption positions of O, N and S containing functional groups, and interpretation of IR spectra of simple organic compounds, Hydrocarbons (saturated and unsaturated), hydroxy compounds, aldehydes, ketones, eseters, anhydrides, amides, amines and nitro compounds. Effect of H-bonding, conjugation, resonance and ring size on IR absorptions, Applications of IR spectroscopy in structure elucidation of organic compounds.	**11**
V	**Practical** 1. *S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid). 2. Estimation of aniline by any one of the following methods: a) Acetylation b) Bromate-bromide method. 3. Preparation of azodye with aniline and 2-Naphthol 4. Hydrolysis of amides and esters 5. Identification of simple organic compounds by IR and NMR spectroscopy (Spectra to be provided).	**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 (02 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

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

SUGGESTED BOOKS

1. Morrison, R. T.; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1 & 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Solomons, T. W. G.; Fryhle, C. B. ; Snyder, S. A. (2016),Organic Chemistry, 12th Edition, Wiley.
4. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P. (2013),Organic Chemistry, Oxford University Press.
5. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
6. Pavia, D.L. Introduction to Spectroscopy, Cengage learning (India) Pvt. Ltd.
7. Silverstein, R. M.; Webster, F. X.; Kiemle, D. J.; Bryce, D.L. (2014), Spectrometric Identification of Organic Compounds, Wiley.
8. Mann, F. G.; Saunders, B. C. (2009), Practical Organic Chemistry, Pearson Education.
9. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012), Vogel's Textbook of Practical Organic Chemistry, Pearson.
10. Ahluwalia, V.K.; Aggarwal, R. (2004), Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.

240/CHE/CC303

UG chemistry

COURSE DETAILS:

Course Title	**Physical Chemistry-III**
Semester	**Semester-III**
Course Code	**CC-A9**
Course ID	
Total Credits	**04 (Lecture: 03, Tutorial: 0, Practical: 01)**
Total Marks	**100**
Marks Distribution	**Theory External: 50** **Theory Internal: 25** **Practical External: 20** **Practical Internal: 05**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

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

Course Objectives:

- To understand the fundamental concepts of crystal structures, including unit cells and Miller indices.
- To analyze crystal systems, Bravais lattices, and their applications using vector algebra.
- To explore the principles and applications of X-ray diffraction and Bragg's Law.
- To examine the structures of common crystals and the principles of close packing in metals.
- To study the electronic properties of semiconductors and insulators, and the effects of defects in crystals.

Course Outcomes:

- Students will be able to describe unit cells, Miller indices, and the classification of crystal systems and Bravais lattices.
- Students will apply vector algebra to describe crystal geometry and properties.
- Students will understand and explain the principles of X-ray diffraction and use Bragg's Law to analyze crystal structures.
- Students will describe the structures of NaCl, CsCl, KCl, diamond, and graphite, and understand the principles of close packing in metals.
- Through practical experiments, students will develop skills in studying adsorption

isotherms, determining surface area using the BET method, and analyzing the solubility and partitioning behavior of substances.

DETAILED CONTENT OF COURSE:

Theory & Practical Syllabus:

Total Contact Hours: 45 (Theory) + 30 (Practical)

Unit	Topics	Contact Hours
I	**Solid State – I** Unit cells and Miller indices: Explaining the basic building blocks of crystal structures and the notation for crystal planes. Crystal systems and Bravais lattices: Detailing the classification of crystals into different systems and the possible lattice structures. Elementary applications of vectors to crystal systems: Using vector algebra to describe crystal geometry and properties.	11
II	**Solid State – II** X-ray diffraction: Describing the principles and techniques used to determine crystal structures. Bragg's Law: Explaining the conditions for constructive interference in crystal diffraction. Structure of NaCl, CsCl, KCl, diamond, and graphite: Analyzing the arrangement of atoms in these common crystal structures.	10
III	**Solid State – III** Close packing in metals and metal compounds: Discussing the arrangements that maximize packing efficiency. Semiconductors and insulators: Describing the electronic properties of these materials and their applications. Defects in crystals: Analyzing point defects, dislocations, and their effects on material properties, Line defects (dislocations) and plane defects (grain boundaries), Role of defects in modifying material properties. Lattice energy: Discussing the energy associated with forming a crystal lattice from individual ions or atoms. Isomorphism: Explaining the phenomenon where different compounds crystallize in the same structure.	9
IV	**Solid State - IV** **Electronic Properties of Solids** Band theory: Conductors, semiconductors, and insulators, Magnetic properties: Diamagnetism, paramagnetism, ferromagnetism, Dielectric properties and ferroelectric materials. **Thermal and Optical Properties** Heat capacity and thermal conductivity in solids, Optical properties of solids, including photoconductivity. **Advanced Topics and Applications** Superconductivity: Basic concepts and types, Applications of solid-state materials in electronics, energy storage, and catalysis.	15
V	**Practicals:**	30

	1. Study of adsorption isotherms (e.g., adsorption of acetic acid on activated charcoal). 2. Determination of the surface area of a solid using BET adsorption method. 3. Study of the effect of temperature on adsorption. 4. Adsorption of dyes on different adsorbents. 5. Determination of the partition coefficient of a substance between two immiscible liquids. 6. Determination of the solubility product of a sparingly soluble salt. 7. Determination of the distribution coefficient of benzoic acid between water and benzene. 8. Study of the solubility of gases in liquids. 9. Determination of the common ion effect on solubility.	

