



BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024.
M.Sc. CHEMISTRY

**CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES
BASED CURRICULUM FRAMEWORK (CBCS - LOCF)**

(Applicable to the candidates admitted from the academic year 2026 - 2027 onwards)

Sem.	Course	Course Title	Ins. Hrs.	Credit	Exam Hrs.	Marks		Total
						Int.	Ext.	
I	Core Course - 1 (CC - 1)	Inorganic Chemistry-I	6	4	3	30	70	100
	Core Course - 2 (CC - 2)	Organic Chemistry-I	6	4	3	30	70	100
	Core Practical - 1 (CP - 1)	Inorganic Chemistry Practical	6	4	6	40	60	100
	Discipline Centric Elective Course - 1 (DCEC - 1)	Any one from the list	5	4	3	30	70	100
	Generic Elective Course - 1 (GEC - 1)	Any one from the list	5	3	3	30	70	100
	Skill Enhancement Course - 1 (SEC - 1)	Chemistry of Consumer Products	2	2	3	30	70	100
	Value Added Course - 1 (VAC - 1)*	Environmental Chemistry	-	2*		30	70	100*
	Total		30	21	-	-	-	600
II	Core Course - 3 (CC - 3)	Organic Chemistry-II	6	4	3	30	70	100
	Core Course - 4 (CC - 4)	Physical Chemistry-I	6	4	3	30	70	100
	Core Practical - 2 (CP - 2)	Organic Chemistry Practical	6	4	6	40	60	100
	Discipline Centric Elective Course - 2 (DCEC - 2)	Any one from the list	4	4	3	30	70	100
	Generic Elective Course - 2 (GEC - 2)	Any one from the list	4	3	3	30	70	100
	Skill Enhancement Course - 2 (SEC - 2)	Research Tools and Techniques in Chemistry	2	2		30	70	100
	Non-Major Elective Course - 1 (NMEC - 1)	One Course from Outside Department	2	2	3	30	70	100
	Total		30	23	-	-	-	700
Summer Internship / Industrial Activity during the Summer Vacation after 1 st Year								

III	Core Course - 5 (CC - 5)	Inorganic Chemistry-II	6	4	3	30	70	100
	Core Course - 6 (CC - 6)	Physical Chemistry-II	6	4	3	30	70	100
	Core Practical - 3 (CP - 3)	Physical Chemistry Practical	6	4	6	40	60	100
	Discipline Centric Elective Course - 3 (DCEC - 3)	Any one from the list	5	4	2	30	70	100
	Generic Elective Course - 3 (GEC - 3)	Any one from the list	5	3	3	30	70	100
	Non-Major Elective Course - 2 (NMEC - 2)	One Course from Outside Department	2	2	3	30	70	100
	Internship / Industrial Activity @			2		20	80	100
	Total		30	23	-	-	-	700
IV	Core Course - 7 (CC - 7)	Analytical Chemistry	6	4	3	30	70	100
	Core Course - 8 (CC - 8)	Chemistry of Nanomaterials	6	4	3	30	70	100
	Core Course - 9 (CC - 9)	Selected Topics in Chemistry	6	4	3	30	70	100
	Discipline Centric Elective Course - 4 (DCEC - 4)	Any one from the list	4	4	2	30	70	100
	Entrepreneurship / Industry Based Course @	Industrial Chemistry	3	3	3	30	70	100
	Project Work @	Project Work	5	5	-	20	80	100
	Value Added Course - 2 (VAC - 2)*	Polymer Chemistry	-	2*		30	70	100*
	Total		30	24	-	-	-	600
Grand Total				91				2600

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE

Discipline Centric Elective Course - 1 (DCEC - 1)	
1.	Kinetics, Electrochemistry and Thermodynamics
2.	Biophysical Chemistry
Discipline Centric Elective Course - 2 (DCEC - 2)	
1.	Bioinorganic and Organometallic Chemistry
2.	Inorganic Photochemistry
Discipline Centric Elective Course - 3 (DCEC - 3)	
1.	Heterocycles, Natural Products and Organic Spectroscopy
2.	Bioorganic Chemistry
Discipline Centric Elective Course - 4 (DCEC - 4)	
1.	Chemistry of Biomolecules
2.	Pharmaceutical Chemistry

LIST OF NON-MAJOR ELECTIVE COURSE (for other Department Students only)

NON-MAJOR ELECTIVE COURSE - 1 (NME-1)	
1	Chemistry of Pollution, Food and Cosmetics
NON-MAJOR ELECTIVE COURSE - 2 (NME-2)	
2	Chemistry in Day-to-day Life

LIST OF GENERIC ELECTIVE COURSE (GEC)

GENERIC ELECTIVE COURSE - 1 (GEC - 1)	
1.	Food Chemistry
2.	Forensic Chemistry
3.	Catalysis
GENERIC ELECTIVE COURSE - 2 (GEC - 2)	
1.	Green Chemistry
2.	Supramolecular Chemistry
3.	Solid State Chemistry
GENERIC ELECTIVE COURSE - 3 (GEC - 3)	
1.	Agricultural Chemistry
2.	Materials Chemistry
3.	Pharmacognosy and Phytochemistry

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES: SCIENCE

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course	9	4	36	900
2.	Core Practical	3	4	12	300
3.	Discipline Centric Elective Course	4	4	16	400
4.	Generic Elective Course	3	3	9	300
5.	Skill Enhancement Course	2	2	4	200
6.	Non-Major Elective Courses	2	2	4	200
7.	Internship / Industrial Activity @	1	2	2	100
8.	Entrepreneurship / Industry Based Course @	1	3	3	100
9.	Project @	1	5	5	100
Total		26	-	91	2600
Value Added Courses *		2*	2	4*	200*

*	The value added courses credit will not be included in the total CGPA. These courses are extra-credit courses. Instruction hours for these courses is 30 hours								
@	Summer Internship will be carried out during the summer vacation after the First year. Viva Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 3rd semester Mark Statement. Summer Internship / Industrial Activity& Project Scheme of Evaluation: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left;">Description</th><th style="text-align: left;">Marks</th></tr> <tr> <td>Report</td><td>80</td></tr> <tr> <td>Viva</td><td>20</td></tr> <tr> <td>Total</td><td>100</td></tr> </table>	Description	Marks	Report	80	Viva	20	Total	100
Description	Marks								
Report	80								
Viva	20								
Total	100								

PROGRAMME OUTCOMES:

PO1	Disciplinary Knowledge: Broad and in-depth knowledge of advanced scientific concepts, principles, and methodologies within the chosen domain. Ability to critically explain, integrate, and apply scientific knowledge to theoretical and practical problems. Opportunities to earn additional credits through specialized and interdisciplinary courses further enhance expertise and broaden disciplinary understanding.
PO2	Critical Thinking: Field visits, academic interactions, and experiential learning activities will help students develop critical observation, interpretation, and analytical skills. Ability to evaluate and interpret scientific data, formulate hypotheses, and draw logical conclusions. Encourages independent thinking and the ability to assess scientific problems from multiple perspectives.
PO3	Analytical Reasoning: Through classroom discussions, scientific literature reviews, and interactive learning environments, students will strengthen their analytical reasoning abilities. Ability to critically evaluate scientific texts, identify gaps in existing knowledge, formulate research questions, and synthesize new ideas and concepts. Promotes evidence-based reasoning and logical interpretation of scientific information.
PO4	Scientific Reasoning: Strong foundation in scientific methods, experimental design, and data interpretation through laboratory-based courses. Enhances practical knowledge of scientific instrumentation, calibration procedures, laboratory safety, and appropriate research techniques. Ability to conduct scientifically sound experiments and interpret results accurately.
PO5	Self-Directed Learning: Encourages independent and self-directed learning through assignments, field reports, project work, and literature-based studies. Ability to organize, analyse, and present scientific findings in professional formats relevant to academic and industrial settings. Fosters responsibility, time management, and continuous self-improvement in learning.
PO6	Reflective Thinking: Laboratory-intensive core courses will expose students to a broad range of research methodologies and experimental techniques. Ability to reflect on learning experiences, evaluate the effectiveness of scientific approaches, and understand the broader applications of scientific techniques within the discipline.
PO7	Problem-Solving Skills: Ability to develop and apply scientific principles, quantitative reasoning, and mathematical concepts to solve discipline-specific problems. Ability to analyse experimental data, interpret scientific observations, and derive meaningful conclusions. Prepares students to address real-world scientific and societal challenges effectively.
PO8	Research-Related Skills: Internships, dissertation work, and research-oriented projects provide opportunities to design, develop, and execute independent research studies. Students gain

	hands-on experience in research methodology, experimental techniques, data analysis, scientific writing, and ethical research practices. These experiences strengthen laboratory competence and prepare students for advanced research and professional careers.
PO9	Lifelong Learning: Cultivates a mind-set of continuous learning and professional adaptability. Ability to identify gaps in knowledge and skills, adapt to emerging technologies and scientific advancements, and pursue self-directed learning throughout their careers. Encourages lifelong learning that supports academic growth, employability, and professional excellence.
PO10	Leadership Readiness: Ability to take initiative, work collaboratively, and manage academic and research responsibilities effectively. Through seminars, group projects, internships, and research activities, students develop decision-making, problem-solving, organizational, and interpersonal skills. Ability to lead scientific teams, communicate effectively in professional environments, and contribute responsibly to academic, industrial, and societal development.

Year: I**CORE COURSE 1****Semester: I****Code:****INORGANIC CHEMISTRY I
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To understand the basic concepts of main group elements.
- To learn the principles of coordination chemistry.
- To remember the theories of metal-ligand bonds.
- To study the reaction mechanism in coordination complexes.
- To provide knowledge on inorganic photochemistry.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Recall the principles of main group chemistry, coordination chemistry, reaction mechanisms and inorganic photochemistry to develop scientific knowledge in inorganic chemistry.	K1
CO2	Understand the chemistry of boron, silicon, coordination compounds, reaction mechanism and inorganic photochemistry to develop problem solving skills.	K2
CO3	Apply the concepts of main group chemistry, coordination chemistry, metal-ligand bonding theories, reaction mechanisms and inorganic photochemistry to enhance scientific thinking in inorganic chemistry.	K3
CO4	Analyze the chemistry of main group, coordination complexes, reaction mechanisms and inorganic photochemistry to strengthen the scientific applications for societal and industrial needs.	K4
CO5	Evaluate main group chemistry, coordination chemistry, metal-ligand bonding, reaction mechanisms and inorganic photochemistry to promote research and development.	K5/K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I MAIN GROUP CHEMISTRY:

Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides. Chemistry of silicon – classification of silicates- silanes- silicon nitrides- silicones. P-N compounds, linear and cyclophosphazenes – S-N compounds – S_2N_2 , S_4N_4 , $(SN)_x$, polythiazyl compounds – S-N cations and anions, S-P compounds – molecular sulphides such as P_4S_3 , P_4S_7 , P_4S_9 and

P₄S₁₀. Ionic model –lattice energy – Born-Lande equation – Kapustinskii equation – high T_c superconductors.

UNIT – II PRINCIPLES OF COORDINATION CHEMISTRY:

Studies of coordination compounds in solution – detection of complex formation in solution – stability constants – stepwise and overall formation constants. Simple methods (potentiometric, pH metric and photometric methods) of determining the formation constants. Factors affecting stability – statistical and chelate effects – forced configurations.

UNIT – III THEORIES OF METAL-LIGAND BOND:

Crystal field theory – splitting of d-orbitals under various geometries – factors affecting splitting – CFSE and evidences for CFSE (structural and thermodynamic effects). Spectrochemical series – Jahn-Teller distortion – spectral and magnetic properties of complexes – site preferences. Limitations of CFT – ligand field theory – MO theory – sigma- and pi-bonding in complexes – Nephelauxetic effect – the angular overlap model.

UNIT – IV REACTION MECHANISM IN COORDINATION COMPLEXES:

Kinetics and mechanism of reactions in solution – labile and inert complexes – ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions. Trans effect – theory and applications – electron transfer reactions – electron exchange reactions – complementary and non- complementary types – inner sphere and outer sphere processes – application of electron transfer reactions in inorganic complexes – isomerization and racemization reactions of complexes. Molecular rearrangements of four- and six-coordinate complexes – interconversion of stereoisomers – reactions of coordinated ligands – template effect and its applications for the synthesis of macrocyclic ligands – unique properties.

UNIT – V INORGANIC PHOTOCHEMISTRY:

Electronic transitions in metal complexes, metal-centered and charge-transfer transitions – various photophysical and photochemical processes of coordination compounds. Unimolecular charge-transfer photochemistry of cobalt(III) complexes – mechanism of CTTM, photoreduction – ligand-field photochemistry of chromium(III) complexes – Adamson's rules, photoactive excited states, V-C model – photophysics and photochemistry of ruthenium – polypyridine complexes, emission and redox properties.

Photochemistry of organometallic compounds – metal carbonyl compounds – compounds with metal-metal bonding – Reinecke's salt chemical actinometer.

UNIT – VI Bonding in Small Molecules (For Continuous Internal assessment only):

Valence Bond (VBT) and Molecular Orbital (MO) Theories - Application to small molecules such as BeCl_2 , BCl_3 and CCl_4 , SF_4 , ClF_3 , BrF_3 , BrF_5 , IF_5 , IF_7 etc – Bonding in Noble gas compounds – XeCl_2 , XeF_4 , XeOF_4 , XeF_6 .

TEXT BOOKS:

1. J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorganic Chemistry; 5th Edn., Pearson Education, 2022.
2. F. A. Cotton and G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry; 6th Edn, Wiley, 2007.
3. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry (formerly Shriver and Atkin's Inorganic chemistry), 6th Edn., Oxford University Press India, 2014.
4. A. K. Das, Fundamental Concepts of Inorganic Chemistry, 3rd. Edn., Vol 1-7, CBS Publishers and Distributors Pvt Ltd, 2021
5. J. D. Lee, Concise Inorganic Chemistry, 5th Edn, Wiley, 2008

REFERENCES:

1. M. C. Day, J. Selbin and H. H. Sisler, Theoretical Inorganic Chemistry; Literary Licensing (LLC), Montana, 2012.
2. A. W. Adamson, Concept of Inorganic Photochemistry; John Wiley and Sons, New York, 1975.
3. S. F. A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum; Academic Publishers, Oxford University Press, New York, 1996.
4. A. W. Adamson and P. D. Fleischauer, Concepts of Inorganic Photochemistry; R. E. Krieger Pubs, Florida, 1984.
5. J. Ferraudi, Elements of Inorganic Photochemistry; Wiley, New York, 1988.
6. F. Basolo and R. G. Pearson, Mechanism of Inorganic Reactions; 2nd Ed., John Wiley, New York, 1967.
7. K. F. Purcell and J.C. Kotz, Inorganic Chemistry; W. B. Saunders Co., New York, 1984.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	2	2	3
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	2.8	3	2.8	2.4	3
Overall Average	2.8				

3-Strong

2-Medium

1-Low

Year: I**CORE COURSE 2****Semester: I****Code:****ORGANIC CHEMISTRY I
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To learn the nomenclature of organic compounds, and study about reactive intermediates and electronic effects.
- To acquire knowledge on methods of determining reaction mechanisms and correlation analysis.
- To learn the fundamentals of stereochemistry including dynamic stereochemistry.
- To understand the basic concepts of aromaticity.
- To know about oxidation and reducing reagents for organic synthesis.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Acquire the basic knowledge of naming organic molecules and identifying aromatic and non-aromatic compounds.	K1
CO2	Understand reaction intermediates, and analyze reaction mechanisms based on the detection of intermediates.	K2, K4
CO3	Understand stereoisomerism and its importance in organic chemistry.	K2
CO4	Elucidate the conformations of organic molecules.	K5
CO5	Know about the applications of various oxidizing and reducing agents in organic chemistry	K3
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I NOMENCLATURE OF ORGANIC COMPOUNDS, REACTIVE INTERMEDIATES AND ELECTRONIC EFFECTS:

Nomenclature of alicyclic, bicyclic, tricyclic and spiro compounds - Nomenclature of heterocycles having not more than two hetero atoms such as oxygen, nitrogen and Sulphur - Nomenclature of heterocyclic compounds of fused ring system. **Reactive Intermediates:** Classical and non-classical carbocations, carbanions-free radicals, carbenes, nitrenes, arynes and singlet oxygen- general methods of generation, detection, geometry, stability and reactivity of these intermediates. **Electronic Effects:** Inductive effect - resonance effect – hyper conjugation (Baker-Nathan effect) hydrogen bonding (inter and intramolecular) and steric effects.

UNIT – II METHODS OF DETERMINING REACTION MECHANISMS AND CORRELATION ANALYSIS

Kinetics and non-kinetic methods of determination of reaction mechanisms - Thermodynamic and kinetic aspects of organic reactions ,energy profile diagrams - spectroscopic studies, isotopic effects - intermediate versus transition states - product analysis and its importance - crossover experiments-isotopic labelling studies. **Correlation Analysis:** Linear Free Energy Relations-Hammett equation - significance - sigma and rho applications and limitations - Taft, Swain-Scott, Grunwald-Winstein equations and their applications, classification of solvents.

UNIT – III STEREOCHEMISTRY I:

Optical isomerism - Optical activity and chirality - elements of symmetry - Stereochemistry of overcrowded molecules (hexahelicene, ansa compounds, cyclophanes and trans cycloalkenes -Newmann, Sawhorse and Fischer projections - representation and interconversion - Absolute configuration – R & S notations for special molecules (allenes, spirans, biphenyls) R-S nomenclature of cyclic chiral compounds - molecules with more than one chiral center. Asymmetric synthesis - Optical purity-determination of enantiomeric excess by NMR – definition of terms like prochirality, enantiotopic and diastereotopic atoms, groups and faces - stereoselective and stereospecific reactions.

UNIT – IV STEREOCHEMISTRY II:

Geometrical isomerism: E and Z nomenclature - determination of configuration of geometrical isomers (cyclisation, converting into compounds of known configuration, dipole moment, converting into less symmetric compounds- spectroscopic methods) configuration of cyclic and bicyclic ring systems - cis- trans nomenclature of three, four and six membered substituted cyclic systems-decalins.

Dynamic Stereochemistry: Quantitative correlation between conformation and reactivity - Winstein-Eliehl equation – Curtin-Hammett principle- conformation, reactivity and mechanism of cyclic systems and fused (decalin) ring systems-bridged(norbornane) systems-saponification of an ester - esterification of an alcohol - chromic acid oxidation of cyclohexanols - neighbouring group participation - deamination of 2- amino cyclohexanol.

UNIT – V AROMATICITY AND REAGENTS IN ORGANIC SYNTHESIS:

Aromaticity: Aromatic character: Five-, six-, seven-, and eight-membered rings-other systems with aromatic sextets – Huckel's theory of aromaticity, Craig's rule- concept of homoaromaticity and antiaromaticity. – NMR concept of aromaticity and antiaromaticity-

non benzenoid aromatic compounds- systems with 2,4,8 and 10 electrons, systems of more than 10 electrons (annulenes), Möbius aromaticity. alternant and non-alternant hydrocarbons (azulene type) – aromaticity in heteroaromatic molecules, sydnones and fullerenes.

Reagents in organic synthesis: Oxidation: Baeyer-Villiger, Jacobsen epoxidation, Shi epoxidation, Jones reagent, DMP, TPAP, NOCl, $\text{Mn}(\text{OAc})_3$, $\text{Cu}(\text{OAc})_2$, Bi_2O_3 , Swern oxidation. Reduction: Hydride transfer reagents from group III and group IV in reductions. (i) triacetoxyborohydride, L-selectride, K-selectride, Luche reduction (ii) stereo/enantioselectivity reductions (Chiral Boranes).

UNIT – VI NAME REACTIONS AND APPLICATIONS IN ORGANIC SYNTHESIS: (For Continuous Internal Assessment Only):

Wagner-Meerwein, Pinacol, Demjanov, dienone-phenol, benzil-benzilic acid, Wolf, Beckmann, Hofmann, Curtius, Schmidt, Lossen and Favorski rearrangements.