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 (02 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

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

Recommended Textbooks:

Theory:

1. Solid State Chemistry and Its Applications – A.R. West, Wiley.
2. Introduction to Solid State Physics – C. Kittel, Wiley.

3. Solid State Physics – N.W. Ashcroft and N.D. Mermin, Cengage Learning.
4. Principles of the Solid State – H.V. Keer, New Age International.
5. Concise Inorganic Chemistry – J.D. Lee, Wiley.
6. Introduction to Solids – L.V. Azaroff, McGraw Hill.
7. Solid State Physics: Structure and Properties of Materials – M.A. Wahab, Narosa Publishing.
8. Introduction to X-ray Crystallography – Anthony R. Easterling, Springer.
9. Solid State Physics – S.O. Pillai, New Age International.
10. Understanding Solids: The Science of Materials – Richard J.D. Tilley, Wiley.
11. Principles of Physical Chemistry – Puri, Sharma, and Pathania, Vishal Publishing Co.

Practical:

1. "Experiments in Physical Chemistry" by C. N. R. Rao and U. C. Agarwala
2. "Practical Physical Chemistry" by B.S. Bahl and Arun Bahl

UG chemistry 240/CHE/MD39

Course Title	**Introductory Chemistry-III**
Semester	**Semester-III**
Course Code	**MDC-3**
Course ID	
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 chemical processes involved in soap and detergent production.
- Learn about acids, bases, and the importance of pH in biological and industrial processes.
- Explore the types and significance of chemical reactions in everyday life.
- Investigate the basic concepts and applications of nanotechnology.
- Enhance practical laboratory skills through hands-on experiments.

COURSE OUTCOMES:

- Students will understand the chemical processes involved in soap and detergent production and their environmental implications.
- Learn about the importance of acids, bases, and pH in various biological and industrial processes.
- Recognize the importance of chemical safety and handling, particularly in household and laboratory settings.
- Explore the impact of nanotechnology on modern science and its potential to revolutionize various fields.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	**Soaps and Detergents:** Introduction, General Structure, Saponification, classification, cleansing action of soap, manufacturing process, additives,	8

	fillers, flavours, bleaching agents and enzymes used in commercial detergents, environmental hazards.	
II	**Acids, Bases, and pH:** Definition and examples, pH scale and its importance in daily life (e.g., acid rain, digestion), acidity of common beverages and household products, pH in gardening and soil health. **Solutions and Solubility:** Types of solutions and their everyday examples (e.g., saltwater, sugar solution), factors affecting solubility, dissolving medicines and vitamins, solubility of gases in liquids (e.g., carbonated drinks)	**8**
III	**Chemical Reactions:** Types of chemical reactions (synthesis, decomposition, combustion, etc.), balancing simple chemical equations, everyday examples of chemical reactions (e.g., cooking, rusting, combustion of fuels), safety precautions during chemical handling.	**7**
IV	**Nanotechnology:** Basic concepts and applications in various fields (medicine, electronics), use in everyday products (sunscreens, cosmetics, textiles), environmental impact and safety concerns, future potential and innovations, role in improving food quality and shelf life, use in water purification.	**7**
V	**Practicals** 1. To prepare soap from a fat or oil through the process of saponification. 2. To investigate the cleansing action of soap in hard and soft water 3. Determine the pH of common household substances (e.g., vinegar, baking soda solution, lemon juice, milk, soap solution) to understand their acidic or alkaline nature using pH paper/pH meter. 4. To study the neutralization reaction between an acid and a base through titration and determine the concentration of an acid solution. 5. To study decomposition reaction in sugar/calcium carbonate 6. Formation of Iron nanoparticle (Magnetite)	**30**

COURSE EVALUATION METHODS

Theory Exams:

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

Internal Assessment: 15 Marks	• Class Participation: NIL • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 10 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: NIL • Seminar/Lab record/Demonstration: 05 Marks
External Assessment: 20 Marks (03 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

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

RECOMMENDED BOOKS

1. **Engineering Chemistry, Jain and Jain, Darpat Rai Publication, 17th Ed., 2015.**
2. **Industrial Chemistry, B.K. Sharma, Krishna Prakashan Publishers, 2012**
3. **Chemistry: The Central Science** by Theodore L. Brown, H. Eugene LeMay Jr., Bruce E. Bursten, Catherine J. Murphy, and Patrick M. Woodward (Pearson)
4. **Environmental Chemistry** by Colin Baird and Michael Cann (W. H. Freeman)
5. **Handbook of Detergents, Part F: Production** by Michael S. Showell (CRC Press)
6. **Laboratory Techniques in Organic Chemistry** by Jerry R. Mohrig, David Alberg, Gretchen Hofmeister, and Paul F. Schatz (W. H. Freeman)
7. **Experimental Organic Chemistry: A Miniscale and Microscale Approach** by John C. Gilbert and Stephen F. Martin (Cengage Learning)
8. **Introduction to Nanoscience and Nanotechnology** by Chris Binns (Wiley)
9. **Chemistry for Changing Times** by John W. Hill and Doris K. Kolb (Pearson)
10. Hand Sanitizer, Easy Guide to Make Anti-Bacterial and Anti-Viral Homemade Hand Sanitizers by H. Miller
11. Chemistry in Daily Life: Third Edition Paperback – 1 January 2012 by Singh K.

240|CHE|MI301
UG chemistry

COURSE DETAILS:

Course Title	**Chemistry of Biomolecules-I**
Semester	**Semester-III**
Course Code	**MIC-3**
Course ID	
Total Credits	**04 (Lecture: 02, Tutorial: 0, Practical: 02)**
Total Marks	**100**
Marks Distribution	**Theory External: 35** **Theory Internal: 15** **Practical External: 35** **Practical Internal: 15**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 6	
Lectures (L) Hours per Week: 2	**Practicals (P) Hours per Week: 4**

COURSE OBJECTIVES:

1. To understand the structure, stereochemistry, and interconversion of carbohydrates.
2. To describe the structure, functions, and deficiency-related effects of essential vitamins.
3. To explore the different types of hormones, their roles and the adverse effects of their imbalances on human body.
4. Develop hands-on skills in the identification, estimation, and isolation of biomolecules such as carbohydrates, proteins using classical and instrumental techniques.

COURSE OUTCOMES:

After completing this course, student will be able to:

1. Explain the classification, structure, and interconversion of monosaccharides and their stereochemistry.
2. Elucidate the structures of disaccharides and describe the composition and function of polysaccharides.
3. Perform basic biochemical experiments for identification, estimation, and characterization of carbohydrates, proteins, DNA.
4. Evaluate the structure, function, and nutritional importance of essential vitamins.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	**Carbohydrates-I** Occurrence, classification and their biological importance. Nomenclature, Monosaccharides, Glucose: Methods of preparation, Physical and chemical properties of D-Glucose, Osazone formation, Reduction , oxidation, open chain structure of glucose and fructose, D and L configuration of Monosaccharides, epimers, Anomers, Limitations of open structure, Ring structure of D glucose, Interconversion of aldoses and ketoses; Haworth projection formulae of Glucopyranose and fructopyranose. Killiani-Fischer synthesis and Ruff degradation.	8
II	**Carbohydrates-II** Disaccharides – Structure elucidation of maltose, lactose and sucrose. Molecular formula and their constituent units, linkages of constituent units, Polysaccharides – Elementary treatment of starch, cellulose and glycogen. Structure of amylose and amylopectin, cellulose, structure of cellulose, Reducing and Non- reducing Saccharides.	7
III	**Vitamins** Classification, Structure and functions, distribution in foods, effects of deficiency and characteristic properties of vitamins – B1 (Thiamine), B2(Riboflavin), B3 (Pantothenic acid), C (ascorbic acid), A(Retinol), D (Calciferol), E (Tocopherol)	8
IV	**Hormones** Introduction to hormones, Definition and it's characteristics, classification of hormones; on the basis of chemical nature and mechanism of hormonal action and on basis of secondary messenger group, Peptide hormones and steroid, amine hormones; Major Endocrine glands and their functions and hormones secreted by them; Hormones related Disorder.	7
V	**Practicals:** 1. Preparation of osazone of glucose, fructose and Maltose (Comparing the time of formation of the two and the shape of crystals using microscope). 2. Identification of given carbohydrates as Reducing and Non-reducing 3. Identification of given carbohydrates as Monosaccharide and Disaccharide 4. Identification of given carbohydrates as Aldose and Ketose 5. Isolation of starch from potato. 6. Qualitative tests of fructose in fruit juice. 7. Estimation of glucose by Fehling's solution. 8. Isolation and estimation of DNA using cauliflower/onion. 9. Determination of Iodine number of the given oil.	60

	10. To determine the number of different components present by using thin layer Chromatography. 11. To Estimate the ascorbic acid present in lemon juice. 12. Colorimetric estimation of glucose in the given solution (Quantitative Analysis) 13. Colorimetric estimation of total protein in the given solution (Quantitative Analysis) 14. Isolation of Caffeine from Tea. 15. Determination of total soluble sugars by ferricyanide (volumetric method)	

COURSE EVALUATION METHODS

Theory Exams:

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

Internal Assessment: 15 Marks	• Class Participation: NIL • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 10 Marks
External Assessment: 35 Marks (03 Hours)	• End Term Exam: 35 Marks

Practical Exam:

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

Internal Assessment: 15 Marks	• Class Participation: 5 • Seminar/Lab record/Demonstration: 10 Marks
External Assessment: 35 Marks (60 Hours)	• End Term Practical Exam: 20 Marks • Lab record: 05 Marks • Viva Voce: 10 Marks

Instruction for End Term Theory Exam:

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

RECOMMENDED BOOKS

1. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2006), Biochemistry. W.H. Freeman and Co.
2. Nelson, D.L.; Cox, M.M.; Lehninger, A.L. (2009), Principles of Biochemistry. W.H. Freeman and Co.

3. Murray, R.K., Granner, D.K., Mayes, P.A.; Rodwell, V.W. (2009), Harper's Illustrated Biochemistry. Lange Medical Books/McGraw-Hill.
4. Brown,T.A. (2018) Biochemistry, (First Indian addition 2018) Viva Books.
5. Satyanarayana, U.; Chakrapani, U. (2017), Fundamentals of Biochemistry, Books and Allied (P) Ltd.
6. Lehninger, A.L; Nelson, D.L; Cox, M.M. (2009), Principles of Biochemistry, W. H. Freeman.
7. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
8. Kumar, A.; Garg, S.; Garg, N. (2012), Biochemical Tests: Principles and Protocols.Viva Books.