TEXT BOOKS:

1. J. March, M.B. Smith, Advanced Organic Chemistry: Reactions, Mechanisms and Structure; 6th Edn., Wiley, New York, 2007.
2. F.A. Carey, R.J. Sundberg, Advanced Organic Chemistry; Parts A & B, 5th Ed., Springer, Germany, 2007.
3. R.B. Fox, W.H. Powell, Nomenclature of Organic Compounds: Principles and Practice, 2nd Edn., Oxford University Press, 2001.
4. D. Nasipuri, Stereochemistry of Organic Compounds-Principles and Applications, 4th Edn., New Academic Science Limited, 2012.
5. P.S. Kalsi, Stereochemistry, 11th Edn., New Age International, 2022.
6. W. Carruthers, L. Coldham, Modern Methods of Organic Synthesis, Cambridge University Press, 2024

REFERENCES:

1. R. Panico, W.H. Powell, L. Jean, C. Richer, A Guide of IUPAC Nomenclature of Organic Compounds, 1993.
2. R.S. Cahn and O.C. Dermer, Introduction to Chemical Nomenclature, 5th Edn., Butterworths, 1997.
3. I. L. Finar, Organic Chemistry; Vol.II, 7th Edn., Pearson education Ltd, New Delhi, 2009.
4. T.H. Lowry, K.S. Richardson, Mechanism and Theory in Organic Chemistry, Addison-Wesley, 1998.
5. E.L. Eliel, S.H. Wilen, Stereochemistry of Organic Compounds, John Wiley, 2008.
6. C.J. Moody and G.H. Whitham, Reactive Intermediates, Oxford University Press; 1992.
7. P. Sykes, Guidebook to Mechanism in Organic Chemistry, 6th Ed. Pearson, 2003.
8. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd Ed., Oxford

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I	CORE PRACTICAL 1	Semester: I
Code:	INORGANIC CHEMISTRY PRACTICAL (Practical)	Credits: 4

COURSE OBJECTIVES:

- To perform the semi-micro qualitative analysis.
 - To estimate the metal ions using colorimeter.
 - To Prepare the coordination complexes
1. **Semi-micro qualitative analysis** of a mixture containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg, NH_4^+) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).
 2. Complexometric titrations: EDTA titrations: Calcium(II), Magnesium(II), Zinc(II), Iron(II), Copper(II), Nickel(II). Total hardness of a sample of hard water.
 3. **Preparation of complexes**
 1. Tris(thiourea)copper(I) chloride
 2. Tetraamminecopper(II) sulphate
 3. Potassium trisoxalatoferrate
 4. Potassium trisoxalatoaluminate(III)
 5. Potassium trisoxalatochromate(III)
 6. Hexamminecobalt(III) chloride

REFERENCES:

1. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; 3rd Ed., National Pubs, London, 1988.
2. G. Svehla, Text Book of Macro and Semimicro Qualitative Inorganic Analysis; 5th Ed., Longman group Ltd, London, 1987.
3. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, 2000.

COURSE OBJECTIVES:

- To learn the basic theories of chemical kinetics.
- To correlate the reaction mechanisms with theories of chemical kinetics.
- To understand the fundamental concepts of electrochemistry.
- To study about the electrode interfaces, electron transfer dynamics, corrosion mechanisms, fuel cells and photovoltaic cells.
- To acquire the knowledge on thermodynamics and its applications

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Explain the theories of chemical kinetics, photochemistry, and radiation chemistry using statistical mechanics principles.	K1, K2
CO2	Apply transition state theory and other kinetic models to analyse reaction mechanisms in gases and solutions.	K3
CO3	Analyse electrochemical phenomena including ion transport, electrode interfaces, and electron transfer dynamics.	K4
CO4	Evaluate corrosion mechanisms, fuel cell operations, and photovoltaic systems for practical applications.	K5
CO5	Formulate thermodynamic relationships for real gases, electrolytes, and multicomponent systems using advanced concepts like fugacity and activity.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I CHEMICAL KINETICS I:

Theories of reaction rate based on statistical mechanics –statistical mechanics and chemical equilibrium-Transition state theory based on statistical mechanics- symmetry numbers and statistical factors- transmission coefficient- reaction coordinate – potential energy surfaces – kinetic isotope effect – Hinshelwood theory – Kassel, Rice and Ramsperger theory (KRRT) – Slater’s treatment. Principle of microscopic reversibility – steady-state approximation – chain reactions: thermal and photochemical reactions between hydrogen and halogens – explosions and hydrogen-oxygen

reactions.

UNIT – II CHEMICAL KINETICS II:

Factors determining reaction rates in solution- Transition state theory- influence of internal pressure- influence of solvation- reaction between ions-influence of solvent dielectric constant- single sphere activated complex-influence of ionic strength (Bronsted-Bjerrum equation)-primary and secondary salt effects. Influence of hydrostatic pressure - Van't-Hoff's equation - volume of activation. Substituent and correlation effects-Hammett equation-LFER-Compensation effects-Taft equation- diffusion controlled reactions (full microscopic diffusion control).

UNIT – III ELECTRO CHEMISTRY I:

Ion transport in solution – migration, convection and diffusion – Fick's laws of diffusion conduction – Debye-Huckel theory – ionic atmosphere – Debye- Huckel- Onsager equation – verification and extension – Debye-Falkenhagen effect and Wien effect, Debye-Huckel limiting law – activity coefficients and ionic strength – Bjerrum model. The electrode – electrolyte interface – electrical double layer and multi layers – theories – electrocapillary curves – Lipmann equation and Lipmann potential- structure of semiconductor interface-Garrett-Brattain space charge model. Electrokinetic phenomena -classification – Tiselius method of separation of proteins — electrocatalysis.

UNIT – IV ELECTROCHEMISTRY II:

Dynamics of electron transfer – Marcus theory – tunneling – the rate of charge transfer – current density – Butler-Volmer equation – Taft equation –Polarization and overvoltage – mechanism of hydrogen evolution and oxygen evolution reactions. Principles of electrode position of metals – corrosion and passivity – Pourbaix and Evans diagrams – methods of protection of metals from corrosion. Power storage systems – fuel cells – construction and functioning – applications– photovoltaic cells.

UNIT – V CLASSICAL THERMODYNAMICS:

Third law – thermodynamics – significance – Nernst heat theorem and other forms of stating the third law – thermodynamic quantities at absolute zero – apparent exceptions to the third law. Thermodynamics of systems of variable composition – partial molar properties chemical potential-Gibbs-Duhem equation and its applications (the experimental determination of partial molar properties not included). Thermodynamic properties of real gases – fugacity concept – calculation of fugacity of real gas – activity and

activity coefficient – concept – definition – standard states and experimental determinations of activity and activity coefficient of electrolytes.

UNIT – VI COLLOIDS AND MICELLES (For Continuous Internal Assessment Only):

Colloids: Distinction between suspension, colloidal solutions and true solutions – lyophilic and lyophobic colloids – Tyndall effect – stability of colloids – coagulation – emulsions – various types. Micelles: Surfactant (amphipathic molecules) – micellization – critical micelle concentration – size of micelle – aggregation number – Thermodynamics of micellization– reverse micelles.

TEXT BOOKS:

1. B. R. Puri, L. R. Sharma and M. S. Pathania, Principles of Physical chemistry, Vishal Publish in Co, 50th Edn, 2026.
2. K. J. Laidler, Chemical Kinetics; 3rd Ed., Pearson Education India, 2003.
3. J. O'M Bockris and A. K. N. Reddy, Modern Electrochemistry; Vol. 1 and 2, 2nd Ed., Plenum Press, New York, 1998.
4. P. W. Atkins, Physical Chemistry; 7th Ed., Oxford University Press, 2001.
5. J. Rajaram and J. C. Kuriacose, Thermodynamics for Students of Chemistry - Classical, Statistical and Irreversible; Pearson Education, New Delhi, 2013.

REFERENCES:

1. J. W. Moore and R. G. Pearson, Kinetics and Mechanism; 3rd Edn., John Wiley and Sons, New York, 1981.
2. M. Mortimer and P. G. Taylor, Chemical Kinetics and Mechanism; 1st Edn., Royal Society of Chemistry, UK, 2002.
3. J. N. Gurtu and A. Gurtu, Advanced Physical Chemistry; 5th Edn., PragathiPrakashan, Meerut, 2006.
4. J. I. Steinfeld, J. S. Francisco and W. L. Hase, Chemical Kinetics and Dynamics; 2nd Edn., Prentice Hall, New Jersey, 1999.
5. K. S. Gupta, Chemical Kinetics and Reaction Mechanism; RBSA Publishers, Jaipur, India, 1992.
6. J. W. Moore and R. G. Pearson, Kinetics and Mechanism; 3rd Edn., John Wiley and Sons, New York, 1981.
7. Amdur and G. G. Hammes, Chemical Kinetics-Principles and Selected Topics; 3rd Edn., McGraw Hill, New York, 2008.
8. S. Glasstone, Introduction to Electrochemistry; Maurice Press, Philadelphia, 2008.
9. L. Antropov, Theoretical Electrochemistry; University Press of the Pacific, USA, 2001.

10. R.K. Dave, Chemical Kinetics; Campus Books, 2000.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

COURSE OBJECTIVES:

- To understand the basic concepts of biological system via physical nature
- To learn the fundamental concepts of bioenergetics and biomolecules
- To study the concepts of biopolymers and its applications.
- To learn the forces involved in biopolymer interactions.
- To study the basics of biomolecular dynamics.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Acquire the basic knowledge of biological cell and its constituents.	K1
CO2	Understand various chain structures of macromolecules.	K2, K4
CO3	Understand and apply various types of binding processes in biological systems.	K2, K3
CO4	Elucidate the thermodynamic principles governing biopolymer solutions.	K6
CO5	Know about the evaluation of size, shape, molecular weight and extent of hydration of biopolymers.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I BIOLOGICAL CELL AND ITS CONSTITUENTS:

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition. Bioenergetics - Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

UNIT – II STATISTICAL MECHANICS IN BIOPOLYMERS:

Chain configuration of macromolecules, statistical distribution end to end dimensions, calculation of average dimensions for various chain structures. Polypeptide and protein structures, introduction to protein folding problem.

UNIT – III BIOPOLYMER INTERACTIONS:

Forces involved in biopolymer interactions. Electrostatic charges

and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria - Various types of binding processes in biological systems. Hydrogen ion titration curves.

UNIT – IV THERMODYNAMICS OF BIOPOLYMER SOLUTIONS:

Thermodynamic principles governing biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical systems.

UNIT – V CELL MEMBRANE AND TRANSPORT OF IONS:

Structure and functions of cell membrane, ion transport through cell membrane and irreversible thermodynamic treatment of membrane transport. Nerve conduction. Biopolymers and their Molecular Weights - Evaluation of size, shape, molecular weight and extent of hydration of biopolymers by various experimental techniques. Sedimentation equilibrium, hydrodynamic methods diffusion, sedimentation velocity, viscosity, electrophoresis and rotational motions.

UNIT – VI BASIC MOLECULAR DYNAMICS (For Continuous Internal Assessment Only):

Equations of motion – potential functions – integration computations – Initial state – boundary conditions – equilibration – dynamics protocols – trajectories –

Analyses of results – AMBER, CHARM, -simple applications to proteins and nucleic acids Miscellaneous topics

TEXT BOOKS:

1. A. L. Lehninger, Principles of Biochemistry, Worth Publishers, 3rd Edn, 2000
2. L.Stryer, and W.H. Freeman, Biochemistry, 5th Edn, 2007
3. Voet and Voet, Biochemistry, John Wiley Publication, 4th Edn, 2012.

REFERENCES:

1. J. David Rawn, Biochemistry, Panima, 2008
2. E. E. Conn and P. K. Stumpf, Outlines of Biochemistry, 4th Edn, Wiley, 2006.
3. H. Dugas and C.Penny, Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Springer-Verlag, 1981
4. F.Wold, Macromolecules: Structure and Function, Prentice Hall, 1971

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2

CO5	3	3	3	3	2	3	3	3	2	3
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3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**GENERIC ELECTIVE COURSE 1****Semester: I****Code:****1. FOOD CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To understand the types of food
- To learn the Food adulteration and poisons
- To study the Food additives and preservation
- To learn the Beverages
- To study the basics of Edible Oils

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the basic concepts of food adulteration.	K1, K2
CO2	Determine and interpret the types of food poisons.	K3
CO3	Analyze and distinguish the various food additives and food colors.	K4
CO4	Evaluate and ensure the quality and stability of beverages.	K5
CO5	Summarize the sources, production and preservation of edible oils.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I Food Adulteration

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals - Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods by simple analytical techniques.

UNIT – II Food Poison

Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) -Chemical poisons - First aid for poison consumed victims.

UNIT – III Food Additives

Food additives - artificial sweeteners – Saccharin - cyclamate and aspartate food flavours -esters, aldehydes and heterocyclic compounds – Food colours – Emulsifying agents – preservatives - leavening agents. Baking powder – yeast – tastemakers – MSG - vinegar.

UNIT – IV Beverages

Beverages – soft drinks – soda – fruit juices - alcoholic beverages – examples - carbonation-addiction to alcohol– diseases of liver and social problems.

UNIT – V Edible oils

Fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heart diseases-determination of iodine value, RM value, saponification values and their significance.

TEXT BOOKS:

1. H. K. Chopra, P. S. Panesar, Food Chemistry, Narosa publishing house, 2010.
2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co. Publishers, 2nd Edn, 2006.
3. Dr. L. Rakesh Sharma, Food Chemistry, Evince publishing, 2022.
4. G. Subbulakshmi, Shobha A. Udiipi, Padmini S. Ghugre, Food Processing and Preservation, New Age International Publishers, 2nd Edn, 2021.

REFERENCES:

1. A. L. Lehninger, Principles of Biochemistry, Worth Publishers, 3rd Edn, 2000
2. L.Stryer, and W.H. Freeman, Biochemistry, 5th Edn, 2007
3. Voet and Voet, Biochemistry, John Wiley Publication, 4th Edn, 2012.
4. J. David Rawn, Biochemistry, Panima, 2008
5. E. E. Conn and P. K. Stumpf, Outlines of Biochemistry, 4th Edn, Wiley, 2006.
6. H. Dugas and C.Penny, Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Springer-Verlag, 1981
7. F.Wold, Macromolecules: Structure and Function, Prentice Hall, 1971

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				
	3-Strong	2-Medium		1-Low	

Year: I**GENERIC ELECTIVE COURSE 1****Semester: I****Code:****2. FORENSIC CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To understand the crime detection through analytical instruments
- To learn the forgery and its detection
- To study the medical aspects involved
- To learn the types of poisons
- To study the tracks and traces in forensics

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the types, classification, diagnosis, and treatment of poisons, including heavy metal contamination and analytical techniques used in toxicology.	K1, K2
CO2	Apply the principles of forensic science to interpret crime detection methods, explosives, security measures, and firearm evidence.	K3
CO3	Analyze forensic techniques for the detection of document forgery, counterfeit currency, precious metals, and gemstones.	K4
CO4	Evaluate forensic evidence obtained from tracks, traces, biological samples, DNA fingerprinting, and other physical evidence for crime investigation.	K5
CO5	Design appropriate forensic approaches for the investigation of medical aspects of crime, arson, and ballistic evidence using modern analytical techniques.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I Poisons

Poisons - types and classification - diagnosis of poisons in the living and the dead -clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of sea foods - use of neutron activation analysis in detecting arsenic in human hair. Treatment in cases of poisoning – use of antidotes for common poisons.

UNIT – II Crime detection

Accidental explosion during manufacture of matches and fireworks (as in Sivakasi). Human bombs - possible explosives (gelatin sticks and RDX) - metal detector devices and other security measures for

VVIP composition of bullets and detecting powder burns.

UNIT – III Forgery and Counterfeiting

Documents - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery methods - writing deliberately modified - uses of ultraviolet rays -comparison of type written letters – checking silver line water mark in currency notes – alloy analysis using AAS to detect counterfeit coins – detection of gold purity in 22 carat ornaments – detecting gold plated jewels - authenticity of diamond.

UNIT – IV Tracks and Traces

Tracks and traces - small tracks and police dogs - foot prints - costing of foot prints -residue prints, walking pattern or tyre marks – miscellaneous traces and tracks – glass fracture - tool marks - paints - fibres - Analysis of biological substances - blood, semen, saliva, urine and hair - Cranial analysis (head and teeth) DNA Finger printing for tissue identification in dismembered bodies - detecting steroid consumption in athletes and racehorses.

UNIT – V Medical aspects

Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum - Gas chromatography-Arson -natural fires and arson - burning characteristics and chemistry of combustible materials -nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms -laboratory examination of barrel washing and detection of powder residue by chemical tests.

TEXT BOOKS:

1. SA Iqbal, M Liviu, Textbook of Forensic Chemistry, Discovery publishing house private limited, 2011.
2. Kelly M. Elkins, Introduction to Forensic Chemistry, CRC Press, Taylor & Francis Group, 2019.
3. Javed I. Khan, Thomas J. Kennedy, Donnell R. Christian, Jr., Basic Principles of Forensic Chemistry, Humana Press, 1st Edn, 2012.
4. Bapuly A.K., Forensic Science – Its Application in Crime Investigation, Paras Medical Publisher, Hyderabad, 2006.
5. Sharma B.R., Scientific Criminal Investigation, Universal Law Publishing Co. Pvt. Ltd, New Delhi, 2006.

REFERENCES:

1. Richard Saferst in and Criminalistics-An Introduction to Forensic Science (College Version), Sopfestein, Printice Hall, 8th Edn, 2003
2. Suzanne Bell, Forensic Chemistry, Pearson, 2nd Int.Edn, 2014.
3. Jay Siegel, Forensic Chemistry: Fundamentals and Applications, Wiley-Blackwell, 1st Edn, 2015.

4. Max M. Houck & Jay A. Segal, Fundamentals of Forensic Science, Elsevier Academic Press, 2006
5. Henry C. Lee, Timothy Palmbach, Marilyn T. Miller, Henry Lee's Crime Scene Book, Elsevier Academic Press, 2006

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**GENERIC ELECTIVE COURSE 1****Semester: I****Code:****3. CATALYSIS
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To understand the basic concepts of catalysis
- To know the different methods of catalysis
- To learn the various techniques and mechanisms involved in catalysis.
- To study the principles, processes, and applications of photocatalysis.
- To know the importance of biocatalysis and the role of enzymes in organic synthesis.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the fundamental concepts of catalysis, adsorption, catalyst activity, selectivity, deactivation, and adsorption isotherms.	K1, K2
CO2	Apply the principles of homogeneous and heterogeneous catalysis to interpret catalytic reactions and industrial catalytic processes.	K3
CO3	Analyze the mechanisms of photocatalysis and electrocatalysis, including semiconductor photocatalysts and their applications in chemical transformations.	K4
CO4	Evaluate the efficiency and applications of catalytic systems in solar energy conversion, photo-electrolysis, petrochemical production, and environmental remediation.	K5
CO5	Design biocatalytic approaches for organic synthesis by integrating enzyme mechanisms and their industrial applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I INTRODUCTION TO CATALYSIS:

Activity, selectivity, promoters, stabilizers and poisons, Catalysts deactivation, Turn over number, inhibitors.

Thermodynamic consideration in catalysis: Energy factor, significance of activation parameters and application to kinetic systems.

Physical adsorption: Unimolecular adsorption- types of adsorption isotherms, Multimolecular adsorption-BET method, and Harkins-Jura equation. Chemisorption of gases on metals and oxides.

UNIT – II HOMOGENEOUS AND HETEROGENEOUS CATALYSIS:

Acid-base catalytic reactions, protolytic and protropic mechanisms, activation energy of the processes, catalytic activity and acid-base strength, acidity functions: Hammett-Zucker treatments, linear free energy relationships. Homogeneous catalysts for the polymerization of olefins, oxidative dehydrogenation, Ethylbenzene to styrene, Ziegler-Natta polymerization.

Partial oxidation: n- butane to maleic anhydride, propylene to acrolein, Fisher- Tropsch synthesis, catalytic reaction of cracking, shape selective catalysis: Zeolites-Alkylation of aniline with alcohols. Catalysts for the production of petrochemicals- production of aromatics, para- xylene, cumene, linear alkylbenzenes and methanol. Phase transfer catalysis – Rhodium water soluble catalyst systems with carboxylated and sulfonated phosphines for hydroformylation reactions.

UNIT – III PHOTOCATALYSIS:

Thermal and photochemical reactions between $\text{H}_2\text{-Cl}_2$ and $\text{H}_2\text{-Br}_2$ and $\text{H}_2\text{-I}_2$ reactions, fluorescence, phosphorescence and quenching-Stern-Volmer equation. Photocatalytic studies using non-stoichiometric oxides such as n-type and p-type semiconductors (TiO_2 , ZnO , Cr_2O_3 , doped and coupled semiconductors for the degradation of dyes)

UNIT – IV ELECTROCATALYSIS:

Solar energy conversion, electrochemical cells, photo-electrolysis of water and photocatalytic reactions. Photocatalytic reduction of dinitrogen, photocatalysis for organic reactions oxidation, reduction, polymerization, substitution and isomerization reaction using TiO_2 .

UNIT – V BIOCATALYSIS: MECHANISM AND APPLICATION:

Mechanisms: Covalent catalysis, acid-base and metal-ion catalysis, entropy and geometric effects, structural complementarity of the active site to the transition state, prevention of the side reactions, the size of the enzymes. Applications of enzymes in organic synthesis: Oxidoreductase: Oxidation - Alcohols, epoxides, sulfoxides, amino acids, lactones, Oxidoreductase: Reduction- α -hydroxyaminoacid, Transferase: Amino acids, amines.