UG chemistry 240|CHE|SE301

COURSE DETAILS:

Course Title	**Food Chemistry**
Semester	**Semester-III**
Course Code	**SEC-3**
Course ID	
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:

1. To introduce the concept of food adulteration, its definition, and various types including intentional and incidental adulterants.
2. To identify commonly adulterated foods and understand the types of adulterants like poisonous substances, cheap substitutes, and foreign matter.
3. To study the health impacts of consuming adulterated food and raise awareness of food safety.
4. To explore traditional and modern methods of detecting adulterants in food items such as milk, oil, sugar, spices, and beverages.
5. To understand the historical development of food legislation in India and the role of regulatory bodies.
6. To examine national and international food safety standards like FSSAI, CODEX, HACCP, ISO 22000, and their applications.
7. To provide hands-on experience in detecting common adulterants using simple qualitative methods in various food samples.

COURSE OUTCOMES:

After completing this course, student will be able to:

1. Define food adulteration and classify different types of adulterants commonly found in the food supply chain.
2. Identify adulterated food items through observation and basic laboratory techniques.
3. Analyze the health consequences of consuming adulterated foods and propose preventive strategies.
4. Perform simple detection tests for adulterants in food samples such as milk, oils, sugar, spices, and honey.
5. Understand the legal framework related to food adulteration and the functioning of food laboratories and regulatory agencies.
6. Interpret food safety standards and implement food safety practices like HACCP and GMP in food production and distribution.
7. Evaluate food products based on standard food testing and quality control procedures for both domestic and export markets.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 45

Unit	Topics	Contact Hours
I	**Introduction to food safety**: Definition, food safety issues, factors affecting food safety, Shelf life of Food Products, Food additives: food colours, preservatives, antimicrobial substances, flavoring, emulsifying, stabilizing agents, anticaking, antifoaming, glazing, acid regulator, chelating agent. Food contaminants of natural origin: seafood toxins, toxic amino acids and lathyrism, goitrogens, haemagglutinins, phytates, cyanogenic glycosides.	12
II	**Adulteration**-Introduction, Definition, Types; Common Foods subjected to Adulteration-Poisonous substances, foreign matter, Cheap substitutes, Spoiled parts. New adulterants in foods, Adulteration through Food Additives – Intentional and incidental. General impact on human health.	11
III	**Adulteration of Common Foods and Methods of Detection** Means of Adulteration; Methods of Detection Adulterants in the following Foods: Milk, Oil, Grain, Sugar, Spices and condiments, processed food, fruits and vegetables	11
IV	**Food safety management system** Historical Food legislation in India and amendments, Food and safety acts India. Central food laboratory, Municipal laboratories, Importance and application of food regulation in the Indian and Global context, responsibilities for maintaining and enforcing food safety FSSAI, CODEX ALIMENTARIUS, HACCP, ISO 22000 series, TQM and codes of GMP. Auditing and accreditation (BIS, QCI, AGMARK etc).	11

V	**Practical** 1. Composition and adulterant detection in the following Foods- Milk, Edible Oil, Sugar, Spices, honey, flours, Ghee Beverages- Alcoholic and Non-alcoholic. (One method of detection for each food item). 2. To detect the presence of adulterants like water, proteins, urea, formalin, detergent, sugar and starch in the milk. 3. To detect the adulteration of insoluble substance, chalk powder and washing soda in sugar. 4. To detect the adulteration of red lead salts/brick powder in chilli powder, yellow lead salts/ colored saw dust in turmeric and dried papaya seeds in pepper. 5. To detect sugar as an adulterant in honey.	**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: 5 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: NIL • Seminar/Lab record/Demonstration: 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. A first course in Food Analysis, A.Y. Sathe, New Age International (P) Ltd., 1999.

2. Food Safety, case studies – R. V. Bhat, NIN, 1992.
3. DART- Detect adulteration with rapid test. FASSAI, Imprinting Trust, assuring safe and nutritious food, Ministry of Health and Family Welfare, Government of India.
4. Rapid detection of food adulterants and contaminants Theory and Practice, S. N. Jh, 2016, Kindle Edition.
5. Domestic Tests for Food Adulterations, H. G. Christian, Forgotten books.
6. A Laboratory Manual of Food Analysis, S. Sehgal, Wiley Publishers.
7. Food Safety and Standards Act, 2006. Bare ACT, November 2020, Commercial law publishers.

UG Chemistry 24Q|CHE|MI401

COURSE DETAILS:

Course Title	**Chemistry of Biomolecules-II**
Semester	**Semester-IV**
Course Code	**MIC-4**
Course ID	
Total Credits	**04 (Lecture: 02, Tutorial: 0, Practical: 02)**
Total Marks	**100**
Marks Distribution	**Theory External: 35** **Theory Internal: 15** **Practical External: 35** **Practical Internal: 15**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

Total Hours per Week: 6	
Lectures (L) Hours per Week: 2	**Practicals (P) Hours per Week: 4**

COURSE OBJECTIVES:

1. To introduce the structure, classification, and synthesis of amino acids and peptides along with their physicochemical properties.
2. To explain the protein structure levels.
3. To understand enzyme classification, mechanisms of action, and role of cofactors and inhibitors.
4. Explore the classification, chemical properties, and analytical parameters (e.g., saponification value, iodine number) of lipids.
5. To explore Structure of Nucleic acids and their functions.