UNIT – VI TECHNIQUES IN CATALYSIS (For Continuous Internal Assessment Only):

Structural characterization-BET surface area method, pore volume, and pore size distribution-BJH method, t-plot method, XRD, SEM, TEM, AFM, STM, TPR and TPD. Special relevance to metal oxides with different structures.

TEXT BOOKS:

1. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, Catalysis: Principles and Applications, Narosa Publishing House, New Delhi, 2004
2. K.J. Laidler, Chemical Kinetics, Tata Mcgraw-Hill Publishing Company Ltd, New Delhi, 1973.

REFERENCES:

1. G.C. Bond, Heterogeneous catalysis: Principles and applications, Oxford University Press, Ely House, London W.I, 1974.
2. V. Murugesan, A. Banumathi and M. Palanichamy, Recent Trends in Catalysis, Narosa Publishing House, New Delhi, 1999.
3. D.K. Chakrabarty, Adsorption and Catalysis by solids, Wiley Eastern Ltd, New Delhi, 1991.
4. J.M. Thomas, W.J. Thomas, Principles and practice of Heterogeneous Catalysis, Wiley- VCH, New York, 1996.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3
	3-Strong			2-Medium			1-Low			

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				
	3-Strong		2-Medium		1-Low

Year: I**SKILL ENHANCEMENT COURSE 1****Semester: I****Code:****CHEMISTRY OF CONSUMER
PRODUCTS
(Theory)****Credits: 2****COURSE OBJECTIVES:**

- To understand the theory and practical work of consumer goods
 - To learn about the chemistry of manufacturing, formulation techniques, and quality control procedures
 - To study the types of fuels and biomass conversion
- To provide hand on experience to prepare consumer products
To develop entrepreneur skills

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the fundamental concepts of consumer chemistry, consumer products, their characteristics, and marketing strategies.	K1, K2
CO2	Apply the principles of soap and detergent chemistry to explain their manufacture, composition, mechanism of action, and environmental impact.	K3
CO3	Analyze the composition, preparation, and applications of cosmetic products, food additives, preservatives, and household chemical products.	K4
CO4	Evaluate the quality, safety, and preservation of food products by assessing food additives, adulterants, contaminants, and preservation techniques.	K5
CO5	Design sustainable approaches for the production and utilization of fuels, biomass energy, biogas, and batteries based on their chemical principles and applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I Basic concepts of consumer products:

Definition of consumer chemistry, types of consumer products, characteristics of consumer products, role of consumer in consumer goods, small scale industry consumer products marketing strategy for consumer products, importance of consumer chemistry in specialty products and its applications.

UNIT – II Chemistry of Cleansing Agents:

Soap: Definition of cleansing agents, Manufacture of soaps. Saponification of oils and fats. Different ingredients used and their

functions, Medicated soaps. Herbal soaps. Mechanism of action of soap. Preparation candle cleaning powder, pain balm, tooth paste tooth powder and disinfectants in small scale.

Detergents: Types of Detergents. Anionic detergents: Manufacture of LAB (linear alkyl benzene). Sulphonation of LAB – preparation of acid slurry. Cationic detergents: Examples, Manufacture and application. Non-ionic detergents: examples. Manufacture of ethylene oxide condensater. Mechanism of action of detergents. Comparison of soaps and detergents, Biodegradation – environmental effects.

UNIT – III Cosmetic Products:

Composition, characteristics of natural and synthetic cosmetic products such as, shampoo, Tooth powder, tooth paste, Talcum powder, Perfumes, creams, lotion-cleansing, moisturizing, all-purpose shaving cream, sunscreen and UV absorbers. Skin bleaching agents. Depilatories. Turmeric and Neem preparations. Vitamin oil, nail polish preparation, nail polish removers.

UNIT – IV Food and household chemical products:

Chemical Composition of Food: Carbohydrates, proteins, fats, vitamins, minerals, and water. Food Additives & Preservatives: Overview of artificial sweeteners (e.g., aspartame, sucralose), flavorings, emulsifiers, and food colorants. Preservation Techniques: Chemical preservatives (benzoates, sorbates), thermal processing (pasteurization, canning), and food safety management systems. Food Adulteration & Contaminants: Identifying common adulterants, testing methods, and pesticide residue analysis.

UNIT – V Fuel and Energy:

Fossil fuels (coal, petroleum, natural gas) LPG and kerosene, Biomass Conversion: Photosynthesis, thermo-chemical and biochemical conversion. Biogas: Aerobic oxidation and anaerobic digestion. Batteries and their functions and uses.

TEXT BOOKS:

1. B. K. Sharma, Industrial Chemistry, Goal publishing house 2000.
2. L. G. Schiffman and J. Wisenblit, Consumer chemistry, Wiley-interscience.

REFERENCES:

1. Malik and Aggarwal, Directory for small industries, Small Industry Research Institute, New Delhi (1975-1976)
2. B.S.Sekar, Small scale industries, Jaime Publications, Bombay, 1975

3. Malik and Dhingra, Handbook of Soap Industries, Small Industry Research Institute, Delhi (1974-1975)
4. Vasan, Siruthozhilal arimugam, New Century Book House Pvt. Ltd., Chennai, 1985.
5. Gobala Rao.S, Outlines of chemical technology, Affiliated East West press, 1998
6. Kafaro, Wasteless chemical processing, Mir publishers, 1995.
7. Sawyer.W, Experimental cosmetics, Dover publishers, New York, 2000.
8. Ayaz Mahmood Dar, Cosmetic Chemistry: An Instant Approach. Educreation Publishing, 2011.
9. P. K. Chattopadhyay, Modern Technology of Soaps, Detergents & Toiletries (with Formulae & Project Profiles) 4th Edn, NIIR Board publication.
10. S. A. Soosai raja, Neengalum Siruthozhilal nadathalam, New Century Book House Pvt. Ltd., Chennai, 1983.
11. George Howard, Principles and Practice of Perfumes and Cosmetics, Stanley Therones, Cheltenham: UK, 1987.
12. Thankamma Jacob, Foods, Drugs and Cosmetics - A Consumer Guide, Macmillan: London, 1997.
13. Willem Haverkot, Fuel cell and batteries, Delft University of Technology 2024

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**VALUE ADDED COURSE 1****Semester: I****Code:****ENVIRONMENTAL CHEMISTRY
(Theory)****Credits: 2*****COURSE OBJECTIVES:**

- To know the fundamentals of various environment.
- To study the Ecosystem, Biodiversity and its Conservation.
- To acquire knowledge about Renewable and Non-renewable energy sources and its conservation policies.
- To develop awareness about waste management practices and pollution monitoring techniques.
- To learn environment related social issues.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Explain various conventional and non-conventional energy resources and evaluate their environmental impacts.	K2
CO2	Understand biodiversity concepts, ecosystem conservation methods, and legal frameworks for biodiversity protection.	K1
CO3	Analyze renewable and non-renewable energy resources and apply principles of energy generation and conservation.	K4
CO4	Demonstrate knowledge of solid and hazardous waste management techniques and related environmental legislations.	K3
CO5	Evaluate environmental and social issues and develop awareness of environmental ethics, laws, and public health.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I ENERGY AND ENVIRONMENT:

Energy resources and their exploitation, Sun as the source of energy- nature of its radiation, Conventional energy sources: coal, oil, biomass and natural gas, nonconventional energy sources: hydroelectric power, tidal, wind, geothermal energy, solar collectors, photovoltaic, solar ponds, nuclear-fission and fusion, magnetohydrodynamic power (MHD), Energy use pattern in different parts of the world and its impact on the environment. CO₂ emission in atmosphere.

UNIT – II ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION:

Biodiversity concepts and patterns, microbial diversity, Plant

diversity, agrobiodiversity, soil biodiversity, economic value of biodiversity, biodiversity losses. Biodiversity hotspots and their characteristic flora and fauna, threatened plants and animals of India, ecosystem people and traditional conservation mechanisms, Biodiversity Convention and Biodiversity Act, IPRs, national and international programmes for biodiversity conservation.

UNIT – III ENERGY RESOURCES AND MAINTENANCE:

Renewable and non-renewable energy resources, growing energy need, solar radiation and its spectral characteristics, fossil fuels classification, composition. Physicochemical characteristics and energy content of coal, petroleum and natural gas. Principle of generation and conservation of conventional and non-conventional energy. Energy from biomass and biogas, an aerobic digestion, energy use pattern and future need projection in different parts of the world, energy conservation policies.

UNIT – IV SOLID AND HAZARDOUS WASTE MANAGEMENT:

Solid wastes: Definition, types, sources, characteristics and impact on environmental health. Waste generation rates. Concepts of waste reduction, recycling and reuse. Collection, segregation and transport of solid wastes Handling and segregation of wastes at source. Collection and storage of municipal solid wastes.

Hazardous wastes: Definition, sources and characteristics: Hazardous waste categorization, generation, collection, transport, treatment and disposal. Legislation on management and handling of municipal solid wastes and hazardous wastes.

UNIT – V SOCIAL ISSUES:

Urban issues - energy - water conservation - environmental ethics - global warming resettlement and rehabilitation issues - environmental legislations – environmental protection Act. 1986 - Air, water, wildlife and forest conservation Act – Population growth and explosion - Human rights and value education - environmental health - HIV/AIDS - Role of IT in environment and human health - women and child welfare -public awareness.

UNIT – VI MECHANISM OF RADIATION ACTION ON LIVING SYSTEMS (For Continuous Internal Assessment Only):

Stochastic and non-stochastic effects; delayed effects, radioactivity from nuclear reactors, fuel processing and radioactive waste, hazards related to power plants, terrestrial and non-terrestrial radiation, dose from environment and nuclear radiations, ultraviolet radiations, pathway analysis and dose assessment,

radiologic age dating, radioactivity risk assessment, criterion for safe exposure. Wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC, Wildlife Protection Act 1972. In-situ conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. Ex-situ conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium; In-vitro Conservation: germplasm and gene Bank; tissue culture: pollen and spore back, DNA bank.

TEXT BOOKS:

1. A.K. De, Environmental Chemistry, New Age International Publishers, 8th Edn, 2017.
2. Sharma B.K, and Kaur H, Environmental Chemistry, Goel Publishing House, Meerut, India, 2014
3. R. Rajagopalan, Environmental Studies, Oxford University Press, 3rd Edn, 2018.

REFERENCES:

1. Jadhav H.V, Elements of Environmental Chemistry, Himalaya, 1992.
2. Samir.K.Banerji, Environmental Chemistry, PHI Learning Pvt. Ltd, 1999.
3. Moore J. W and Moore E. A, Environmental Chemistry, Academic Press, New York, 1976.
4. Lunn G. and Sansone E.B, Destruction of Hazardous Chemicals in the laboratory, Wiley, New York, 1990.
5. Dara S.S, A Text book of Environmental Chemistry and Pollution Control, 8th Edn, S. Chand & Company, New Delhi, 2017.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**CORE COURSE 3****Semester: II****Code:****ORGANIC CHEMISTRY II
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To understand the nucleophilic and electrophilic substitution reactions.
- To learn the addition reactions.
- To study a variety of heterocycles.
- To learn the mechanism of elimination reactions.
- To know the chemistry of terpenoids, steroids and alkaloids.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the fundamental concepts, mechanisms, and factors influencing nucleophilic and electrophilic substitution reactions.	K1, K2
CO2	Apply the principles of addition and elimination reactions to interpret reaction mechanisms, stereochemistry, and product formation in organic reactions.	K3
CO3	Analyze the synthesis, reactivity, and mechanistic behavior of aromatic and non-aromatic heterocyclic compounds.	K4
CO4	Evaluate the influence of substituent effects, reaction conditions, stereochemical factors, and mechanistic pathways on the reactivity and selectivity of organic reactions.	K5
CO5	Design efficient synthetic strategies by integrating substitution, addition, elimination, photochemical, and pericyclic reactions for the synthesis of structurally complex organic molecules.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 – Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I NUCLEOPHILIC SUBSTITUTION REACTIONS:

Aliphatic nucleophilic substitution – mechanisms – SN1, SN2, SNi – ion-pair in SN1 mechanisms – neighbouring group participation, non-classical carbocations – substitutions at allylic and vinylic carbons. Reactivity – effect of structure, nucleophile, leaving group and stereochemical factors – correlation of structure with reactivity – solvent effects – rearrangements involving carbocations– Wagner-Meerwein and dienone-phenol rearrangements. Aromatic nucleophilic substitutions – SN1, SNAr, Benzyne mechanism – reactivity orientation – Ullmann, Sandmeyer and Chichibabin

reaction – rearrangements involving nucleophilic substitution – Stevens – Sommelet-Hauser and von-Richter rearrangements.

UNIT – II ELECTROPHILIC SUBSTITUTION REACTIONS:

Aromatic electrophilic substitution reaction – orientation, reactivity and mechanisms based on transition state theory with suitable reactions – substitutions in thiophene and pyridine – N-oxide – quantitative treatment of the structural effects on reactivity.

Substituent effects – origins of Hammett equation – principles of Hammett correlation – effect of structure on reaction mechanisms Hammett parameters – σ and ρ , modified forms of Hammett equation, Taft Equation. Aliphatic electrophilic substitution – SE_2 , SE_i and SE_1 mechanisms – diazonium coupling reactions – metals as electrophile in substitution reactions and decomposition of diazonium salts.

UNIT – III ADDITION AND ELIMINATION REACTIONS:

Addition to carbon-carbon multiple bonds – electrophilic, nucleophilic and free radical additions – orientation of the addition – stereochemical factors influencing the addition of bromine and hydrogen bromide, hydroxylation, 1,2- dihydroxylation – hydroboration leading to formation of alcohols – oxidation and ozonolysis. Addition to carbonyl and conjugated carbonyl systems – mechanism – Grignard reagents – 1,2- and 1,4-additions (lithium dimethylcuprate) – addition to carbon-oxygen double bond – Benzoin, Knoevenagel, Stobbe, Darzens glycidic ester condensation and Reformatsky reactions. Elimination reactions – mechanisms; E_1 , E_2 , E_1cB – stereochemistry of elimination, Hofmann's and Zaitsev's rules – competition between elimination and substitution – pyrolytic cis – elimination, Chugaev reaction – examples such as dehydration, dehydrohalogenation, Hofmann degradation, Cope elimination – Bredt's rule with examples.

UNIT – IV ORGANIC PHOTOCHEMISTRY:

Fundamental concepts- Jablonski diagram- energy transfer- characteristics of photo reactions-photo oxidation-photo reduction-photo reactions of ketones and enones- Norrish type I and II- reactions- photo-chemistry of alkenes, dienes and aromatic compounds- photosensitization- photo additions- Barton reaction- Paterno-Buchi reaction. Photo-Fries rearrangement – Zimmerman's di- π -methane rearrangement.

UNIT – V PERICYCLIC REACTIONS:

Concerted reactions- stereochemistry- orbital symmetry and

correlation diagram- Frontier molecular orbital approach- Woodward- Hoffmann rules- electrocyclic reactions- cycloaddition reactions- selection rules- sigmatropic rearrangements- selection rules with examples- 1,3 and 1,5 hydrogen shifts- Cope and Claisen rearrangements.

UNIT – VI ASYMMETRIC SYNTHESIS (For Continuous Internal Assessment Only):

Enantioselectivity and diastereoselectivity – Determination of enantiomeric and diastereomeric excess – Asymmetric induction: Nucleophilic addition to α -chiral carbonyl compounds: Prediction of stereochemistry using Cram and Felkin-Anh models – Diastereoselective aldol reaction: Addition of lithium and boron enolates to carbonyl compounds: Prediction of stereochemistry using Zimmerman-Traxler model – Classification of asymmetric synthesis – Asymmetric synthesis using chiral substrate: Synthesis using chirons such as amino acids, sugars and terpenoids (chiral pool synthesis) – Asymmetric synthesis using chiral auxiliary: Alkylation of chiral enolates, Evans oxazolidinones and chiral hydrazones – Asymmetric Diels-Alder reaction – Asymmetric synthesis using chiral reagents: Chiral lithium amides, BINAL-H and boranes – Asymmetric synthesis using chiral catalysts: Asymmetric oxidation (dihydroxylation, Sharpless and Jacobsen epoxidations) – Asymmetric reduction (Noyori and Corey-Bakshi-Shibata).

TEXT BOOKS:

1. J. March and M. B. Smith, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 6th Ed., Wiley, New York, 2007.
2. F. A. Carey, and R. J. Sundberg, Advanced Organic Chemistry, Parts A and B, 5th Ed., Springer, Germany, 2007.
3. S. Sankararaman, Pericyclic Reactions – A Textbook: Reactions, Applications and Theory; Wiley-VCH, New York, 2005.
4. R. K. Bansal, Reaction Mechanism in Organic Chemistry; Tata McGraw Hill, Noida, 1990.
5. J. D. Coyle, Organic Photochemistry, Wiley, New York, 1998.
6. I.L. Finar, Organic Chemistry; Vol.II, 7th Ed., Pearson Education Ltd., New Jersey, 2009.

REFERENCES

1. S. H. Pine and J. B. Hendrickson, D. J. Cram and G. S. Hammond, Organic Chemistry; 5th Ed., McGraw Hill, Noida, 1987.
2. J. M. Coxon, and B. Halton, Organic Photochemistry; 2nd Ed., Cambridge, University Press, UK, 1987.

3. G.R. Chatwal, Organic Photochemistry; 1st Ed., Himalaya Publications house, Bangalore, 1998.
4. T. H. E. Lowry and K. S. Richardson, Mechanism and Theory in Organic Chemistry; 3rd Ed., Benjamin-Cummings Publishing, USA, 1997.
5. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry, 2nd Ed., Oxford University Press, UK, 2012.
6. E. J. Corey, and X-M. Cheng, The Logic of Chemical Synthesis; 1st Ed., Wiley- Interscience, New York, 1995.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**CORE COURSE 4****Semester: II****Code:****PHYSICAL CHEMISTRY I
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To study the applications of quantum chemistry.
- To learn the applications of group theory.
- To study the basic concepts and mechanisms involved in photochemistry.
- To learn the effects of radiation on chemical systems and the applications of radiation chemistry in various fields.
- To understand the principles of statistical thermodynamics and their applications principles of statistical thermodynamics

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Demonstrate a clear understanding of the fundamental principles of quantum mechanics, quantum chemistry, and statistical thermodynamics.	K1, K2
CO2	Apply mathematical formulations and quantum mechanical models to analyse atomic, molecular, and thermodynamic systems.	K3
CO3	Analyse and interpret the behaviour of chemical systems using advanced concepts such as approximation methods, molecular orbital theory, and quantum statistics.	K4
CO4	Evaluate experimental techniques in fast reactions, photochemistry, and radiation chemistry, and assess their applications in modern chemical research.	K5
CO5	Compare and contrast classical, Bose–Einstein, and Fermi–Dirac statistics, and apply them to explain chemical phenomena and scientific applications.	K5, K6

K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating

UNIT – I BASIC QUANTUM MECHANICS:

Inadequacy of classical mechanics – black body radiation – Planck's quantum concept – photoelectric effect – Bohr's theory of hydrogen atom – hydrogen spectra – wave-particle dualism – uncertainty principle – decline of old quantum theory. Schrödinger equation – postulates of quantum mechanics – operator algebra: linear operator, Hermitian operators, eigenfunctions and eigenvalues, angular momentum operator – commutation relations and related theorems – orthogonality and normalization. Applications of wave mechanics to simple systems – particle in a box, one-and three-dimensional, particle with finite potential

barrier – the quantum mechanical tunneling.

UNIT – II QUANTUM CHEMISTRY –APPLICATIONS:

Applications of wave mechanics – the harmonic oscillator, rigid rotator – hydrogen and hydrogen like atoms – shapes and nodal properties of orbitals – space quantization – approximation methods – methods of variation, application to hydrogen and helium atoms – perturbation method – non- degenerate systems – helium atom – effective nuclear charge. Electron spin – many electron atoms – Pauli's principle – Slater determinants – atomic structure calculation – self-consistent field method – Hartree-Fock method for atoms – angular momentum in many electron systems –vector atom model- spin-orbit interaction, L-S and j-j coupling schemes.

UNIT – III MOLECULAR QUANTUM MECHANICS:

Born-Oppenheimer approximation-MO and VB treatments of hydrogen molecule- comparison- hybridization, solving wave equation for sp, sp² and sp³ hybrid orbitals – Huckel's molecular orbital theory and its application to ethylene and butadiene – charge density, pi-bond order and free valence. Computational Quantum chemistry- ab initio calculations (elementary treatment only)-valence shell ionization potentials.