COURSE OUTCOMES:

After completing this course, student will be able to:

1. Understand the structure, classification, and ionic properties of amino acids, peptides, and proteins.
2. Analyse enzyme action mechanisms, substrate specificity, and the role of coenzymes and inhibitors.
3. Analyse the structure, properties, and chemical values of lipids and their industrial significance.
4. Analyse the structure of nucleic acid and know about their functions.
5. Perform qualitative and quantitative biochemical experiments involving amino acids, proteins, and enzymatic activity.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	**Amino Acids** Amino acids, Nomenclature and structure and classification. α-Amino Acids – Acid base Behaviour of amino acids, effect of pH on structure, Isoelectric point of Zwitterions, pKa values, isoelectric point of amino acids: electrophoresis; preparation and properties of amino acids, Reaction involving both carboxylic and amino group Synthesis of peptides using N-protecting, C-protecting and C activating groups, Solid-phase synthesis; primary, secondary and tertiary structures of proteins, Denaturation of proteins.	8
II	**Peptides and Proteins** Peptides: Nomenclature; classification of peptides, formation of peptide bond. Synthesis of peptides using N-protecting, C-protecting and C activating groups, Solid-phase synthesis Proteins: classification of proteins, conformations of protein, primary, secondary and tertiary Denaturation of proteins.	7
III	**Enzymes** Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Enzyme action, factors affecting enzyme action, coenzymes and cofactors (NAD, FAD), enzyme inhibitors and their importance.	7
IV	**Lipids:** Introduction to oils and fats; common fatty acids present in oils and fats, hydrogenation of fats and oils, Saponification value, acid value, iodine number, Reversion and rancidity **Nucleic Acids** Introduction and constituents of nucleic acids, Structure of purines and pyramidines, Nucleosides, Nucleotides, Types of Nucleic acids, Structure of Nucleic acids and their functions	8
V	**Practicals:** 1. Qualitative tests for amino acids and proteins. 2. Qualitative tests for lipids. 3. Separation and identification of mixture of amino acids by paper chromatography. 4. Isolation of casein from milk. 5. Estimation of proteins by Lowry's method. 6. Estimation of Protein by Biuret method. 7. Study of the titration curve of glycine. 8. Study of the action of salivary amylase on starch under optimum conditions. 9. Effect of temperature on the action of salivary amylase. 10. Estimation of amino acids by formal titration.	60

	11. Qualitative test for the presence of fatty acids in the given sample by titrimetric method. 12. To perform Aclorein test for detection of lipids. 13. Prepare a soap sample from the given oil/fat 14. Determination of Iodine number of the given oil. 15. Colorimetric estimation of total protein in the given solution (Quantitative Analysis)	

COURSE EVALUATION METHODS

Theory Exams:

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

Internal Assessment: 15 Marks	• Class Participation: NIL • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 10 Marks
External Assessment: 35 Marks (03 Hours)	• End Term Exam: 35 Marks

Practical Exam:

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

Internal Assessment: 15 Marks	• Class Participation: 5 • Seminar/Lab record/Demonstration: 10 Marks
External Assessment: 35 Marks (60 Hours)	• End Term Practical Exam: 20 Marks • Lab record: 05 Marks • Viva Voce: 10 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. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2006), Biochemistry. W.H. Freeman and Co.
2. Nelson, D.L.; Cox, M.M.; Lehninger, A.L. (2009), Principles of Biochemistry. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A.; Rodwell, V.W. (2009), Harper's Illustrated Biochemistry. Lange Medical Books/McGraw-Hill.
4. Brown, T.A. (2018) Biochemistry, (First Indian addition 2018) Viva Books.

5. Satyanarayana, U.; Chakrapani, U. (2017), Fundamentals of Biochemistry, Books and Allied (P) Ltd.
6. Lehninger, A.L; Nelson, D.L; Cox, M.M. (2009), Principles of Biochemistry, W. H. Freeman.
7. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
8. Kumar, A.; Garg, S.; Garg, N. (2012), Biochemical Tests: Principles and Protocols. Viva Books.

UG chemistry 240/CHE/VA401

Course Title	**Chemistry in everyday life-Soaps, detergents & dyes**
Semester	**Semester-4**
Course Code	**VAC-3**
Course ID	
Level of Course	
Total Credits	**02 (Lecture: 02, Tutorial: 0, Practical: 0)**
Total Marks	**50**
Marks Distribution	**Theory External: 35** **Theory Internal: 15** **Practical External: NA** **Practical Internal: NA**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

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

COURSE OBJECTIVES:

- Understand the historical development and evolution of soaps and detergents.
- Explain the chemical structure and properties of soaps and detergents.
- Compare and contrast traditional soap making (saponification) with modern industrial methods.
- Describe the manufacturing processes involved in making detergents, including sulfonation and sulfation.
- Identify different types of soaps and detergents and their respective applications and uses.

COURSE OUTCOMES:

- Students will be able to trace the historical timeline and major developments in the field of soaps and detergents.
- Students will analyze and interpret the chemical compositions and properties of various types of soaps and detergents.
- Students will demonstrate practical knowledge of traditional and modern manufacturing methods of soaps and detergents.
- Students will evaluate the suitability of different types of soaps and detergents for specific applications and industries.

DETAILED CONTENT OF COURSE:

Theory Syllabus: Total Contact Hours: 30

Unit	Topics	Contact Hours
I	**Introduction to Soaps and Detergents** History and Development, Chemical Structure and Properties, Manufacturing Processes: Traditional soap making (saponification) Modern industrial methods (cold process, hot process, melt and pour) Manufacturing of detergents (sulfonation and sulfation) Types of Soaps and Detergents, Applications and Uses	8
II	**Analytical and Quality Control Methods** Qualitative Analysis: Determination of pH, Foam stability and surface tension; Quantitative Analysis: Acid value, saponification value, and iodine value; Moisture content and total fatty matter; Quality Control: Standards and specifications (BIS, ASTM); Testing protocols and safety measures, Environmental and Health Aspects	8
III	**Dyes and Pigments** Fundamentals of Dyes; Introduction (Definition and classification of dyes, Natural vs synthetic dyes, Historical development; Chemical Structure and Properties: Chromophores and auxochromes; Absorption of light and color, Solubility and fastness properties	7
IV	**Synthesis and Application of Dyes** Synthesis Techniques, Synthetic Methods-Batch and continuous processes; Common intermediates and starting materials; Green Chemistry Approaches-Eco-friendly synthesis methods, Use of natural sources; Environmental Impact-Treatment of dye effluents, Regulations and sustainable practices	7

COURSE EVALUATION METHODS

Theory Exams:

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

Internal Assessment: 15 Marks	• Class Participation: NIL • Seminar/Presentation/ Assignment: 05 Marks • Mid Term Exam: 10 Marks
External Assessment: 35 Marks (02 Hours)	• End Term Exam: 35 Marks

Instruction for End-Term Theory Exam:

The Examiner is requested to set nine questions in total, selecting two questions from each section. Question-1 will be a compulsory question consisting short answer type questions

covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

RECOMMENDED BOOKS

- "Soaps and Detergents: Manufacture, Properties, and Formulation" by Luis Spitz (Wiley)
- "Chemistry and Technology of Surfactants" by Richard J. Farn (Blackwell Publishing)
- "Analytical Chemistry: Principles and Techniques" by H.D. Belitz, W. Grosch, P. Schieberle (Springer)
- "Instrumental Methods of Chemical Analysis" by B.K. Sharma (Goel Publishing House)
- "The Chemistry of Synthetic Dyes" by K. Venkataraman (Academic Press)
- "Organic Chemistry of Synthetic High Polymers" by G. R. Koshti (New Age International Publishers)

UG chemistry 240|CHE|CC401

COURSE DETAILS:

Course Title	**Physical Chemistry-IV**
Semester	**Semester-IV**
Course Code	**CC-A12**
Course ID	
Total Credits	**04 (Lecture: 03, Tutorial: 0, Practical: 01)**
Total Marks	**100**
Marks Distribution	**Theory External: 50** **Theory Internal: 25** **Practical External: 20** **Practical Internal: 05**

COURSE CURRICULUM DELIVERY WEEKLY DISTRIBUTION:

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

COURSE OBJECTIVES:

- To introduce fundamental thermodynamic principles and provide mathematical treatment of thermodynamic relationships.
- To explain the First and Second Laws of Thermodynamics, and their applications in energy conservation and entropy analysis.
- To develop an understanding of thermodynamic functions such as enthalpy, entropy, Gibbs free energy, and their interrelationships.
- To familiarize students with chemical equilibria concepts, equilibrium constants, and the effects of external parameters on equilibrium.
- To introduce the laws of photochemistry, their applications, and the significance of photochemical reactions in chemical and biological systems.

COURSE OUTCOMES:

- Apply mathematical methods to analyze thermodynamic properties and processes involving exact and inexact differentials.
- Explain and differentiate between reversible and irreversible processes and apply the First and Second Laws of Thermodynamics.
- Analyze thermochemical changes and evaluate thermodynamic functions such as enthalpy, entropy, and Gibbs free energy for various processes.
- Solve problems related to chemical equilibria, equilibrium constants, and predict system behavior using the Le Chatelier principle.
- Demonstrate an understanding of photochemical laws, quantum yields, and photochemical processes, including their role in real-world applications.

DETAILED CONTENT OF COURSE:

Theory & Practical Syllabus:

Total Contact Hours: 45 (Theory) + 30 (Practical)

Unit	Topics	Contact Hours
I	**Chemical Thermodynamics - I** Mathematical treatment of thermodynamics: Including exact and inexact differentials, partial derivatives, Euler's reciprocity, and the cyclic rule. Reversible and irreversible processes: Explaining the concepts and differences between these types of thermodynamic processes. First and Second Laws of Thermodynamics: Discussing the principles of energy conservation and entropy. Thermochemistry: Analyzing the heat changes associated with chemical reactions and physical processes. Thermodynamic functions: enthalpy, entropy, and Gibbs free energy: Discussing their properties, significance, and applications. Relationships between thermodynamic functions: Exploring the connections and dependencies among different thermodynamic quantities.	15
II	**Chemical Thermodynamics – II** Partial molar quantities: Explaining the concept and its application in solutions and mixtures. Dependence of thermodynamic parameters on composition: Analyzing how variables like temperature and pressure affect these parameters. Gibbs-Duhem equation: Discussing its derivation and applications in thermodynamic systems. Chemical potential: Explaining its significance and role in determining the direction of chemical processes.	8
III	**Chemical Equilibria** Law of mass action: Describing the relationship between the concentrations of reactants and products at equilibrium. Equilibrium constants (K_p, K_c, K_x, and K_n): Discussing their definitions, units, and calculations. Effect of temperature on equilibrium: Analyzing the temperature dependence and its implications for reaction conditions. Le-Chatelier principle: Explaining the principle and its applications in predicting the response of equilibrium systems to changes in conditions.	8
IV	**Photochemistry** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.	14
V	**Practicals:** 1. Determination of the enthalpy change of a reaction using a calorimeter. 2. Determination of the entropy change of a reaction from equilibrium constant measurements.	30

	3. Determination of the free energy change of a reaction from cell potential measurements. 4. Determination of the heat capacity of a solid using calorimetry. 5. Determination of the heat of neutralization of a strong acid with a strong base. 6. Determination of the heat of solution of a sparingly soluble salt. 7. Measurement of enthalpy of fusion of a solid. 8. Determination of enthalpy of vaporization of a liquid.	