UNIT – IV FAST REACTION TECHNIQUES, PHOTOCHEMISTRY AND RADIATION CHEMISTRY

Introduction – flow methods (continuous and stopped flow methods) – relaxation methods (T and P jump methods) – pulse techniques (pulse radiolysis, flash photolysis) – shock tube method – molecular beam method – lifetime method. Photophysical processes of electronically excited molecules – Jablonski diagram Stern-Volmer equation and its applications – experimental techniques in photochemistry – chemical actinometers – lasers and their applications. Differences between radiation chemistry and photochemistry – sources of high energy radiation and interaction with matter – radiolysis of water, solvated electrons – definition of G value, Curie, linear energy transfer (LET) and Rad – scavenging techniques – use of dosimetry and dosimeters in radiation chemistry – applications of radiation chemistry.

UNIT – V STATISTICAL THERMODYNAMICS:

Thermodynamic probability – probability theorems – relation between entropy and probability (Boltzmann-Planck equation), ensembles, phase space, Ergodic hypothesis, microstates and macrostates, Maxwell-Boltzmann distribution law.

partition functions – translational, rotational, vibrational and electronic partition functions. Relationship between partition functions and thermodynamic properties – calculation of equilibrium constants from partition functions – heat capacities of monatomic crystals – Einstein theory and Debye theory. Quantum statistics – Bose-Einstein (B.E.) and Fermi-Dirac (F.D.) distribution equations – comparison of B.E. and F.D. statistics with Boltzmann statistics – applications of quantum statistics to liquid helium, electrons in metals and Planck's radiation law – concept of negative Kelvin temperature.

UNIT – VI FUNDAMENTAL CONCEPTS OF QUANTUM CHEMISTRY (For Continuous Internal Assessment Only):

Preliminary mathematics; Fundamental concepts and problems in trigonometric - Exponential functions - Matrices Vector Algebra - Differential equations – Integrations - Legendre differential equations - Legendre and associated Legendre Polynomials - Hermite and Associated Laguerre polynomials - Orthogonal functions and Sturm-Liouville problems.

TEXT BOOKS:

1. A.K. Chandra, Introductory Quantum Chemistry; 4th Edn., Tata McGraw Hill, Noida, 1994.
2. D. A. McQuarrie, Quantum Chemistry; University Science Books, Sausalito, 2008.
3. J. Rajaram and J. C. Kuriakose, Thermodynamics for Students of Chemistry - Classical, Statistical and Irreversible; Pearson Education, New Delhi, 2013.
4. K. K. Rohatgi-Mukherjee, Fundamentals of Photochemistry; 3rd Edn., New Age International Pvt. Ltd., New Delhi, 2014.
5. Puri, Sharma & Pathania, Principles of Physical chemistry, Vishal Publishing Co, 56th Edn, 2026

REFERENCES:

1. S. F. A. Kettle, Symmetry and Structure; 2nd Edn., John Wiley and Sons, Chichester, 1995.
2. I. N. Levine, Quantum Chemistry; 5th Ed., Prentice Hall, New Jersey, 2000.
3. R.K. Prasad, Quantum Chemistry; 4th Edn., New Age International Publishers, New Delhi, 2014.
4. P. W. Atkins, Physical Chemistry; 7th Edn., Oxford University Press, Oxford, 2001.
5. HoriaMetiu, Physical Chemistry, Thermodynamics; Taylor and Francis, Singapore, 2006.
6. J. W. T. Spinks and R. J. Woods, Introduction to Radiation Chemistry; 3rd Edn., John Wiley and Sons, New York, 1990.
7. J. P. Lowe, and K. A. Peterson, Quantum Chemistry; 3rd

- Ed., Academic Press, Cambridge, 2005.
8. G. W. Castellan, Physical Chemistry; Narosa, New Delhi, 1986.
 9. J. N. Gurtu and A. Gurtu, Advanced Physical Chemistry; 5th Edn., Pragathi Prakashan, Meerut, 2006.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I

CORE PRACTICAL 2

Semester: II

Code:

ORGANIC CHEMISTRY PRACTICAL
(Practical)

Credits: 4

COURSE OBJECTIVES:

- To perform the qualitative analysis of a given organic mixture.
- To estimate the organic compounds

1. Qualitative analysis of an organic mixture containing two components (Separation followed by analysis of any one component)

Mixtures containing two components are to be separated (pilot separation) and purified (bulk separation) – The physical constants are to be reported (analysis).

2. Quantitative analysis of organic compounds Estimation of phenol, aniline, ketone and glucose.

3. Preparation (Double stages)

1. Acetanilide to *p*-nitroacetanilide to *p*-nitroaniline
2. Benzoin to benzil to benzilic acid
3. Benzophenone to benzopinacol to benzopinacolone
4. Aniline to tribromoaniline to tribromobenzene
5. Methyl benzoate to methyl-*m*-nitrobenzoate to methyl-*m*-nitrobenzoic acid
6. Methyl salicylate to salicyclic acid to acetyl salicyclic acid

REFERENCES:

1. J. Mohan, Organic Analytical Chemistry: Theory and Practice; Narosa, 2003.
2. V. K. Ahluwalia, P. Bhagat, and R. Agarwal, Laboratory Techniques in Organic Chemistry; I. K. International, 2005.
3. N. S. Gnanaprakasam and G. Ramamurthy, Organic Chemistry Lab Manual; S.V. Printers, 1987.
4. A. I. Vogel, A. R. Tatchell, B. S. Furniss, A. J. Hannaford and P. W. G. Smith, Vogel's Textbook of Practical Organic Chemistry; 5th Ed., Prentice Hall, 1989.

Year: I**DISCIPLINE CENTRIC ELECTIVE
COURSE 2****Semester: II****Code:****1. BIOINORGANIC AND
ORGANOMETALLIC CHEMISTRY
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To understand the role of metal ions in biological process.
- To learn the basic concepts of chemotherapy.
- To learn the fundamentals of organometallic compounds and catalysis.
- To understand the basic concepts and scope of bioinorganic chemistry.
- To study the structure and functions of heme and non-heme proteins.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the fundamental principles of bioinorganic chemistry, including the biological roles of metal ions, porphyrins, corrins, and photosynthetic systems.	K1, K2
CO2	Apply the concepts of bioinorganic chemistry to explain the structure, function, and mechanisms of heme and non-heme proteins, metalloenzymes, and metal-containing biomolecules.	K3
CO3	Analyze the roles of essential and toxic metals in medicine, including metal-based drugs, chelation therapy, chemotherapy, and radiopharmaceutical applications.	K4
CO4	Evaluate the structure, bonding, reactivity, and stability of organometallic compounds using concepts such as the 18-electron rule, hapticity, and the isolobal principle.	K5
CO5	Design organometallic catalytic strategies by integrating fundamental organometallic reactions and catalytic cycles for industrial and synthetic applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 - Creating		

UNIT – I GENERAL PRINCIPLES OF BIOINORGANIC CHEMISTRY:

Occurrence and availability of inorganic elements in biological systems – Porphyrin and corrin systems in biology- Vitamin B12 – Structure and function. Function and transport of alkali and alkaline earth metal ions: characterization of K^+ , Na^+ , Ca^{2+} and Mg^{2+} – complexes of alkali and alkaline earth metal ions with macrocycles – ion channels – ion pumps, catalysis and regulation of bioenergetic processes by the alkaline earth metal ions – Mg^{2+}

and Ca^{2+} . Metals at the center of photosynthesis – primary processes in photosynthesis – photosystems I and II-light absorption (energy acquisition) – exciton transport (direct energy transfer) – charge separation and electron transport – manganese catalyzed oxidation of water to O_2 .

UNIT – II HEME AND NON-HEME PROTEINS AND ENZYMES:

Heme and non-heme proteins – hemoglobin and myoglobin – oxygen transport and storage – electron transfer and oxygen activation – cytochromes, ferredoxins and rubredoxin – model systems, mononuclear non-heme iron enzymes. Copper containing proteins – classification and examples – electron transfer – oxygen transport-oxygenation – oxidases and reductases – cytochrome oxidase – superoxide dismutase (Cu, Zn) – nickel containing enzyme: urease.

UNIT – III METALS IN MEDICINE:

Bioinorganic chemistry of quintessentially toxic metals – lead, cadmium, mercury, aluminium, chromium, copper and plutonium – detoxification by metal chelation – drugs that act by binding at the metal sites of metalloenzymes. Chemotherapy – chemotherapy with compounds of certain non-essential elements – platinum complexes in cancer therapy – cisplatin and its mode of action – cytotoxic compounds of other metals. Gold containing drugs as anti-rheumatic agents and their mode of action – lithium in psychopharmacological drugs – radiopharmaceuticals – technetium.

UNIT – IV ORGANOMETALLICS:

Hapticity - The 18 electron rule – applications and limitations – preparation, properties, structure and bonding in metal carbonyls, metal nitrosyls – metal alkenes (Zeise salt)- metal alkyne – metallocene (Ferrocene)- metal arenes- dinitrogen complexes – fluxional molecules. Isolobal concept and its applications.

UNIT – V CATALYSIS IN ORGANOMETALLICS:

Organometallic reactions – ligand association and dissociation – oxidative addition and reductive elimination – insertion reactions- reactions of coordinated ligands. Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation(Oxo process), olefin oxidation (Wacker process) and carbonylation of methanol (acetic acid synthesis)- epoxidation of olefin, polymerization of olefins (Ziegler Natta catalyst)- olefin metathesis.

UNIT – VI METAL DRUG, DISCOVERY AND DESIGN (For Continuous Internal Assessment Only):

Drug discovery and design - Therapeutic index and chemotherapeutic index - Structure - activity relationship - Factors governing drug design - Computer aided drug design - Gold-based

drugs -treatment of cancer and rheumatoid - mechanism of interaction. Lithium containing drugs- uses - mode of interaction - side effects. Silver based drugs - anti-bacterial - antifungal agent - anticancer agent. Bismuth containing drugs - the treatment of acidity and related diseases.

TEXT BOOKS:

1. J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorganic Chemistry; 5th Edn., Pearson Education, 2022.
2. F. A. Cotton and G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry; 6th Edn, Wiley, 2007.
3. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry (formerly Shriver and Atkin's Inorganic chemistry), 6th Edn., Oxford University Press India, 2014.
4. J. D. Lee, Concise Inorganic Chemistry, 5th Edn, Wiley, 2008

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1. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; Thomson Learning, Boston, 1980.
2. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry; Panima Publishing Company, New Delhi, 1997.
3. W. Kaim and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Ed., John Wiley and Sons, New York, USA, 2013.
4. G. L. Eichhorn, Inorganic Biochemistry; Volumes 1 and 2, 2nd Ed., Elsevier Scientific Publishing Company, New York, 1975.
5. R. C. Mehrotra and A. Singh, Organometallic Chemistry; 2nd Ed., New Age International Ltd. New Delhi, 2014.
6. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals; 3rd Ed., John Wiley and Sons, New York, 2001.
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8. A. J. Pearson, Advances in Metal-Organic Chemistry, Vol. 1; Jai Press, Inc., Greenwich, 1989.
9. A. W. Parkins and R. C. Poller, An Introduction to Organometallic Chemistry; 1987, Oxford University Press, Chennai.
10. I. Haiduc and J. J. Zuckerman, Basic Organometallic Chemistry; Walter De Gruyter Inc, USA, 1985.
11. P. Powell, Principles of Organometallic Chemistry; 2nd Ed., Chapman and Hall, London, 1988.
12. B. Douglas, D. H. McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry; 3rd Ed., John Wiley and sons, New York, 1994.
13. M. Bochmann, Organometallics 1: Complexes with

transition metal-carbon bonds; Oxford Chemistry Primers Series, No. 12, and M. Bochmann, Organometallics 2: Complexes with transition metal-carbon bonds; No. 13, 1994.

14. J. P. Collman, L. S. Hegedus, J. R. Norton and R. G. Finke, Principles and Applications of Organotransition Metal Chemistry, University Science Books, California, 1987.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**DISCIPLINE CENTRIC ELECTIVE
COURSE 2****Semester: II****Code:****2. INORGANIC PHOTOCHEMISTRY
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To educate students on the principles of photochemistry.
- To understand the various photochemical properties of transition metal complexes.
- To acquire knowledge in charge transfer photochemistry.
- To learn the photochemical behavior of transition metal complexes.
- To know the various photochemical reactions taking place on solid surfaces.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and recall the fundamental principles of photochemistry, including photochemical laws, electronic excitation, energy dissipation, absorption and emission processes, Jablonski diagram, and photochemical techniques.	K1, K2
CO2	Apply the principles of photochemistry to explain the photophysical and photochemical behaviour of transition metal complexes, including photosubstitution, photoredox, photorearrangement, and ligand field effects.	K3
CO3	Analyze charge transfer photochemistry and ligand field photochemistry by interpreting charge transfer excitations, excited-state properties, energy transfer processes, and the photochemical reactions of coordination complexes.	K4
CO4	Evaluate the photochemical properties and reaction mechanisms of transition metal complexes by correlating excited-state electronic structures, photolysis rules, photosensitization, and redox behaviour with experimental observations.	K5
CO5	Design photochemical strategies for practical applications by integrating the principles of semiconductor photocatalysis, photoelectron transfer, solar energy conversion, water photolysis, carbon dioxide reduction, nitrogen fixation, and environmental remediation.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I PRINCIPLES OF PHOTOCHEMISTRY:

Absorption, excitation, photochemical laws, quantum yield.

Absorption and emission for complexes with different ground state /excited state for ML₆ complexes. Potential energy function and energy levels for ML₆ complexes. Flash photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes, absorption spectra. Frank-Codon principle, photochemical stages – primary and secondary processes. Jablonski diagram for photochemical process.

UNIT – II PHOTOCHEMICAL PROPERTIES OF TRANSITION METAL COMPLEXES:

Photo physical process, Photochemical process, Photo substitution reactions, photo redox reactions, Photo rearrangement reaction, Prompt and Delayed Photochemical reactions, Photolysis rules and ligand field theory.

UNIT – III CHARGE TRANSFER PHOTOCHEMISTRY:

Introduction, charge transfer absorption spectra, types of charge transfer excitations and their energy level scheme for charge transfer excitations, Types of reactions observed by charge transfer metal complexes.

UNIT – IV LIGAND FIELD PHOTOCHEMISTRY OF TRANSITION METAL COMPLEXES:

Photochemistry Cr(III) of complexes: Photo-substitutions, properties of ligand field excited states, Photoaquation reactions, photolysis rule, photoisomerization, photo racemization, photoanation reactions, sensitizer, energy transfer process, Mechanism of photosensitization, photo reactive excited state. The Doublet hypothesis, Role of quartet excited states, Photochemistry of Co(III) complexes: Introduction, energy level diagram, Photoaquations in Co(III) amine, Co(III) cyanide complexes, Fe(II) low spin complexes, Ru(II) ammine derivative complexes, Photo redox properties of Ce(III) and Ce(IV) complexes, photochemistry of Cu(II) (1,3 diketone) complexes.

UNIT – V PHOTOCHEMICAL REACTIONS ON SOLID SURFACE:

Introduction, photo electron transfer mechanism, energy level diagram of solid acceptor and donor levels, Examples of photo catalytic metal/mixed metal oxides and their applications, semiconductor supported metal oxides for photolysis of water, Decomposition of organic pollutants, experimental setup, end product of organic products, carbon dioxide reduction, nitrogen fixations, solar energy conversion and its storage. Chemiluminescence's in coordination complexes, Hexi state and Franck Condon state.

UNIT – VI REDOX REACTIONS BY EXCITED METAL COMPLEXES AND METAL COMPLEX SENSITIZERS: (For Continuous Internal Assessment Only)

Energy transfer under conditions of weak interaction and strong interaction- examples formation; condition of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates, (2,2-bipyridine and 1,10-phenanthroline complexes), illustration of reducing and oxidizing character of Ruthenium+2 (bipyridal complex, comparison with Fe (bipy); role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants into high energy products, chemical energy into light.

Metal complex sensitizer, electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation and carbon dioxide reduction.

TEXT BOOKS:

1. Adamson and Kutal, Inorganic Photochemistry, Jhon Wiley & Sons, 1975.
2. Porter, Introduction to Inorganic Photochemistry, Jhon Wiley & Sons, 1983.
3. S. Atkins, Inorganic Chemistry, Oxford University press, 7th Edn, 2022
4. Huheey, Keiter, Huheey, Medhi, Inorganic Chemistry, Pearson, 5th Edn, 2022

REFERENCES:

1. Ferraudi, G.J, Elements of Inorganic Photochemistry, Wiley, New York, 1988.
2. Lever, A. B. P, Inorganic Electronic Spectroscopy, Elsevier Science, 1984.
3. VeeraReddy, K, Symmetry and Spectroscopy of Molecules, New Age International, 1998

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				
3-Strong	2-Medium		1-Low		

Year: I**GENERIC ELECTIVE COURSE 2****Semester: II****Code:****1. GREEN CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To learn the green chemistry and their principles.
- To learn the importance of greener reactions.
- To study the various condensation reactions and their applications
- To know the different methods and reagents used in oxidation and reduction reactions.
- To understand the phase-transfer catalyst in green chemistry.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Acquire the basic knowledge of the principles of green chemistry, green synthesis, solvent selection, catalysts, and sustainable synthetic methodologies.	K1
CO2	Understand the concepts of green organic reactions, including addition, condensation, oxidation, reduction, and phase-transfer catalytic reactions under environmentally benign conditions.	K2
CO3	Apply green chemistry principles to perform and explain oxidation, reduction, phase-transfer catalysis, and sonochemical reactions in organic synthesis.	K3
CO4	Analyze various green synthetic methodologies by comparing reaction mechanisms, reaction media, catalysts, and environmentally friendly approaches for organic transformations.	K4
CO5	Evaluate suitable green synthetic strategies by selecting appropriate reaction conditions, catalysts, solvents, and energy sources for efficient and sustainable organic synthesis.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I INTRODUCTION TO GREEN CHEMISTRY:

Introduction to green chemistry – twelve principles of green chemistry – planning a green synthesis in a chemical laboratory – evaluating the type of reaction involved – rearrangement, addition, substitution, elimination and pericyclic reactions. Selection of appropriate solvent – aqueous phase reaction – reactions in ionic liquids – organic synthesis in solid state – solid supported organic

synthesis – selection of starting materials – use of protecting group
– use of catalyst – use of microwaves and sonication.

UNIT – II ADDITION AND CONDENSATION REACTIONS:

Addition reactions – Michael addition in [aqueous medium and solid state] – Diels-Alder reactions in aqueous phase. Condensation reactions – Aldol condensation of aldehydes with nitroalkanes and nitriles – Aldol condensation in solid phase – benzoin condensation under catalytic conditions – applications.

UNIT – III OXIDATION AND REDUCTION REACTIONS:

Oxidation reactions – Baeyer-Villiger oxidation in aqueous phase and solid state – enzymatic Baeyer-Villiger oxidation. Reduction reactions – Clemmensen reduction – mechanism – limitations – applications

UNIT – IV PHASE-TRANSFER CATALYST REACTIONS:

Phase-transfer catalyst reactions – Heck reaction – Michael addition reaction – oxidation of toluene to benzoic acid – Reimer-Tiemann reaction – Baker- Venkataraman synthesis – Williamson ether synthesis – Dozen reaction.

UNIT – V SONICATION REACTIONS:

Sonication reactions – Barbier reaction – Reformatsky reaction – Simmons-Smith reaction – Strecker synthesis – Ullmann coupling reaction – Wurtz reaction – Bouveault reaction.

UNIT – VI Emerging Green Technology, Alternative Energy Sources and Renewable Resources: (For Continuous Internal Assessment Only)

Design for Energy Efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry- Microwave heating –Microwave assisted reactions- Sono chemistry and Green Chemistry – Electrochemical Synthesis- Examples of Electrochemical synthesis. Biomass –Renewable energy – Fossil Fuels-Energy from Biomass-Solar Power- Other forms of renewable energy-Fuel Cells-Alternative Economics-Syngas economy- hydrogen economy-Bio refinery chemicals from fatty acids-Polymer from Renewable Resources –Some other natural chemical resources.