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 (02 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

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

Recommended Textbooks:

Theory:

1. Physical Chemistry – P.W. Atkins and J. de Paula, Oxford University Press.
2. Thermodynamics for Chemists – S. Glasstone, East-West Press.
3. Principles of Physical Chemistry – Puri, Sharma, and Pathania, Vishal Publishing Co.
4. Chemical Thermodynamics – R.P. Rastogi and R.R. Misra, Vikas Publishing House.
5. Thermodynamics and Statistical Mechanics – M.W. Zemansky and R.H. Dittman, McGraw Hill.
6. Physical Chemistry: A Molecular Approach – D.A. McQuarrie and J.D. Simon, University Science Books.
7. Introduction to Photochemistry – A. Cox and T. Camp, McGraw Hill.

8. Photochemistry and Photophysics – J. G. Calvert and J.N. Pitts, Wiley.
9. Essentials of Physical Chemistry – B.S. Bahl, G.D. Tuli, and Arun Bahl, S. Chand Publishing.
10. Modern Physical Chemistry – G.H. Barrow, McGraw Hill.
11. Principles of Thermodynamics – J.R. Partington, Butterworths.

Practical:

1. "Experiments in Physical Chemistry" by C. N. R. Rao and U. C. Agarwala
2. "Practical Physical Chemistry" by B.S. Bahl and Arun Bahl

UG chemistry 240|CHE|CC402

COURSE DETAILS:

Course Title	**Organic Chemistry-IV**	
Semester	**Semester-4**	
Course Code	**CC-A11**	
Course ID		
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: 5	
Lectures (L) Hours per Week: 3	**Practicals (P) Hours per Week: 2**

COURSE OBJECTIVES:

- Develop an understanding of the nomenclature, classification, preparation methods, and reaction mechanisms of nitro compounds and nitriles.
- Explore the physical and chemical properties of nitrogen-containing functional groups, focusing on their reactivity in various reaction conditions.
- Learn the basic principles of NMR spectroscopy, including chemical shifts, spin-spin coupling, and interpretation of spectra for simple organic molecules.
- Study the synthesis, structure, and reactivity of organometallic compounds such as Grignard reagents, organolithium, and organozinc compounds.

COURSE OUTCOMES:

- Students will be able to explain the preparation, classification, and reaction mechanisms of nitro compounds and nitriles, including their synthetic applications.
- Analyze the physical and chemical properties of nitrogen-containing functional groups under different reaction conditions.
- Interpret proton NMR spectra, including chemical shifts, coupling constants, and spectral features of simple organic molecules.
- Apply the principles of NMR spectroscopy to identify and characterize organic compounds.
- Demonstrate knowledge of the synthesis, structure, and reactivity of key organometallic compounds like Grignard reagents, organolithium, and organozinc compounds in organic synthesis.

DETAILED CONTENT OF COURSE:

- **Theory & Practical Syllabus:**
- **Total Contact Hours: 45 (Theory) + 30 (Practical)**

Unit	Topics	Contact Hours
I	**Nitrogen Containing Functional Groups-II** **Nitro compounds** (Aliphatic and Aromatic): Nomenclature, classification and general methods of preparation: from alkyl halides, alkanes, oxidation of amines and oximes and diazonium salts. Properties: Physical properties, discussion on the following reactions with mechanism: Reaction with alkali and its synthetic applications, condensation reaction, Mannich reaction, Hydrolysis, Reduction-electrolytic reduction, reduction in acidic, basic and neutral medium (for aromatic compounds), reaction with nitrous acid, Electrophilic substitution-Halogenation, nitration and sulphonation reaction, and Nucleophilic substitution on the ring.	11
II	**Nitrogen Containing Functional Groups-III** **Nitriles**: Introduction, Nomenclature and uses. Preparation from the following reactions: Dehydration of amides and aldoximes, substitution reaction in alkyl halides and tosylates, from Grignard reagents and from dehydrogenation of primary amines. Properties: Physical properties, discussion on the following reactions with mechanism: Reaction with Grignard reagent, hydrolysis, addition reaction with HX,NH_3, reaction with aqueous ROH, Reduction reactions-catalytic reduction and Stephen's reaction, Condensation reactions-Thorpe Nitrile Condensation.	11
III	**NMR Spectroscopy** Basic principles of nuclear magnetic resonance, spectrum, number of signals, peak areas, magnetic equivalent and nonequivalent protons, positions of signals, chemical shift and factors influencing it, shielding and deshielding of protons, Spin-Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Discussion of PMR spectra of the molecules: ethyl bromide, n-propyl bromide, isopropyl bromide, 1,1-dibromoethane, ethanol, acetaldehyde, ethyl acetate, toluene, benzaldehyde and acetophenone. Applications of NMR for identification of simple organic molecules.	12
IV	**Organometallic Compounds** Grignard reagents: Synthesis, structure and chemical reactions. Organolithium compounds: Synthesis and chemical reactions. Organozinc compounds: Synthesis and chemical reactions. Organocopper: Synthesis and chemical reactions.	11
V	**Practical** 1. Systematic qualitative analysis of organic compounds possessing monofunctional groups: amide, amines, halo-hydrocarbons and carbohydrates (Including Derivative preparation). 2. Identification of simple organic compounds NMR spectroscopy	30

	(Spectra to be provided). 3. *m*-Dinitrobenzene from nitrobenzene (use 1:2 conc. HNO_3 - H_2SO_4 mixture if fuming HNO_3 is not available). 4. Selective reduction of m-dinitrobenzene to m-nitroaniline. 5. Separation of a mixture of *o*-and *p*-nitrophenol or *o*-and *p*-aminophenol by thin layer chromatography (TLC).	