TEXT BOOKS:

1. V.K. Ahluwalia, Green Chemistry, 2nd Edn, Ane Books Pvt Ltd., New Delhi, 2016.
2. Mike Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry, 2016

REFERENCES:

1. P.T. Anastas and J. C. Warner, Green chemistry Theory and Practice, Oxford University Press, New York, 2005.

2. V.K. Ahluwalia and K. Agarwal, Organic Synthesis, Special Techniques; 2nd Edn, Narosa Publishing House, New Delhi, 2007.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**GENERIC ELECTIVE COURSE 2****Semester: II****Code:****2. SUPRAMOLECULAR
CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To know the fundamentals of supramolecular chemistry.
- To study the role of inter-ligand hydrogen bonding, crystal engineering, and supramolecular interactions
- To learn co-receptor molecules and multiple recognition
- To study the supramolecular reactivity and catalysis.
- To learn the principles and applications of supramolecular photonic, electronic, ionic, and switching devices including molecular wires, sensors, and energy transfer systems.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and explain the fundamental concepts of supramolecular chemistry, including non-covalent interactions, molecular recognition, crystal engineering, and supramolecular synthons.	K1, K2
CO2	Apply the principles of supramolecular chemistry to design and interpret metal-organic frameworks, nanoporous materials, crystal-engineered solids, and functional molecular assemblies.	K3
CO3	Analyze the structure, recognition properties, and dynamic behaviour of co-receptor molecules, metallo-receptors, molecular cages, and supramolecular host-guest systems.	K4
CO4	Evaluate the role of supramolecular catalysis, solution-phase supramolecular systems, and receptor-based catalytic processes for chemical and biological applications.	K5
CO5	Design supramolecular devices and functional materials by integrating molecular recognition, photonic and electronic systems, molecular switches, sensors, and nanotechnology-based applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 - Creating		

UNIT – I CONCEPTS OF SUPRAMOLECULAR CHEMISTRY:

Concepts and languages of supramolecular chemistry – various types of non-covalent interactions – hydrogen bonds, C-H...X interactions, halogen bonds – π - π interactions, non-bonded interactions – various types of molecular recognition.

Crystal engineering of organic solids – hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudo polymorphism–supramolecular isomorphism / polymorphism – crystal engineering of pharmaceutical phases.

UNIT – II METALLO ORGANIC FRAMEWORKS:

M.O.F (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. – design of nanoporous solids – Inter-ligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO materials, OLED.

UNIT – III CO-RECEPTOR MOLECULES AND MULTIPLE RECOGNITION:

Dinuclear and polynuclear metal ion cryptates– linear recognition of molecular length by ditopic co-receptors – heterotopic co-receptors – cyclophane receptors, amphiphilic receptors and large molecular cages – multiple recognition in Metallo receptors–supramolecular dynamics.

UNIT – IV SUPRAMOLECULAR REACTIVITY AND CATALYSIS:

Catalysis by reactive macro cyclication receptor molecules – catalysis by reactive anion receptor molecules – catalysis with cyclophane type receptors – supramolecular Metallo catalysis–cocatalysis– catalysis of synthetic reactions – biomolecular and abiotic catalysis.

Supramolecular chemistry in solution – cyclodextrin, micelles, dendrimers, gelators– classification and typical reactions – applications.

UNIT – V SUPRAMOLECULAR DEVICES:

Supramolecular devices and sensors – various types of supramolecular devices – an overview – supramolecular photochemistry – molecular and Supramolecular photonic devices – light conversion and energy transfer devices – molecular and supramolecular electronic devices – electronic conducting devices – molecular wires, modified and switchable molecular wires – molecular and supramolecular ionic devices – tubular mesophases, molecular protonics– switching devices – electro-photo switch – ion and molecule sensors – role of supramolecular chemistry in the development of nanoscience and technology.

UNIT – VIBIOLOGICAL SUPRAMOLECULAR SYSTEMS: (For Continuous Internal Assessment Only)

Ionophores, Porphyrin and other Tetrapyrrolic Macrocycles, Coenzymes, Neurotransmitters, DNA and Biochemical Self-assembly. Supramolecular reactivity: Biomimetic systems and Artificial receptors:

- (a) Cation Binding Hosts - Podand, Crown Ether, Cryptand, Spherand; Nomenclature, Selectivity and Solution Behaviour; Alkalides, Electrides, Calixarenes and Siderophores.
- (b) Anion binding hosts - Challenges and Concepts, Biological Receptors, Conversion of Cation Hosts to Anion Hosts, Neutral Receptors, Metal- Containing Receptors, Cholapods.
- (c) Ion Pair Receptors - Contact Ion Pairs, Cascade Complexes, Remote Anion and Cation Binding Sites, Symport and Metals Extraction.
- (d) Hosts for Neutral Receptors -Clathrates, Inclusion Compounds, Zeolites, Intercalates, Coordination Polymers, Guest Binding by Cavitands and Cyclodextrins, cucurbituril.

TEXT BOOKS:

- 1. J. M. Lehn, Supramolecular Chemistry; Wiley India Pvt. Ltd, 2014.
- 2. Katsuhiko Ariga and Toyoki Kunitake, Supramolecular Chemistry - Fundamentals and Applications, Springer, 2006.
- 3. J. M. Lehn, Transition Metals in Supramolecular Chemistry; John Wiley and Sons: New York, 1999.

REFERENCES:

- 1. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, United States, 1989.
- 2. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press, Oxford, 1999.
- 3. G. A Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press: UK, 1997.
- 4. G. R. Desiraju, Current Science; 2001, 81, 1038.
- 5. Web source:
 - (i) Crystal Growth and Design,
<http://www.pubs.acs.org/journals/cgdefu/index.html>
 - (ii) Crystal Engineering Communication
<http://www.rsc.org/Publishing/Journals/ce/index.asp>

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**GENERIC ELECTIVE COURSE 2****Semester: II****Code:****3. SOLID STATE CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To learn the band theory and defects of solids.
- To study the preparative methods and solid-state reactions.
- To learn the applications of thermal and magnetic materials.
- To study the chemistry of organic solids.
- To learn the applications of metal-organic frame work.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand and explain the fundamental concepts of solid-state chemistry, including band theory, crystal structures, crystal defects, semiconductors, superconductors, and the electronic properties of solids.	K1, K2
CO2	Apply the principles of solid-state chemistry to explain the preparation of solid materials, solid-state reactions, and the synthesis of advanced functional solids using various preparative techniques.	K3
CO3	Analyze the thermal, electrical, and magnetic properties of solids by interpreting heat capacity models, thermoelectric effects, magnetic behaviour, and structure–property relationships.	K4
CO4	Evaluate the influence of crystal packing, host–guest interactions, conductive organic solids, and solid-state reaction mechanisms on the properties and applications of organic solid-state materials.	K5
CO5	Design advanced functional materials by integrating the principles of metal–organic frameworks, crystal engineering, nanoporous solids, and organometallic systems for applications in optoelectronics, drug design, and nanotechnology.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I THEORY OF SOLIDS AND CRYSTAL DEFECTS:

Metallic state - free electron and band theories- Metals, insulators and semiconductors, electronic structure of solid-band theory, band structure of metals, insulators and semiconductor, intrinsic and extrinsic semiconductors, n- and p-type- doping semiconductor, p-n-junction, super conductors-general applications.

Defects in solids: Stoichiometry-Schottky defects and Frenkel defects - non- Stoichiometry defects- dislocations in solids-line-point defects.

UNIT – II PREPARATIVE METHODS AND SOLID STATE

REACTIONS:

Preparative methods: Chemical Precursor methods, co-precipitation, sol-gel metathesis, self-propagating high temperature synthesis, ion exchange reactions, intercalation/deintercalation reactions; hydrothermal and template synthesis, high pressure synthesis. Types of solid state reactions (Solid-solid, solid-liquid, solid-gas)

UNIT – III THERMAL AND MAGNETIC PROPERTIES OF SOLIDS:

Electronic specific heat, lattice heat capacity, Hall effect, Einstein theory, Debye theory, Born's modification of the Debye theory - thermoelectric effects, Thomson, Peltier, Seebeck.

Origin and classifications of magnetic substance, magnetic moment, ferromagnetic, antiferromagnetic and ferromagnetic ordering, magnetic susceptibility, Curie and Curie-Weiss law, super exchange, magnetic domains, and hysteresis.

UNIT – IV ORGANIC SOLID STATE CHEMISTRY:

Topochemical control of solid state organic reactions – intramolecular reactions – conformational effects – intermolecular reactions – molecular packing effects – photodimerization of 2-ethoxycinnamic acid (α form, β form, γ form) – photopolymerization of 2,5-distyrylpyrazine – photopolymerizations of diacetylenes.

Organic reactions within inorganic host structures – electrically conductive organic solids – organic metals, conjugated systems, doped polyacetylene, polyparaphenylene, polypyrrole – organic charge transfer complexes.

UNIT – V METALLO ORGANIC FRAMEWORKS:

M.O.Fs (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. Design of nanoporous solids.

Inter-ligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO and OLED materials.

UNIT – VI CRYSTAL ENGINEERING OF ORGANIC SOLIDS: (For Continuous Internal Assessment Only)

Hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudo polymorphism – supramolecular isomorphism,

polymorphism and crystal engineering of pharmaceutical phases.

TEXT BOOKS:

1. E. A. Moore and J. Readman, Solid State Chemistry: An introduction, CRC press, 2025.
2. A. R. West, Solid State Chemistry and Its Applications; 2nd Ed., John Wiley and sons, New York, 2014

REFERENCES:

1. J. M. Lehn, Supramolecular Chemistry; VCH, Weinheim, 1995.
2. G. R. Desiraju, Crystal Engineering: The Design of Organic Solids; Elsevier, Amsterdam, 1989.
3. G. R. Desiraju, and T. Steiner, The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press: Oxford, 2002.
4. G. A. Jeffrey, Introduction to Hydrogen Bonding; Oxford University Press, New York, 1997.
5. J. M. Lehn, Transition Metals in Supramolecular Chemistry; Vol 5, John Wiley and Sons, New York, 1999.
6. C. N. R. Rao, Current Science, 2001, 81, 1030.
7. Journals:
 - (i) Crystal Growth and Design
<http://www.pubs.acs.org/journals/cgdefu/index.html>
 - (ii) Crystal Engineering Communication,
<http://www.rsc.org/Publishing/Journals/ce/ind>

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I**SKILL ENHANCEMENT COURSE 2****Semester: II****Code:****RESEARCH TOOLS AND TECHNIQUES
IN CHEMISTRY
(Theory)****Credits: 2****COURSE OBJECTIVES:**

- To learn and understand the meaning and concepts of research, scientific methods, literature and scientific metrics.
- To gain skill and knowledge on scientific writing and publication ethics.
- To acquire knowledge on various scientific software, fundamentals of data analysis, statistical and regression analysis
- To understand the modern separation, spectral and microscopic analytical instruments
- To learn and improve the good laboratory skills, safety management in the laboratory, knowledge on project management and intellectual property rights.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand the fundamentals of research, literature, scientific writing, research ethics, computational and statistical tools, modern instruments, laboratory safety, project management and intellectual property rights.	K1, K2
CO2	Apply advanced scientific software and modern instrumental techniques for material analysis.	K3
CO3	Analyse the data using scientific software, output results using the statistical tools, the characters of prepared materials using advanced chromatographic, spectroscopic and microscopic instruments.	K4
CO4	Acquire skills on scientific writing, intellectual honesty, research integrity, citations and referencing	K2, K3
CO5	Learn and implement the skills on laboratory safety and management.	K3
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I RESEARCH FUNDAMENTALS AND LITERATURE SURVEY:

Introduction to Research: Meaning, objectives, significance, and types of research (basic, applied, qualitative, and quantitative).

Scientific Method: Formulating research problems and hypotheses; research design (exploratory, descriptive, and experimental).

Literature Sources: Primary, secondary, and tertiary sources; journals, reviews, monographs, and textbooks.

Literature Search: Using search engines (Google Scholar, Scirus, Chem Industry) and databases (ScienceDirect, SciFinder, Scopus, Web of Science).

Research Metrics: Understanding impact factors, citation index, h-index, g-index, and i10 index.

UNIT – II SCIENTIFIC WRITING AND PUBLICATION ETHICS:

Technical Writing: Structure of reports, dissertations, theses, and manuscripts; preparation of posters and review articles.

Citations and Referencing: Styles (APA, MLA, ACS), use of footnotes, and reference management software like Zotero or Mendeley.

Research Ethics: Scientific conduct, intellectual honesty, and research integrity.

Publication Misconduct: Definitions of plagiarism, falsification, fabrication, and redundant publications; ethical issues in human and animal research.

UNIT – III COMPUTATIONAL TOOLS AND STATISTICAL DATA ANALYSIS:

Scientific Software: Introduction to Microsoft Office, ChemDraw, ChemSketch, and Origin for chemical data representation.

Data Analysis Fundamentals: Significant figures, precision, accuracy, and types of errors (determinate and indeterminate).

Statistical Methods: Mean, standard deviation, and confidence intervals; statistical tests including the t-test, F-test, Q-test, and Chi-square test.

Regression Analysis: Least square analysis, correlation coefficients, and linear/non-linear regression.

UNIT – IV MODERN INSTRUMENTAL TECHNIQUES:

Chromatographic Techniques: Principles and applications of GC and HPLC; column efficiency and detector types.

Thermal and Electroanalytical Methods: Principles of TGA, DTA, DSC, and Cyclic Voltammetry.

Structural Elucidation: Integrated approach using UV-Vis, IR, NMR (¹H and ¹³C), and Mass spectral techniques.

Microscopic Techniques: Introduction to surface characterization using SEM, TEM, and AFM.

UNIT – V LABORATORY SAFETY, PROJECT MANAGEMENT, AND IPR:

Good Laboratory Practices (GLP): History, principles, and training; safe storage and disposal of hazardous/waste chemicals.

Laboratory Safety: Personal protective equipment (PPE), emergency procedures, first aid, and fire extinguisher use.

Project Management: Development stages, work breakdown

structure, and time/risk management.

Intellectual Property Rights (IPR): Definition and types of patents, patent application procedures, and criteria for patenting.

TEXT BOOKS:

1. H. Beall and J. Trimbur, A short Guide of Writing about Chemistry, 2nd Edn, Longman, 2001.
2. Handbook Good Laboratory Practice (GLP) Quality Practices for Regulated Non- Clinical, Research Development, 2nd Ed., 2008.
3. C. R. Kothari and Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 5th Edn, 2024
4. Ramesh Kumari, Computers and their Applications to Chemistry, Alpha Science International, 2nd Edn, 2005.
5. D. A. Skoog, D. M. West, and F. J. Holler, Fundamentals of Analytical Chemistry, Cengage Learning, 2022

REFERENCES:

1. A. M. Coghill and L. R. Gardson, The ACS Style Guide: Effective Communication of Scientific Information, Oxford University Press.
2. R. M. Silverstein and F. X. Webster, Spectrometric Identification of Organic Compounds, John Wiley, 1998.
3. K. Arora, The Patents Act, 1970 as amended by the Patents Act 2005, Professional Book Publishers.
4. James P. Lewis, Fundamentals of Project Management, amacom.
5. Jerry March, Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, John Wiley & Sons.
6. R. F. Egerton, Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM, Springer, 2016.

Websites:

1. INFLIBNET: <http://www.inflibnet.ac.in>
2. SWAYAM: <https://swayam.gov.in>
3. American Chemical Society (ACS) Publications: <http://www.pubs.acs.org>
4. Royal Society of Chemistry (RSC): <http://www.rsc.org>
5. Indian Patent Office: <http://www.patentoffice.nic.in/ipr/pa>
6. SpringerLink: <http://www.springerlink.com>

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: I	NON-MAJOR ELECTIVE COURSE 1	Semester: II
Code:	CHEMISTRY OF POLLUTION, FOOD AND COSMETICS (Theory)	Credits: 2

COURSE OBJECTIVES:

- To provide knowledge about different types of environmental pollution and their effects on human health and the environment.
- To understand the sources, characteristics, prevention and control measures of air, water and soil pollution.
- To familiarize students with the composition, analysis, standards, additives and adulteration of food products.
- To impart knowledge on cosmetic ingredients, formulations, quality standards and analytical methods used in cosmetics.
- To develop analytical skills and awareness regarding food safety, environmental protection and cosmetic quality control.

Course Outcomes (CO)		Knowledge Level
CO No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Understand the sources, types, effects, and prevention methods of air pollution and their impact on human health.	K1
CO2	Explain the water quality parameters, causes and effects of water pollution, and methods for water pollution control and prevention.	K2
CO3	Analyze soil pollutants, monitoring techniques, and the environmental impact of industrial and domestic waste on soil quality.	K3
CO4	Understand the composition, analysis, standards, additives, adulterants, and quality assessment of various food products.	K1
CO5	Explain the formulation, standards, ingredients, and analytical methods used in cosmetic products and preparations.	K2
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I AIR POLLUTION:

Air - Introduction- Definition- Composition of air- Air Pollution- Definition-Air Pollutants-Types of Air pollution - Causes of Air pollution on human health-Prevention of Air pollution

UNIT – II WATER POLLUTION:

Water – Introduction – Definition - Sources of water - Types of water - Water quality parameters - Water pollution – Definition - Types of Water pollution - Causes of Water pollution on human health-Prevention of Water pollution.

UNIT – III SOIL POLLUTION:

Soil quality standards, monitoring and analysis of selected soil contaminants: pesticides, heavy metals, POP's, fluoride, cyanide, nitrate, phosphate, oil & grease, Geobiochemical impact of municipal solid waste, steel plants effluent, domestic sewage.

UNIT – IV FOOD CHEMISTRY:

Introduction to general Constituents of food, Proximate Constituents and their analysis, Additives- Introduction -Types - Study of preservatives colors and Antioxidants and method of estimation, adulteration - Introduction, Types, Test for adulterants.

Introduction of standards composition and analysis of following foods: Wheat, Bread, Biscuits, Jam, Jelly, Honey, Milk, Ice Cream, Butter, Cheese, Milk Powder, Oils and Fats, Tea, Coffee, Soft drinks, Alcoholic beverages, Cereal and pulses, Confectionery, Fruits, Vegetables, Egg, Fish, Meat.

UNIT – V COSMETICS:

Introduction of Cosmetics, evaluation of cosmetics materials, raw material and additives, Cosmetics colors, Perfumes in cosmetics, Cosmetics formulating, introduction, standards and methods of analysis, Creams, Face powders, Make-up, Shaving preparations, Bath preparations.

UNIT – VI NOISE POLLUTION: (For Continuous Internal Assessment Only)

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods.

TEXT BOOKS:

1. A. K. De, Environmental Chemistry, Wiley Eastern, 2017.
2. B. Srilakshi, Food Chemistry, New age International Publishers, 7th Edn, 2018.
3. Sharma and Kaur, Environmental chemistry, Krishna Publishers.

REFERENCES:

1. S.M. Khopkar, Environmental Chemistry, Wiley Eastern.
2. F.J. Welcher Vol. III, Standard Method of Chemical Analysis, Van Nostr and Reinhold.Co.
3. Ed. J. Rose, Environmental Toxicology, Gordon and Breach Science Publication.
4. C. Baird, W.H. Freeman, Environmental Chemistry.
5. G.D. Christian, Analytical chemistry, J. Wiley.
6. S. M. Khopkar, Environmental Solution Analysis, Wiley Eastern.
7. F. Settle, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**CORE COURSE 5****Semester: III****Code:****INORGANIC CHEMISTRY II
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To educate students on electronic and Raman spectroscopy.
- To acquire knowledge in NMR spectroscopy
- To understand the fundamental principles of IR spectroscopy.
- To learn the applications of spectroscopic methods in structural and chemical analysis.
- To study the spectral characteristics and interpretation of EPR and Mossbauer spectra.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Recall the principles of electronic, IR, Raman, NMR, EPR, Mossbauer and NQR spectroscopy to develop fundamental knowledge in inorganic chemistry	K1
CO2	Understand electronic transitions, molecular vibrations EPR, Mossbauer and NQR spectroscopy to enhance critical thinking and decision-making skills for entrepreneurial development	K2
CO3	Apply the concepts of electronic, IR, Raman, NMR, EPR, Mossbauer and NQR spectroscopy to design and implement research-oriented approaches in inorganic chemistry	K3
CO4	Analyze electronic transitions, molecular vibrations, nuclear magnetic resonance, electron paramagnetic resonance, quadrupolar resonance and Raman spectroscopy to strengthen analytical and problem solving skills.	K4
CO5	Evaluate electronic, IR, Raman, NMR, EPR, Mossbauer and NQR spectroscopy to contribute effectively to societal development through scientific knowledge and collaboration	K5, K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I ELECTRONIC SPECTROSCOPY:

Microstates, terms and energy levels for d1 – d9 ions in cubic and square fields intensity of bands – group theoretical approach to selection rules – effect of distortion and spin-orbit coupling on spectra – evaluation of $10Dq$ and β for octahedral complexes of cobalt and nickel – applications to simple coordination compounds

– charge transfer spectra – electronic spectra of $[\text{Ru}(\text{bipy})_3]^{2+}$.

UNIT – II INFRARED AND RAMAN SPECTROSCOPY:

Vibrations in simple molecules (H_2O , CO_2) and their symmetry notation for molecular vibrations – group vibrations and the limitations – combined uses of IR and Raman spectroscopy in the structural elucidation of simple molecules like N_2O , ClF_3 , NO_3^- , ClO_4^- – effect of coordination on ligand vibrations – uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate and dimethyl sulfoxide.

Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls with reference to the nature of bonding – applications of Raman spectroscopy – Combined application of Raman and IR spectroscopy in inorganic small molecules.

UNIT – III NMR SPECTROSCOPY:

Examples for different spin systems – chemical shifts and coupling constants (spin-spin coupling) involving different nuclei (^1H , ^{19}F , ^{31}P , ^{13}C) interpretation and applications to inorganic compounds – Effect of quadrupolar nuclei (^2H , ^{10}B , ^{11}B) on the ^1H NMR spectra-Systems with chemical exchange-kinetic and thermodynamic parameters from NMR- satellite spectra – study of fluxional behaviour of molecules – NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions – lanthanide shift reagents.

UNIT – IV EPR SPECTROSCOPY:

Theory of EPR spectroscopy – Isotropic and anisotropic system-Hyperfine splitting (methyl, p-benzosemiquinone, naphthalene radical)-spin densities and McConnell relationship –g values ($g_{\perp}$ and $g_{\parallel}$)- factors affecting the magnitude of g and A tensors in metal species – Zero-field splitting and Kramers degeneracy – spectra of $\text{V}(\text{II})$, $\text{Mn}(\text{II})$, $\text{Fe}(\text{II})$, $\text{Co}(\text{II})$, $\text{Ni}(\text{II})$ and $\text{Cu}(\text{II})$ complexes – applications of EPR to a few biological molecules containing $\text{Cu}(\text{II})$ and $\text{Fe}(\text{III})$ ions.

UNIT – V MOSSBAUER SPECTROSCOPY AND NQR SPECTROSCOPY:

Theory of MB spectra- Isomer shifts -quadrupole splitting – magnetic interactions – applications to iron and tin compounds.

NQR spectroscopy – characteristics of quadrupolar nucleus – effects of field gradient and magnetic field upon quadrupolar energy levels – NQR transitions – applications of NQR

spectroscopy.

**UNIT – VI PHOTOELECTRON SPECTROSCOPY & X-RAY
ABSORPTION SPECTROSCOPY: (For Continuous Internal
Assessment Only)**

Photoelectron spectroscopy (UV and X-ray) – Physical principle – Experimental details - Koopman's theorem - chemical shift and correlation with electronic charges – Applications of PES. X-ray absorption spectroscopy (XAS) and Extended X-ray absorption fine structure (EXAFS) – Applications of X-ray absorption spectroscopy. X-ray Absorption Edges - X-ray Fluorescence - Measurement of X-ray Absorption Spectra -Theoretical Description of EXAFS Spectra - Single scattering, Multiple scattering – Data reduction and analysis - Applications: structure determination, Resolution of crystallographic disorder, Oxidation state, prediction of molecular symmetry, determinations of atoms present in the first coordination sphere (Edge & EXAFS analysis) – Structure of Metal clusters.

TEXT BOOKS:

1. R.S. Drago, Physical Methods in Inorganic Chemistry, Affiliated East-West Press Pvt. Ltd., New Delhi, 2012.
2. R.S. Drago, Physical Methods in Chemistry, Saunders College Publications, Philadelphia, 1992.
3. A. K. Das, M. Das, Fundamental Concepts of Inorganic Chemistry, Vol 5, CBS Publishers, 2019.
4. J. A. Iggo, K. Luzyanin, NMR Spectroscopy in Inorganic Chemistry, 2nd Edn, Oxford Chemistry Primers, Oxford University Press 2020.
5. P.K. Ghosh, Introduction to Photoelectron Spectroscopy, John Wiley, New York, 1989

REFERENCES:

1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 6th Edn, Wiley- Eastern Company, New Delhi, 1999.
2. P.J. Wheatley, The Determination of Molecular Structure, 2nd Edn, Dover Publications, Mineola, 1981.
3. D.N. Sathyanarayana, Electronic Absorption Spectroscopy and Related Techniques, University Press, Hyderabad, 2001.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**CORE COURSE 6****Semester: III****Code:****PHYSICAL CHEMISTRY II
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To understand the basic concepts and types of different spectroscopic techniques.
- To know the principles and instrumentation involved in various spectroscopic methods.
- To acquire knowledge about the applications of spectroscopy in chemical and structural analysis.
- To understand the concepts, mechanisms, and applications of surface phenomena in physical and chemical processes.
- To study the types and mechanisms of catalysis.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Understand and explain the fundamental principles of molecular spectroscopy, including microwave, infrared, Raman, electronic, photoelectron, and laser Raman spectroscopy, and their applications in molecular structure determination.	K1, K2
CO2	Apply the concepts of group theory to determine molecular symmetry, assign point groups, construct character tables, and predict IR and Raman spectral activities of molecules.	K3
CO3	Analyze molecular spectra and symmetry-related properties by interpreting rotational, vibrational, electronic, and photoelectron spectra using spectroscopic principles and selection rules.	K4
CO4	Evaluate adsorption phenomena, surface characteristics, and homogeneous and heterogeneous catalytic mechanisms using adsorption isotherms, kinetic models, and micellar catalysis concepts.	K5
CO5	Design solutions to advanced chemical problems by integrating the principles of spectroscopy, group theory, surface chemistry, and catalysis for research and industrial applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I SPECTROSCOPY I:

Interaction of electromagnetic radiation with molecular systems –

time evolution of the systems under radiation – Einstein transition probability for induced absorption and spontaneous and stimulated emission – absorption coefficients- transition moment and oscillator strength. Microwave spectroscopy – rotational spectra of diatomic molecules, rigid and non- rigid rotors – intensity of spectral lines – effects of isotopic substitution – microwave spectra of polyatomic molecules – linear and symmetric top molecules – Stark effect

UNIT – II SPECTROSCOPY II:

Infrared spectra – diatomic molecules, simple harmonic and anharmonic oscillators – diatomic vibrating rotator rotation – vibration spectrum of carbon monoxide – interaction of rotation and vibration (breakdown of Born- Oppenheimer approximation) – influence of the rotation on the spectrum of polyatomic molecules, linear and symmetric top molecules, parallel and perpendicular vibrations – influence of nuclear spin. Raman spectra - rotational Raman spectra of linear and symmetric top molecules – vibrational Raman spectra – rotational fine structure-polarization of light and Raman effect. Laser Raman spectroscopy- principle-applications.

UNIT – III SPECTROSCOPY III:

Electronic spectra of diatomic molecules- vibrational coarse structure – intensity of vibrational lines in electronic spectra – Franck-Condon principle- predissociation-rotational fine structure- Fortrat diagram. Electronic spectra of poly atomic molecules. Photoelectron Spectroscopy: Basic Principles – Koopman's theorem – UPES, XPS (ESCA and Auger Spectroscopy) – valence and core binding analysis, examples and applications of ESCA with two examples.

UNIT- IV GROUPTHORY AND ITS APPLICATIONS:

Symmetry and group theory: Symmetry elements and operations – point groups – assignment of point groups to molecules – group postulates and types of groups – group multiplication tables, sub groups, similarity transformations – conjugate elements and classes. Matrix representation of symmetry operations and point groups – reducible and irreducible representations – properties of irreducible representation. The great orthogonality theorem – construction of character table (C_{2v} & C_{3v})– direct product – projection operators – symmetry of hybrid orbitals. Applications: vibrational spectra – selection rules for fundamental vibrational transition – IR and Raman activity of fundamentals in CO_2 , HO , N_2F_2 –the rule of mutual exclusion and Fermi resonance.

UNIT – V SURFACE PHENOMENA AND CATALYSIS:

Adsorption of gases on solids – Langmuir theory-BET theory of multilayer adsorption-derivation of BET equation-surface area determination-adsorption from solutions-Gibbs adsorption isotherm – solid-liquid interfaces – contact angle and wetting.

Homogeneous catalysis: General catalytic mechanism-Equilibrium and steady state treatments-acid-base catalysis-protolytic and prototropic mechanisms- Brønsted relations- Acidity functions. Heterogeneous catalysis: role of surface-semiconductor catalysis-Kinetics of heterogeneous catalysis-- Langmuir- Hinshelwood mechanism, Langmuir-Rideal mechanism – Rideal-Eley mechanism. Surfactants-micelle formation-CMC-Micellar catalysis.

UNIT – VI ELECTROCHEMISTRY III (For Continuous Internal Assessment Only):

Electrochemical Cells: Electromotive force - measurement of EMF - the potentiometer - the electrochemical potential - the cell EMF and the cell reaction - reversible cells - types of half cells - classification of cells - the standard EMF of a cell - standard electrode potentials - calculation of the EMF of a cell - Nernst equation and its limitations - calculation of solubility products - standard free energies and entropies of aqueous ions - electrode concentration cells - electrolyte concentration cells - cells with liquid junctions - oxidation - reduction reactions, measurement of pH, concentration cells with transference – Electrochemical energy systems - Li-ion batteries-Methanol Fuel cells.

TEXT BOOKS:

1. C. N. Banwell, Fundamentals of Molecular Spectroscopy, 4th Edn, McGraw Hill Education, Noida, 1994.
2. Puri, Sharma & Pathania, Principles of Physical chemistry, Vishal Publishing Co, 46th Edn, 2024.
3. F. A. Cotton, Chemical Applications of Group Theory, 3rd Edn, John Wiley & Sons, Singapore, 2003.
4. P. Atkins and J. de Paula, Physical Chemistry; 9th Edn, W. H. Freeman Publications, New York, 2009.

REFERENCES:

1. G. W. Castellan, Physical Chemistry, Narosa, New Delhi, 1986.
2. B.P. Straughan and S. Walker, Spectroscopy; Vol.1-3, Halstead Press, Sydney, 1978.
3. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, New York, 1964.
4. R. L. Flurry, Jr, Symmetry Groups: Theory and Chemical Applications, Prentice Hall, New Jersey, 1980.
5. S. Glasstone, Introduction to Electrochemistry, Maurice Press, Philadelphia, 2008.
6. L. Antropov, Theoretical Electrochemistry, University Press of the Pacific, USA, 2001.
7. S. Glasstone, An Introduction to Electrochemistry, Read Books, New Delhi, 2007.
8. J. O'M Bockris and A. K. N. Reddy, Modern Electrochemistry, Vol. 1 and 2, 2nd Edn., Plenum Press, New York, 1998.
9. M. Gratzel and K. Kalyanasundaram, Kinetics and

Catalysis in Micro Heterogeneous Systems, Academic Press,
New York, 1991.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

To perform the various techniques of physical chemistry experiments.

1. Colorimetry-Determination of integral and differential heat of solutions.
2. pH titration of Ortho-phosphoric acid.
3. Adsorption – Oxalic Acid\Acetic Acid on charcoal using Freundlich isotherm.
4. Study of phase diagram of three components system (acetic acid, benzene, and water)
5. Kinetics – Saponification of Ester – Determination of E_a by Conductivity method.
6. Conductometry – Mixture of acid-base titration.
7. Conductometry – Precipitation titration.
8. Conductometry – Determination of dissociation constant of weak acids.
9. Conductometry – Solubility product of sparingly soluble silver salts.
10. Conductometry-Verification of Onsager equation.
11. Potentiometric titrations – Mixture of acid-base titration.
12. Potentiometric titrations – Precipitation titration.
13. Potentiometry – Determination of dissociation constant of week acids.
14. Potentiometry – Determination of solubility of silver salts.
15. Potentiometry – Determination of activity and activity coefficients of Ions.

REFERENCES:

1. B.P. Levitt, Findlay's Practical Physical Chemistry; 9th Edn, Longman, 1985.
2. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry; Vol. 1- Physical, S. Chand and Co., New Delhi, 1987.
3. J.B. Yadav, Advanced Practical Physical Chemistry; 20th Edn, GOEL Publishing House, Krishna Prakashan Media Ltd., Chennai, 2001.

Year: II DISCIPLINE CENTRIC ELECTIVE COURSE 3 Semester: III

Code: 1. HETEROCYCLES, NATURAL PRODUCTS AND Credits: 4
ORGANIC SPECTROSCOPY
(Theory)

COURSE OBJECTIVES:

- To learn the photochemistry and pericyclic reactions
- To apply the various spectroscopic techniques of organic compounds
- To understand the retro synthetic analysis and strategy.
- To learn the applications of spectroscopic and mass spectrometric techniques in structural elucidation and chemical analysis.
- To know the instrumentation and working methods involved in different spectroscopic techniques.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Identify and explain the fundamental concepts of heterocyclic chemistry, natural products, and advanced spectroscopic techniques used for the structural elucidation of organic compounds.	K1, K2
CO2	Apply the principles of heterocyclic chemistry, biosynthetic pathways, and spectroscopic techniques to explain the structure, synthesis, and characterization of organic compounds.	K3
CO3	Analyze the synthesis, reactivity, and biological significance of heterocyclic compounds and natural products, and interpret spectroscopic data for structural elucidation.	K4
CO4	Evaluate the effectiveness of spectroscopic methods and synthetic approaches in determining molecular structure, stereochemistry, and reaction pathways of organic compounds..	K5
CO5	Formulate synthetic and analytical strategies for the identification and characterization of organic compounds by integrating heterocyclic chemistry, natural product chemistry, and spectroscopic methods.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I HETEROCYCLES:

Non-aromatic heterocycles – synthesis of aziridines – oxiranes – thiiranes – azetidines – oxetanes – tetrahydrofurans – pyrrolidines – tetrahydropyrans – piperidines. Synthesis and reactivity of

aromatic heterocycles: oxazoles – imidazoles – thiazoles- isoxazoles – pyrazoles – isothiazoles – triazoles – pyrimidines – purines – triazines.

UNIT – II NATURAL PRODUCTS:

Terpenoids: Introduction – biosynthesis of menthol and camphor – total synthesis: Corey's synthesis of longifolene, Curran's synthesis of hirsutene. **Steroids:** Introduction – biosynthesis of cholesterol – partial synthesis of androsterone and testosterone (from Cholesterol) – total synthesis: Johnson's synthesis of progesterone and Vollhardt's synthesis of estrone.

Alkaloids: Introduction – biosynthesis of nicotine – total synthesis: Corey's synthesis of epibatidine and Woodward's synthesis of reserpine.

UNIT – III ULTRAVIOLET AND VISIBLE SPECTROSCOPY & INFRARED SPECTROSCOPY:

Ultraviolet and visible Spectroscopy: Basic principles of electronic transitions- correlation of energy change with electronic transitions- Applications of UV- visible spectroscopy- Woodward Fischer Scott rules- applications to conjugated dienes, trienes and polyenes- unsaturated carbonyl compounds- conjugated cyclic ketones- acetophenones – benzene and its substituted derivatives- other aromatic hydrocarbons- heterocyclic systems- differentiation of position isomers- stereo-chemical factors affecting electronic spectra of biphenyl and binaphthyls- cis trans isomers- angular distortion- cross conjugation.

Infrared Spectroscopy: Factors influencing group frequencies- quantitative studies- finger print region - identification of functional groups- hydrogen bonding, intermolecular and intra molecular- solvent effect on vibrational frequencies.

UNIT – IV NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:

¹H NMR Spectroscopy – multiplicity – coupling constants – spin-spin splitting – vicinal and geminal coupling constants – Karplus equation – long range coupling constants, influence of stereochemical factors on chemical shift of protons.

Simplification of complex spectra – double resonance techniques, shifts reagents – chemical spin decoupling of rapidly exchangeable protons (OH, SH, COOH, NH, NH₂) – an elementary treatment of NOE phenomenon.

¹³C NMR Spectroscopy – broad band decoupling – off resonance decoupling – chemical shifts of common functional groups – FT NMR and its importance– DEPT spectra – identification of small

compounds based on NMR data – 2D techniques: ¹H–¹H COSY, ¹H– ¹³C HETCOR – NOESY-Heteronuclear Multiple Bond correlation (HMBC).

UNIT – V MASS SPECTROMETRY AND SPECTROMETRIC IDENTIFICATION OF ORGANIC COMPOUNDS:

Mass Spectrometry: Resolution – ESI, EI, CI and FAB methods – base peak, isotopic peaks, metastable peaks – importance of metastable peaks, parent peak, recognition of molecular ion peak – fragmentation – general rules – pattern of fragmentation for various classes of compounds, McLafferty rearrangement – nitrogen rule.

Application of UV, IR, NMR and mass spectroscopy – structural elucidation of organic compounds – (minimum 15 problems should be worked out).

UNIT – VI RETROSYNTHETIC ANALYSIS (For Continuous Internal Assessment Only):

Introduction to disconnections – synthons and synthetic equivalents – synthon approach – electron donors (nucleophiles) – electron acceptors (electrophiles) Introduction of functional groups – umpolung reactions – one group disconnections: alcohols, olefins, ketones, acids – two group disconnections: 1,2-, 1,3-, 1,4- and 1,5-difunctional compounds – convergent syntheses. Functional group interconversion – functional group addition – carbon-heteroatom bonds – methods for 3- and 4-membered rings – synthesis of mono-and difunctional open chain molecules – mono and bicyclic molecules with substituents.

TEXT BOOKS:

1. I. L. Finar, Organic Chemistry, Vol.II, Pearson Education India; 5th Edn, 2002.
2. T. L. Gilchrist, Heterocyclic Chemistry, 3rd Ed., Prentice Hall, 1997.
3. J.A. Joule, K. Mills, Heterocyclic Chemistry, 4th Ed., Blackwell Publishing, 2007.
4. M. Silverstein and F. X. Western, Spectroscopic Identification of Organic Compounds, 8th Edn, John Wiley, New York, 2014.
5. Y. R. Sharma, Elementary Organic Spectroscopy – Principles and Chemical applications, S. Chand, New Delhi, 1992.
6. P. S. Kalsi, Spectroscopy of Organic Compounds, 6th Edn, New Age International Publishers, New Delhi, 2004. 1999.

REFERENCES:

1. W. Kemp, Organic Spectroscopy, 3rd Edn, Palgrave, New York, 1991.
2. J. R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, PHI Learning, New Delhi, 2009.
3. K. C. Nicolaou and E. J. Sorensen, Classics in Total Synthesis, Targets, Strategies, Methods; Wiley VCH, Germany, 1996.
4. Longifolene: F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry; Vol.2. 5th Ed., Springer, Berlin, 2008.
5. Androsterone and Testosterone: J. Chem. Soc. Perkin Trans. I; 1986, 117.
6. Epibatidine: J. Org. Chem; 1993, 58, 5600.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

COURSE OBJECTIVES:

- To learn the preparation, properties of amino acids and proteins.
- To study the activity of enzymes and cofactors.
- To know basics of lipids and nucleic acids.
- To learn the concept of bioenergetics.
- To learn the principles of lead and analogue synthesis.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Understand and explain the fundamental concepts of amino acids, proteins, enzymes, cofactors, lipids, nucleic acids, and bioenergetics, including their structures, properties, and biological functions.	K1, K2
CO2	Apply the principles of enzymology, bioenergetics, and biomolecular chemistry to explain enzyme mechanisms, cofactor functions, ATP-mediated energy transformations, and biomolecular processes.	K3
CO3	Analyze the structural organization and functional relationships of proteins, lipids, nucleic acids, and metabolic energy systems using biochemical and thermodynamic principles.	K4
CO4	Evaluate synthetic strategies by applying retrosynthetic analysis, functional group interconversions, asymmetric synthesis, stereoselective and stereospecific reactions, and catalytic methodologies.	K5
CO5	Design efficient synthetic strategies for biomolecules by integrating bond-forming and bond-breaking reactions, biological group transfer mechanisms, terpene biosynthesis, Merrifield solid-phase peptide synthesis, and peptide/DNA sequencing methods for research and pharmaceutical applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I AMINO ACIDS AND PROTEINS:

Structure, classification, synthesis and properties of amino acids – biosynthesis of amino acids – peptides – N-terminal and C-terminal residue analysis – solid phase peptide synthesis. Proteins – classification and properties (denaturation, isoelectric point and

electrophoresis), primary, secondary, tertiary and quaternary structures of proteins – biological roles of proteins.

UNIT – II ENZYMES AND COFACTORS:

Chemical nature of enzymes – characteristics of enzymes – colloidal nature, catalytic nature. Mechanism of enzymes – Michaelis-Menten hypothesis – Fischer's lock and key model – regulation of enzyme activity. Structure and biological functions of coenzyme A, NAD⁺, FAD and vitamin B12.

UNIT – III LIPIDS AND NUCLEIC ACIDS:

Lipids – definition – simple lipids – fats and oils – compound lipids – phospholipids, glycolipids – physical properties – solubility, melting point, surface tension, emulsification and geometric isomerism – chemical properties – reaction involving -COOH group, -OH group and double bonds. Nucleic Acid – definition – nucleosides and nucleotides – deoxyribonucleic acid (DNA) – internucleotides linkages – base composition – double helical structure.

UNIT – IV BIOENERGETICS:

Concept of energy – thermodynamic principles – first law, second law, combining the two laws – relationship between standard free energy change and equilibrium constant. Standard free energy values of chemical reactions – Adenosine triphosphate (ATP) as universal currency of free energy in biological systems – ATP hydrolysis and equilibria of coupled reactions – inter conversion of adenine nucleotides.

UNIT – V BIOORGANIC REACTIONS

Timing of Bond formation and fission – Acyl group transfer – C-C bond formation and fission – Catalysis of proton transfer reactions – Transfer of hydride ion – Alkyl group. Transfer – Terpene biosynthesis – Merrifield state peptide synthesis – Sanger method for peptide and DNA sequencing.

UNIT – VI LEAD AND ANALOGUE SYNTHESIS: (For Continuous Internal Assessment Only):

Designing organic synthesis – disconnection approach – synthons and synthetic equivalents – one group disconnections: alcohol, acid and ketone – functional group interconversions. Asymmetric synthesis – basic principles – stereoselective and stereospecific reactions – reagents, catalysts and their applications (wherever applicable) in alkylation and hydrogenation – Jacobsen's catalyst –

Evan's catalyst.

TEXT BOOKS:

1. J. L. Jain, Fundamentals of Biochemistry; S. Chand and Co., New Delhi, 2007.
2. A. L. Lehninger, Principles of Biochemistry, Worth Publishers, 3rd Edn, 2000
3. Voet and Voet, Biochemistry, John Wiley Publication, 4th Edn, 2012.
4. I.L. Finar, Organic Chemistry; Vol.II, 7th Edn, Pearson Education Ltd., New Jersey, 2009.

REFERENCES:

1. N. C. Price and L. Stevens, Fundamental of Enzymology; Oxford University Press, UK, 1999.
2. L.Stryer, and W.H. Freeman, Biochemistry, 5th Edn, 2007
3. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry: Part-A and Part-B; 5th Edn, Springer, Germany, 2008
4. S. Warren, Designing Organic Synthesis: The Disconnection Approach; 2nd Ed., Wiley, New York, 2008.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3
	3-Strong			2-Medium			1-Low			

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				
	3-Strong		2-Medium		1-Low

Year: II**GENERIC ELECTIVE COURSE 3****Semester: III****Code:****1. AGRICULTURAL CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To study the information about soil fertility.
- To understand the soil fertility and nutrient transformation.
- To know about soil quality.
- To learn about the essential plant nutrients.
- To understand the mechanism of potassium fixation.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Understand the fundamental concepts, principles, and scope of Soil Science, including the nature and composition of soils.	K1
CO2	Explain the role of soil-forming factors and soil-forming processes in the development and classification of soils.	K2
CO3	Apply the knowledge of soil physical, chemical, and biological properties to interpret their influence on plant growth and soil productivity.	K3
CO4	Analyze soil fertility, essential plant nutrients, and nutrient transformations to evaluate their significance in crop production and soil health.	K4
CO5	Evaluate different approaches to soil fertility management through the use of manures, fertilizers, and integrated nutrient management practices for sustainable agriculture.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I SOIL FERTILITY AND SOIL PRODUCTIVITY:

Nutrient sources - fertilizers and manures; essential plant nutrients - functions and deficiency symptoms-Soil and fertilizer nitrogen - sources, biological nitrogen fixation -types, mechanism-microorganisms and factors affecting- nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency

UNIT – II SOIL QUALITY:

Define soil-causes poor soil quality-Fertilizer use efficiency; blanket fertilizer recommendations - usefulness and limitations; site-specific nutrient management; plant need based nutrient management; integrated nutrient management- soil fertility

evaluation.

UNIT – III PRIMARY AND SECONDARY MACRONUTRIENTS:

Calcium and magnesium fertilizers, macronutrients - critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants- Role of chelates in nutrient availability- common soil test methods for fertilizer recommendations.

UNIT – IV ESSENTIAL MACRONUTRIENTS:

Chemical analysis of soil for total N, P & K and available nutrients (N, P, K, S, Cu, Fe, Mn, Zn, Mo, B), analysis of plants for essential elements (N, P, K, S, Cu, Fe, Mn, Zn, Mo, B).

UNIT – V FIXATION OF NUTRIENT:

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions, potassium - forms, equilibrium in soils and its agricultural significance-mechanism of potassium fixation.

UNIT – VI FIELD VISIT (For continuous internal assessment only):

Types of soil, selection of soil for cultivation, testing of soil and water. Fertilizer-types need for fertilizer merits and demerits for usage of fertilizer. Pesticide-types, advantages and disadvantages of pesticides. Comparison of natural and synthetic fertilizers & pesticides.

TEXT BOOKS:

1. T. Anderson, Elements of Agricultural Chemistry, Tredition Classics, 2012.
2. S. E. Manahan, Environmental Chemistry, Lewis Publishers, 11th Edn, 2022
3. P. Gurumurthy and K. P. C. Reddy, Text Book of Soil Science and Agricultural Chemistry, S Pubilshers, 2022.
4. A. K. De, Environmental Chemistry, Wiley Eastern, 11th Edn, 2023.

REFERENCES:

1. Brady NC & Weil RR, The Nature and Properties of Soils, 13th Edn. Pearson Edu., 2002
2. Kannaiyan S, Kumar K & Govindarajan K., Biofertilizers Technology, Scientific Publ., 2004
3. Leigh JG., Nitrogen Fixation at the Millennium, Elsevier, 2002
4. Mengel K & Kirkby EA., Principles of Plant Nutrition, International Potash Institute, Switzerland, 1982
5. Mortvedt JJ, Shuman LM, Cox FR & Welch RM., Micronutrients in Agriculture, 2nd Edn. SSSA, Madison, 1991
6. Pierzinsky GM, Sims TJ & Vance JF, Soils and Environmental Quality, 2nd Edn. CRC Press, 2002.
7. Troeh FR & Thompson LM. Soils and Soil Fertility, Blackwell, 2005

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3
	3-Strong			2-Medium			1-Low			

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				
	3-Strong		2-Medium		1-Low

Year: II**GENERIC ELECTIVE COURSE 3****Semester: III****Code:****2. MATERIALS CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To learn the fundamental structural aspects and symmetry of solid-state materials.
- To understand the chemistry and methodologies behind the synthesis of advanced materials.
- To explore the structure, properties, and applications of polymers and composite systems.
- To know the correlation of the physical properties of materials with their chemical structure for technological use.
- To examine materials at the nanoscale and their role in modern energy and environmental research.
- To learn through self-study on the theoretical principles and analytical applications of modern materials, bridging the gap between fundamental chemistry and industrial technology.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Understand the fundamental concepts of solid-state synthesis, phase transitions, polymer structure and properties, composite materials, electronic, magnetic, optical, dielectric, nanomaterials, and advanced materials for energy conversion and storage.	K1, K2
CO2	Apply preparative techniques for advanced materials, X-ray diffraction for polymer crystallinity, electrical and magnetic measurement methods, microscopic and thermal characterization techniques, and principles of photovoltaic devices, batteries, and fuel cells.	K3
CO3	Analyze the structure–property relationships of polymers, composites, semiconductors, nanomaterials, and energy materials using XRD, SEM, TEM, thermal analysis, and electrochemical characterization techniques.	K4, K5
CO4	Evaluate the synthesis strategies, functional performance, and characterization of advanced materials, including nanomaterials, composite materials, electronic and magnetic materials, and energy storage and conversion devices for technological applications.	K5, K6
CO5	Create the application strategies for advanced functional materials, nanomaterials, polymers, composites, photovoltaic devices, batteries, and fuel cells to address contemporary scientific and technological challenges.	K6

UNIT – I PREPARATIVE STRATEGIES AND SYNTHESIS TECHNIQUES IN MATERIALS CHEMISTRY:

Synthesis Basics: Thermodynamics and kinetic aspects of solid-state synthesis; phase transitions in solids. **Preparative Techniques:** High-temperature solid-state synthesis, co-precipitation, precursor methods, sol-gel synthesis, combustion, and intercalation. **Advanced Methods:** Chimie douce, ion-exchange, microwave-assisted synthesis, electrochemical, sonochemical, and hydrothermal synthesis; high-pressure synthesis strategies. **Nanomaterial Synthesis:** Top-down and bottom-up approaches, including chemical vapor deposition (CVD), physical vapor deposition (PVD), and ball milling.

UNIT – II POLYMERS AND COMPOSITE MATERIALS:

Polymer Structure: Chain structure, micro structure, and crystallinity; determination of crystallinity and crystallite orientation using X-rays. **Polymer Properties:** Classification and nomenclature; glass transition temperature (T_g) and crystalline melting; viscoelastic behavior and rubber-like elasticity. **Composite Materials:** Detailed study of Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC), and Polymer Matrix Composites (PMC). **Advanced Applications:** Properties and applications of functional polymers and reinforcements such as whisker-reinforced ceramics and carbon-carbon composites.

UNIT – III ELECTRONIC, MAGNETIC, AND OPTICAL PROPERTIES:

Transport and Electrical Properties: Electronic conductors (metals, semiconductors, superconductors) and ionic conductors (solid electrolytes, fast ion conductors); two-and four-probe measurements. **Semiconductor Materials:** Properties of intrinsic and extrinsic semiconductors; bandgap modification and heterostructures; applications in photovoltaic devices. **Magnetic Properties:** Classification into dia, para, ferro, anti-ferro, and ferri-magnetism; study of spinels and garnets; magnetic susceptibility measurements. **Optical and Dielectric Properties:** Optical absorption and band gaps; luminescence and lasers; dielectric, ferroelectric, piezoelectric, and pyroelectric properties and their applications.

UNIT – IV NANOMATERIALS AND MATERIALS FOR ADVANCED TECHNOLOGY:

Nano domains: Materials in zero, one, and two dimensions; quantum confinement effects; preparation and properties of gold and silver nanoparticles and quantum dots (ZnO, ZnS, CdSe).

Carbon Nanostructures: Chemistry of fullerenes, graphene, carbon nanotubes (CNT), and graphene quantum dots; growth mechanisms and spectroscopic properties.

Energy Materials: Advanced materials for lithium batteries (electrode and electrolyte materials), Solid Oxide Fuel Cells (SOFC), and thermoelectric materials.

Characterization Techniques: Instrumentation and application of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and Thermal methods (TG/DTG, DTA, DSC).

UNIT – V APPLIED MATERIALS FOR ENERGY CONVERSION

Photovoltaics: Physics of p-n junctions and heterojunctions; advancement in new generation solar cells including perovskite, dye-sensitized, and quantum dot solar cells.

Energy Storage: Thermodynamics and kinetics of electrochemical reactions in Li-ion batteries; characterization via impedance spectroscopy and charging/discharging cycles.

Fuel Cells: Comparative study of PEMFC, PAFC, and Solid-Oxide Fuel Cells (SOFC); reaction kinetics and mass transport.

UNIT – VI CARBON NANOTECHNOLOGY (For continuous internal assessment only):

Fullerenes: Structure and bonding of C₆₀ and higher fullerenes; growth mechanisms (Arc Discharge, Pyrolysis) and chemical properties like hydrogenation.

Carbon Nanotubes (CNT): Classification into Single-walled (SWCNT) and Multi-walled (MWCNT); nomenclature (Zigzag and Armchair); Raman and IR spectroscopic properties.

Graphene: Physical and chemical synthesis methods; electronic properties including mobility, density of carriers, and the Quantum Hall Effect.

TEXT BOOKS:

1. B. D. Fahlman, Materials Chemistry, 2nd Ed., Springer, 2011..
2. H. R. Allcock, Introduction to Material Chemistry, John Wiley & Sons, Inc., 2008.
3. C. K. Krishnan, Composite Materials – Science and Engineering, Springer, 2012.

REFERENCES:

1. S. O. Kasap, Principles of Electronic Materials and Devices, McGraw Hill, 2006.
2. R. J. Young and P. A. Lovell, Introduction to Polymers, 3rd Ed., CRC Press, 2011.
3. A. Krueger, Carbon Materials and Nanotechnology, Wiley-VCH, 2010.
4. Y. Gogotsi, Carbon Nanomaterials, Taylor and Francis, 2006.
5. D. Kingery, Introduction to Ceramics, 2nd Edn, Wiley, 1992

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**GENERIC ELECTIVE COURSE 3****Semester: III****Code:****3. PHARMACOGNOSY AND PHYTO
CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To develop the knowledge of natural products, biological functions and pharmacological uses.
- To develop knowledge on primary and secondary metabolites and their sources.
- To understand the concepts of isolation methods and separation of bioactive compounds.
- To provide the knowledge on selected glycosides and marine drugs.
- To familiarize the guidelines of WHO and different sampling techniques.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Recall the sources of natural medicines and analysis of crude drugs.	K1
CO2	Understand and explain the methods of evaluation based on various parameters.	K1, K2
CO3	Analyze the isolated drugs	K4
CO4	Apply various techniques to discover new alternative medicines	K3
CO5	Evaluate the isolated drugs for various pharmacological activities	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I: PHARMACOGNOSY AND STANDARDIZATION OF HERBAL DRUGS:

Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine, and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.

UNIT – II: EXTRACTION TECHNIQUES:

General methods of extraction, types – maceration, Decoction, percolation, Immersion and soxhlet extraction. Advanced techniques- counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process.

UNIT – III: DRUGS CONTAINING TERPENOIDS AND VOLATILE OILS:

Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral-Structure uses. Pentacyclic triterpenoids: Amyrines, Taraxasterol: Structure and pharmacological applications.

UNIT – IV: DRUGS CONTAINING ALKALOIDS:

Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses.

UNIT – V: PLANT GLYCOSIDES AND MARINE DRUGS:

Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides-Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs - Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.

TEXT BOOKS:

1. V.D. Rangari, Pharmacognosy & Phytochemistry, 4th Edn., 2023
2. Gurdeep R Chatwal, Organic chemistry of Natural products, Volume I&II, 5th Edn, Himalaya publishing House, 2022

REFERENCES:

1. S.V. Bhat, B.A. Nagasampagi, M. Sivakumar, Chemistry of Natural Products, Revised Edition, Narosa Publishers, 2014
2. Jeffrey B. Harborne, Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th Edn, Indian reprint, Springer, 2022
3. Ashutoshkar, Pharmacognosy and Pharmacobiotechnology, 2nd Edn, New Age International Pvt. Ltd, New Delhi, 2007

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**NON-MAJOR ELECTIVE COURSE 2****Semester: III****Code:****CHEMISTRY IN DAY-TO-DAY LIFE
(Theory)****Credits: 2****COURSE OBJECTIVES:**

- To acquire the fundamental concepts related to the chemistry in daily life
- To understand the importance of different types of commercial products for the environment
- To apply the basic concepts of chemistry in the manufacture of commercial products for the society
- To find the efficiency and the utility of the byproducts derived from the basic and applied concepts of chemistry
- To have knowledge about the basic concepts of various micronutrients, fertilizer, dyes, disinfectants and detergents.
- To introduce the properties, structural elucidation, applications and the demerits of the products of the applied chemistry.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Describe the definition, classification, sources, functions, applications, and deficiency diseases of essential micronutrients, including carbohydrates, proteins, lipids, nucleic acids, and vitamins.	K1, K2
CO2	Explain the classification, characteristics, and uses of soil nutrients, fertilizers, pesticides, insecticides, and food additives, and discuss their significance in agriculture and food preservation.	K2
CO3	Apply the principles of classification and properties of dyes, paints, pigments, varnishes, soaps, detergents, disinfectants, perfumes, and cosmetics to identify their appropriate industrial and domestic applications.	K3
CO4	Analyze the composition, characteristics, manufacturing processes, and functional properties of dyes, paints, soaps, detergents, disinfectants, ceramics, cement, and glass.	K4
CO5	Evaluate the properties, quality, manufacturing methods, and practical applications of ceramics, cement, and glass materials for their effective use in industrial and engineering fields.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I ESSENTIAL MICRONUTRIENTS:

Carbohydrates - Proteins - Lipids - Nucleic acids and Vitamins – Definition, Sources, Classification, Applications and Diseases due to deficiency.

UNIT – II AGROCHEMICALS AND FOOD ADDITIVES:

Fertilizers – Pesticides - Insecticides – Definition, Classification, Characteristics and Uses. Additives –Definition, Characteristics, Uses and Abuse of additives in foods and beverages.

UNIT – III DYES, PAINTS AND PIGMENTS:

Dyes – Definition, Classification based on mode of application and structure, Applications. Paints – Definition, Ingredients, Characteristics, uses and drying process. Pigments -Varnishes - Definition, Characteristics, Types and Uses.

UNIT - IV SOAPS, DETERGENTS AND DISINFECTANTS:

Soaps and Detergents - Definition, Ingredients, Classification, Characteristics and Uses. Disinfectants – Definition, Characteristics and Uses. Perfumes - Definition, Characteristics, Raw materials and perfumes used in soaps - Cosmetics.

UNIT – V CERAMICS, CEMENT AND GLASS:

Ceramics: General properties, porous and non-porous wares. Manufacturing process, extrusion, turning, drying, decoration). Porcelain and China. **Cement:** Types, manufacture, additives, setting, properties & testing of cement. Glass: Manufacture, properties, shaping of sheets & plate glasses. Annealing, finishing. Special glasses.

UNIT – VI PLASTICS AND POLYMERS (For Continuous Internal Assessment Only):

Introduction to polymers, types of polymers. Plastic in daily use: HDPE, LDPE, PVC, PET, PP. Environmental Hazards of plastics. Recycling of plastics International universal recycling codes and symbols for identification. Biodegradable plastics. Alternatives: Paper news print, writing paper, paper boards, cardboards and Natural materials: Wood, cotton, jute, coir.

TEXT BOOKS:

1. B. K. Sharma, Introduction to Industrial Chemistry, Goel Publishing, Meerut, 1998
2. K. Bagavathi Sundari, Applied Chemistry, MJP Publishers, 2006

REFERENCES:

1. Ashutosh Kar, Medicinal Chemistry, New Age International, 8th Edn, 2023
2. Marcel Dekker, Vol. II, Drugs and Pharmaceutical Sciences Series, INC, New York
3. H.E. Cox, Chemical Analysis of Foods, Cox and Pearson.
4. N. Shakuntala Many and S. Swamy, Foods: Facts and Principles, 4th Edn, New Age International, 1998
5. P.I. Atkins and J. de Paula, Physical Chemistry, 7th Edn, Oxford University Press, 2002
6. Swaminathan and Goswamy, Handbook on Fertilizer Technology, 6th Edn, FAI, 2001
7. Des W. Connell, Basic Concepts of Environmental Chemistry, 2nd Edn, Taylor & Francis Group, 2016
8. Ley E. Manahan, Fundamentals of Environmental Chemistry, 3rd Edn, CRC Press, Taylor & Francis Group, 2009

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

COURSE OBJECTIVES:

- To learn the instrumental methods
- To learn the nature of errors and their types.
- To understand the various techniques in chromatography.
- To understand the principles and instrumentation of thermoanalytical and fluorescence techniques.
- To studying detail, the electroanalytical techniques.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Describe the principles, instrumentation, sampling techniques, and applications of instrumental methods of analysis, including EXAFS, SEXAFS, AAS, FES, turbidimetry, UV-Visible, and IR spectroscopy.	K1, K2
CO2	Explain and apply statistical methods for data interpretation, error analysis, hypothesis testing, regression, correlation, and curve fitting in analytical chemistry.	K2, K3
CO3	Apply chromatographic techniques such as solvent extraction, ion-exchange, paper, TLC, HPTLC, HPLC, and GC-MS for the separation, identification, and quantitative analysis of chemical substances.	K3
CO4	Analyze thermoanalytical methods (TGA, DTA, DSC), fluorescence spectroscopy, and electrochemical sensor technologies for the characterization and analysis of chemical systems.	K4
CO5	Evaluate electroanalytical techniques, including polarography, cyclic voltammetry, chronopotentiometry, coulometry, and amperometric titrations, for their principles, advantages, limitations, and analytical applications.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I INSTRUMENTAL METHODS OF ANALYSIS:

Principles and applications of extended X-ray absorption fine structure (EXAFS) – surface extended X-ray absorption (SEXAFS) – atomic absorption spectroscopy (AAS) – flame emission spectroscopy (FES) – turbidimetry – theory and applications. Instrumentation and sampling techniques in UV-visible and IR

spectroscopy.

UNIT – II DATA AND ERROR ANALYSIS:

Various types of error – accuracy, precision, significant figures – frequency distributions, the binomial distribution, the Poisson distribution and normal distribution – describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements. Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, paired t-Test – analysis of variance (ANOVA) – correlation and regression. Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – general polynomial equation fitting, linearizing transformations, exponential function fit – r and its abuse – multiple linear regression analysis, elementary aspects.