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 (02 Hours)	• End Term Practical Exam: 10 Marks • Lab record: 05 Marks • Viva Voce: 05 Marks

Instruction for End Term Theory Exam:

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

SUGGESTED BOOKS

1. Gilchrist, T.L. (1997),Heterocyclic Chemistry, Pearson Education.
2. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Nomenclature and Chemistry of three to five membered Heterocycles), Elsevier publication.
3. Ram V. J.; Sethi, A.; Nath, M.; Pratap, R.; (2019), The Chemistry of Heterocycles (Chemistry of six to eight membered N, O, S, P and Se heterocycles), Elsevier publication.
4. Pavia, D.L. Introduction to Spectroscopy, Cengage learning (India) Pvt. Ltd.
5. Kemp, W. (1991), Organic Spectroscopy, Palgrave Macmillan.
6. Practical: 1. Vogel, A.I. (2012), Quantitative Organic Analysis, Part 3, Pearson.

7. Mann, F.G.; Saunders, B.C. (2009), Practical Organic Chemistry, Pearson Education.
8. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012),Vogel's Textbook Of Practical Organic Chemistry, 5th Edition, Pearson.
9. Ahluwalia, V.K.; Dhingra, S. (2004), Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.

UG chemistry 240|CHE|CC403

COURSE DETAILS:

Course Title	**Inorganic Chemistry-IV**
Semester	**Semester-4**
Course Code	**CC-A10**
Course ID	
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:

1. To study the oxoacids and properties of oxygen and halogen families.
2. To understand the periodic trends and properties of d-block elements.
3. To explore the structures and properties of transition metal compounds.
4. To learn the nomenclature, isomerism, and bonding theories of coordination compounds.
5. To understand advanced concepts like crystal field theory and Jahn-Teller effects in coordination chemistry.
6. To develop practical skills in titrations, spectrophotometry, and complex characterization.

COURSE OUTCOMES:

By the end of the course, students will be able to:

1. Explain the structures and properties of oxoacids, hydrogen peroxide, and interhalogen compounds.
2. Compare the periodic trends and magnetic/spectral properties of d-block elements.
3. Analyze structures and bonding in compounds like TiO_2, $VOCl_2$, and $Ni(CO)_4$.
4. Apply IUPAC rules for coordination compound nomenclature and identify isomerism.
5. Use crystal field theory to explain splitting patterns in transition metal complexes.
6. Perform complexometric titrations and spectroscopic characterization of coordination complexes.

DETAILED CONTENT OF COURSE:

Theory & Practical Syllabus:

Total Contact Hours: 45 (Theory) + 30 (Practical)

Unit	Topics	Contact Hours
I	**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.	11
II	**Chemistry of d-block elements** Definition of transition elements, position in the periodic table, General characteristic properties of d-Block elements, Comparison of properties of 3d elements with 4d and 5d elements with reference only to ionic radii, oxidation state, magnetic and spectral properties. Structures & properties of some compounds of transition elements – TiO_2, $VOCl_2$, $FeCl_3$, $CuCl_2$ and $Ni(CO)_4$.	11
III	**Coordination compounds – Part I** Coordination Compounds and double salts; IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with the coordination numbers 4 and 6, Chelate effect, Werner's theory and Valence Bond Theory (VBT) of transition metal complexes and its limitations.	11
IV	**Coordination Chemistry – Part II** Limitations of valence bond theory, an elementary idea of crystal-field theory, spectrochemical series, d-orbital splitting in octahedral and tetrahedral complexes, pairing energies, factors affecting the magnitude of crystal field splitting, tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar complexes.	12
V	**Practical** 1. Complexometric titrations: Determination of Mg^{2+}, Zn^{2+} by EDTA. 2. To verify Beer - Lambert law for $KMnO_4$ /$K_2Cr_2O_7$ and determine the concentration of the given $KMnO_4$ /$K_2Cr_2O_7$ solution. 3. Characterization of complexes using infrared spectroscopy (Tetraamminecarbonatocobalt (III) ion, Potassium tris(oxalate)ferrate(III))	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 (02 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 of short answer type questions covering all the units of the syllabus. All questions should carry equal marks. Log table and non-programmable calculator is allowed.

SUGGESTED BOOKS

1. "Inorganic Chemistry" by J.D. Lee
2. "Inorganic Chemistry" by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr
3. "Inorganic Chemistry" by Catherine Housecroft and Alan G. Sharpe
4. "Inorganic Chemistry" by Duward Shriver, Peter Atkins, Tina Overton, and Jonathan Rourke
5. "Quantitative Inorganic Analysis" by A. I. Vogel
6. "Practical Pharmaceutical Chemistry - Part I: Qualitative Analysis" by K. A. Pathan and S. J. Shaikh