UNIT – III CHROMATOGRAPHY:

Solvent extraction – principles of ion exchange, paper, thin-layer and column chromatography techniques – columns, adsorbents, methods, R_f values, McReynold's constants and their uses – HPTLC, HPLC techniques – adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques – methods, principles and uses.

UNIT – IV THERMOANALYTICAL METHODS AND FLUORESCENCE SPECTROSCOPY:

Principles – instrumentations and applications of thermogravimetry analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) – thermometric titrations – types – advantages. Basic aspects of synchronous fluorescence spectroscopy – spectral hole burning – flow cytometry – fluorometers (quantization) – instrumentation – applications.

UNIT – V ELECTROANALYTICAL TECHNIQUES:

Electrochemical sensors, ion-sensitive electrodes, glass – membrane electrodes, solid- liquid membrane electrodes – ion-selective field effect transistors (ISFETs) – sensors for the analysis of gases in solution. Polarography – principles and instrumentation – dropping mercury electrode – advantages – Ilkovic equation – applications of polarography – polarographic maxima – oscillographic polarography, AC polarography – cyclic voltammetry – advantages over polarographic techniques – chronopotentiometry – advantages – controlled potential coulometry – amperometric titrations: principles – techniques – applications – estimation of lead.

UNIT – VI TYPES OF TITRATIONS (For Continuous Internal Assessment Only):

Redox titration: Redox potentials, theory and feasibility of redox titration, calculation of potentials at different stages of titrations, redox indicators, their choice and applications. Precipitation titrations: Theory and types, Mohr, Volhard and Fajan's methods. Adsorption indicators: theory, choice and applications. Complexometric titrations: Theory, Stepwise and overall formation constants, Titrations involving chelates (EDTA). Metallochromic indicators: Theory and Choice, Masking and demasking methods and applications.

TEXT BOOKS:

1. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis; 6th Ed., CBS Publishers and Distributors, Chennai, 1986.
2. D. A. Skoog, D. M. West and D. J. Holler, Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore, 2004.

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1. D. B. Hibbert and J. J. Gooding, Data Analysis for Chemistry; Oxford University Press, UK, 2006.
2. J. Topping, Errors of Observation and Their Treatment; 4th Ed., Chapman Hall, London, 1984.
3. A. Braithwaite and J. F. Smith, Chromatographic Methods; 5th Ed., Springer, Germany; 1995.
4. V. K. Srivastava and K. K. Srivastava, Introduction to Chromatography; 2nd Ed., Holden Day, New York, 1985.
5. A. Sharma, S. G. Schulman, Introduction to Fluorescence Spectroscopy; Wiley- Interscience, New York, 1999.
6. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy; 4th Ed., Tata McGraw-Hill, New Delhi, 1994.
7. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, 2000.
8. D. C. Harris, Quantitative Chemical Analysis; 4th Ed., W. H. Freeman Publications, New York, 1995.
9. S. C. Gupta, Fundamentals of Statistics; 6th Ed., Himalaya Publications, Delhi, 2006.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

COURSE OBJECTIVES:

- To know the synthetic methods of nanomaterials.
- To understand the characterization of nanomaterials.
- To understand carbon clusters and nanostructures.
- To learn nanotechnology and Nano devices.
- To study the principles of nanomedicine.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Describe the fundamental concepts, classification, unique properties, and various synthetic methods of nanomaterials, including inorganic and organic nanomaterials.	K1, K2
CO2	Explain and apply the principles of advanced characterization techniques such as AFM, TEM, STEM, STM, SNOM, and other scanning probe methods for nanoscale materials.	K2, K3
CO3	Apply the concepts of Nano confinement, Nano catalysis, Nano capsules, zeolites, MOFs, and related nanostructures to understand reactions occurring in nanoparticles.	K3
CO4	Analyze the structure, synthesis, properties, characterization, functionalization, and applications of carbon clusters, fullerenes, carbon nanotubes, and nanowires.	K4
CO5	Evaluate the design, fabrication, and applications of Nano devices, DNA-based nanomaterials, molecular electronics, protein Nano arrays, Nano sensors, and nanoparticle-mediated technologies.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I SYNTHETIC METHODS OF NANOMATERIALS:

Definition of Nano dimensional materials – historical milestones – unique properties due to Nano size, quantum dots, classification of nanomaterials. General methods of synthesis of nanomaterials – hydrothermal synthesis, solvothermal synthesis – microwave irradiation– sol-gel and precipitation technologies – combustion flame – chemical vapour condensation process – gas-phase condensation synthesis – reverse micelle synthesis – polymer-

mediated synthesis – protein microtubule-mediated synthesis – synthesis of nanomaterials using microorganisms and other biological agents – sonochemical synthesis – hydrodynamic cavitation. Inorganic nanomaterials – typical examples – nano TiO₂/ZnO/CdO/CdS, organic nanomaterials – examples – rotaxanes and catenanes

UNIT – II CHARACTERISATION OF NANOSCALE MATERIALS:

Principles of Atomic Force Microscopy (AFM) – Transmission Electron Microscopy(TEM) Resolution and Scanning Transmission Electron Microscopy (STEM) – Scanning Tunneling Microscopy (STM) – Scanning Nearfield Optical Microscopy (SNOM). Scanning ion conductance microscope, scanning thermal microscope, scanning probe microscopes and surface plasmon spectroscopy.

UNIT – III REACTIONS IN NANOSPACE:

Reactions in Nano space – Nano confinement – Nano capsules. Cavitands, cucurbiturils, zeolites, M.O.Fs, porous silicon, Nano catalysis-homogeneous and heterogeneous Nano catalysis.

UNIT – IV CARBON CLUSTERS AND NANOSTRUCTURES:

Nature of carbon bond – new carbon structures – carbon clusters – discovery of C₆₀–alkali doped C₆₀–superconductivity in C₆₀–larger and smaller fullerenes. Carbon nanotubes – synthesis –single walled carbon nanotubes – structure and characterization – mechanism of formation – chemically modified carbon nanotubes – doping – functionalizing nanotubes – applications of carbon nanotubes. Nanowires –synthetic strategies – gas phase and solution phase growth –growth control – properties.

UNIT – V NANOTECHNOLOGY AND NANODEVICES

DNA as a nanomaterial – DNA – knots and junctions, DNA – Nano mechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase – DNA complexes– molecular recognition and DNA based sensor. Protein Nano array, Nano pipettes, molecular diodes, self-assembled Nano transistors, nanoparticle mediated transfection.

UNIT – VI NANOMEDICINE (For Continuous Internal Assessment Only):

Principles of nanomedicine – impact of nanotechnology in medicine- Nano medical perspective and the medical applications- nanoparticles delivery for cancer therapy – Bioactive nanomaterials in medicine- Nano diagnostics - Nano arrays for diagnostics- nanoparticles for molecular diagnostics self-assembled protein

Nano arrays- protein Nano biochip - Nano biosensor-CNT biosensor-DNA biosensor.

TEXT BOOKS:

1. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials; Vol. 1 and 2; Wiley-VCH; Germany, Weinheim, 2004.
2. C. P. Poole, Jr: and F. J. Owens, Introduction to Nanotechnology; Wiley Interscience, New Jersey, 2003.
3. K. J. Klabunde, Nanoscale Materials in Chemistry; 2nd Edn, Wiley- Interscience, New York, 2009.
4. T. Pradeep, Nano: The Essentials in Understanding Nanoscience and Nanotechnology; 1st Edn, Tata McGraw Hill, New York, 2007.
5. H. Fujita, Micromachines as Tools in Nanotechnology; Springer-Verlag, Berlin, 2003.

REFERENCES:

1. BengtNolting, Methods in Modern Biophysics; 3rd Edn, Springer-Verlag, Berlin, 2009.
2. H. Gleiter, Nanostructured Materials: Basic Concepts, Microstructure and Properties, Elsevier, Chennai, 2000.
3. W. Kain and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Edn, John-Wiley R Sons, New York, 2013.
4. T. Tang and P. Sheng (Eds), Nanoscience and Technology, Novel Structures and Phenomena; Taylor andFrancis, New York, 2003.
5. A. Nabok, Organic and Inorganic Nanostructures; Artech House, Boston, 2005.
6. E.A. Rietman, Molecular Engineering of Nanosystems; Springer-Verlag, New York, 2001.
7. Home page of Prof. Ned Seeman - <http://seemanlab4.chem.nyu.edu/>
8. Nanoletters - <http://pubs.acs.org/journals/nalefd/index.html>
9. Nanotation - <http://www.acsnanotation.org/>

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

COURSE OBJECTIVES:

- To acquire the knowledge about crystallographic techniques.
- To understand the rings, cages and clusters.
- To know the concepts of nuclear chemistry.
- To learn the principles and applications of phase equilibria.
- To study the knowledge about advanced organic name reactions.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Understand and explain the fundamental principles of crystallography, crystal symmetry, diffraction techniques, space group determination, and crystallographic structure analysis.	K1, K2
CO2	Apply the concepts of boron, silicon, phosphorus–nitrogen, sulfur–nitrogen compounds, clusters, and electron counting rules to explain their structures, bonding, and reactivity.	K3
CO3	Analyze nuclear reactions, radiation detection techniques, particle accelerators, and their applications using the principles of nuclear chemistry.	K4
CO4	Evaluate phase equilibria in multicomponent systems by applying Gibbs phase rule, phase diagrams, and equilibrium concepts to interpret phase behaviour and material properties.	K5
CO5	Design efficient synthetic strategies by integrating advanced organic name reactions, palladium-catalyzed cross-coupling reactions, and modern carbon–carbon bond-forming methodologies for research and industrial applications.	K6
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I CRYSTALLOGRAPHY:

Crystal symmetry elements- crystal classes- crystal systems- unit cell- Bravais lattices –space groups- differences between point group and space group- screw axis-glide planes relationship between molecular symmetry and crystallographic symmetry-the concept to reciprocal lattice and its application-x-ray diffraction by single crystal- structure factor- systematic absence- determination

of space groups-Fourier synthesis-heavy atom method- a brief account of Cambridge Structural Database (CSD) and Protein Data Bank(PDB). Neutron diffraction by crystals-magnetic scattering – measurement techniques – comparison with X-ray diffraction elucidation of structure of magnetically ordered unit cell.

UNIT – II RINGS, CAGES AND CLUSTERS:

Chemistry of boron –classification, structure and bonding of borane, higher boranes, borazines, boron nitrides, hydroborate ions Lipscomb styx rule. Carboranes – nido, closo, arachno structure and bonding Chemistry of silicon – classification of silicates, silicones-siloxanes, silanes, higher silanes, silicon nitrides. P-N compounds-linear and cyclic phosphazenes, S-N compounds – structure and bonding of S₄N₄, polythiazyl (SN)_x compounds. Cluster compounds – bi-, tri-, tetra- and hexa-nuclear clusters (Metal halides and oxides only), Wade and Mingo's rule, polyatomic Zintl anions and cations.

UNIT – III NUCLEAR CHEMISTRY:

Nuclear reactions, nuclear cross section, Q-Values, coulombic barrier, threshold energy and excitation function – different types of nuclear reactions-transmutation, stripping and pick-up reactions-isotope distribution analysis-neutron activation analysis.

Projectile capture and particles emission, spallation, fragmentation, nuclear fission, nuclear fusion – proportional counter, Geiger-Muller counter, scintillation counter and Cherenkov counter – linear accelerator, cyclotron and synchrotron.

UNIT – IV: PHASE EQUILIBRIA

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems. Three component systems – representation by triangular diagrams, systems of three liquids – formation of one pair of partially miscible liquids, formation of two pairs of partially miscible liquids, formation of three pairs of partially miscible liquids – solid-liquid phases - Eutectic systems.

UNIT – V: ADVANCED ORGANIC NAME REACTIONS:

Peterson olefination – Julia olefination and its modifications – McMurry Reaction -Grubbs Olefin metathesis Click reaction (azide-alkyne cycloaddition) – Mukaiyama aldol addition – Baylis-Hillman reaction –Nazarov cyclization – Weinreb ketone synthesis – Biginelli reaction – Ugi reaction. Palladium-catalyzed cross-coupling reactions: Heck, Suzuki, Sonogashira, Stille, Negishi, Hiyama and Kumuda reactions.

UNIT – VI F-BLOCK ELEMENTS: (For Continuous Internal Assessment Only):

Position in the Periodic Table-General characteristics of Lanthanides and Actinides, Lanthanide contraction and its consequences. Isolation of Lanthanides from Monazite including the Ion exchange resin method. Actinides-occurrence and preparation. Chemistry of Thorium and Uranium -Important compounds-preparation, properties and uses of Uranyl nitrate, Uranium hexafluoride, Thorium dioxide.

TEXT BOOKS:

1. B.D. Cullity and S.R. Stock, Elements of X-Ray Diffraction, Pearson, 3rd Edn, 2022
2. I.L. Finar, Organic Chemistry, Volume-II, 5th Edn, 2006
3. H.J. Arnikaar, Essentials of Nuclear Chemistry; 4th Edn, New Age International Publishers, New Delhi, 2005
4. P. Atkins & J. De Paula, Physical Chemistry, 9th Edn, Oxford University Press, 2010
5. Puri, Sharma & Pathania, Principles of Physical chemistry, Vishal Publishing Co, 46th Edn, 2024.
6. Gurtu, J. N., & Gurtu, K. S. Phase Rule, Pragati Prakashan, Meerut, 1975.
7. Madan, R.D., Modern Inorganic Chemistry, 1st Edn, S. Chand & company Ltd, New Delhi, 2014
8. L. Kurti, B. Czako, Strategic Applications of Named Reactions in Organic Synthesis, Elsevier, 2005.
9. A. Hassner, C. Stumer, Organic Synthesis Based on Name and Unnamed Reactions, Elsevier Science Ltd., UK, 1994.

REFERENCES:

1. W. Clegg, Crystal Structure Determination, Oxford University press, UK, 1998.
2. G.H Stout and L. H. Jensen, X-ray Structure Determination: A Practical Guide, John Wiley and Sons, New York, 1992.
3. J.P. Glusker and K. N. Trueblood, Crystal Structure Analysis: A Primer, 3rd Edn., Oxford University Press, UK, 2010
4. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry, Parts A and B, 5th Edn., Springer, Germany, 2007.
5. W. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, 4th Edn, Cambridge University Press, 2004.
6. G. Friedlander, E. S. Macias, J. W. Kennedy and J. M. Miller, Nuclear and Radiochemistry; 3rd Edn., John Wiley and Sons, London, 1981.
7. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry-Principles of structure and Reactivity, 4th Edn, New Delhi, Pearson education, India, 2013

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**DISCIPLINE CENTRIC ELECTIVE
COURSE 4****Semester: IV****Code:****1. CHEMISTRY OF BIOMOLECULES
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To learn the biological importance of carbohydrates and the principles of bioenergetics.
- To understand the properties and functions of amino acids, peptides, proteins, and enzymes in biological systems.
- To acquire knowledge on the biological significance of lipids and steroids.
- To learn the structure and functions of nucleic acids in genetic information transfer.
- To understand the major metabolic pathways and their role in energy production.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Describe the structure, classification, properties, biological functions, and energy-related roles of carbohydrates, bioenergetics, ATP, electron transport chain, oxidative phosphorylation, free radicals, and antioxidants.	K1
CO2	Explain and apply the concepts of amino acids, peptides, proteins, enzymes, enzyme kinetics, peptide synthesis, and protein structure–function relationships.	K2, K3
CO3	Apply the knowledge of lipids, lipoproteins, prostaglandins, steroids, and cholesterol biosynthesis to explain their physiological functions and biochemical significance.	K3
CO4	Analyze the structure and functions of nucleic acids and interpret the molecular mechanisms of DNA replication, transcription, translation, mutation, and gene expression.	K4
CO5	Evaluate the metabolic pathways of carbohydrates, proteins, and lipids, including their regulation, integration, and significance in maintaining cellular energy and metabolic homeostasis.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT - I: CARBOHYDRATES AND BIOENERGIES:

Carbohydrates – classification, properties, structure and biological importance of glucose, fructose, sucrose, starch, cellulose and glycogen. Photosynthesis. Bioenergetics – concepts of free energy, ATP as an energy carrier, electron transport chain, oxidative phosphorylation, biological energy transducers, free radicals and

antioxidants.

UNIT – II: PROTEINS AND ENZYMES

Amino acids – classification, structure and properties. Peptides – C-terminal and N-terminal amino acid determinations, synthesis of peptides, Merrifield solid state peptide synthesis. Proteins – primary, secondary, tertiary and quaternary structures, classification according to function, uses. Enzymes-classification, mechanism of enzyme action, factors affecting enzyme activity, coenzymes, isoenzymes.

UNIT – III: LIPIDS AND STEROIDS

Lipids – classification and functions, role of LDL and HDL. Classification and functions of prostaglandins. Steroids – configuration, structural elucidation and functions of cholesterol, oestrone, androsterone, progesterone and cortisone, biosynthesis of cholesterol.

UNIT – IV: NUCLEIC ACIDS

Nucleic acids – Components, nucleosides, nucleotides, structure and functions of DNA and RNA, Watson and Crick model of DNA, types of RNA, DNA – denaturation and renaturation DNA – replication, transcription, translation, mutation.

UNIT – V: METABOLISM

Metabolic concepts – catabolism and anabolism. Metabolism of carbohydrates – digestion, absorption, storage – glycogenesis, oxidation – glycolysis (Embden – Meyerhof pathway), citric acid cycle, pentose phosphate pathway (HMP shunt), gluconeogenesis, Cori's cycle. Metabolism of proteins – digestion, absorption, metabolic nitrogen pool, nitrogen balance, disposal of nitrogen – transamination, oxidative deamination, glutamine formation, direct excretion, formation of urea. Metabolism of lipids – digestion, absorption, β -oxidation of fatty acids, ketone bodies – ketogenesis and ketosis, biosynthesis of fatty acids.

UNIT – VI: MEDICAL APPLICATIONS OF BIOMOLECULES (For Continuous Internal assessment only):

Biomolecules in medicine – drug-biomolecules interactions, receptors and mechanism of drug action, pharmacological importance of proteins, carbohydrates, lipids, nucleic acids, medicinal applications of enzymes and hormones. Clinical biochemistry – biochemical diagnosis of diseases, blood glucose, cholesterol and serum enzymes in disease diagnosis, biochemical basis of jaundice, anaemia and diabetes mellitus. DNA fingerprinting – principles and applications, polymerase chain reaction(PCR) and its types, recombinant DNA technology, genetic

engineering and gene therapy. Applications of biomolecules in biotechnology and diagnostics-biosensors, immunoassays, nanomaterials and biomedical applications.

TEXT BOOKS:

1. P.L. Soni and H.M. Chawla, Text Book of Organic Chemistry, 29th Edn, Reprint, Sultan Chand & Sons, 2014
2. Lehninger, Principles of Biochemistry, 8th Edn, W.H. Freeman and Company, New York, 2021
3. U. Sathyanarayana and U. Chakrapani, Essential of Biochemistry, 3rd Edn, Elsevier, 2021
4. G.R. Agarwal and O.P. Agarwal, Textbook of Biochemistry, 7th Edn, Goel Publishing House, 1993

REFERENCE BOOKS:

1. B.S. Bahl and Arun Bahl, Advanced Organic Chemistry, 4th Edn, Sultan Chand & Co., New Delhi, 2010
2. Bhupinder Mehta and Manju Mehta, Asoke K. Ghosh, Organic Chemistry, Prentice - Hall of India Pvt. Ltd., 2005
3. L.Stryer, and W.H. Freeman, Biochemistry, 5th Edn, 2007
4. J.L. Jain, Fundamentals of Biochemistry, 4th Edn, S.Chand & Company Ltd, 1995
5. Ambika Shanmugam, Fundamentals of Biochemistry for medical students, 6th Edn, Lippincott Williams, 1989
6. O.P. Agarwal, Chemistry of Natural products, 7th Edn, Goel Publishing House, Meerut.
7. D.M. Vasudevan, S. Sreekumari, Kannan Vaidyanathan, Textbook of medicinal Biochemistry, 9th Edn, Jaypee Brothers Medical Publishers, 2022
8. S.B. Primrose, R.M. Twyman, Principles of Gene Manipulation and genomics, 7th Edn, Blackwell Publishers, 2006

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**DISCIPLINE CENTRIC ELECTIVE
COURSE 4****Semester: IV****Code:****2. PHARMACEUTICAL CHEMISTRY
(Theory)****Credits: 4****COURSE OBJECTIVES:**

- To understand the basics of pharmaceutical chemistry.
- To study the antibiotics and their activity.
- To learn the analgesic and antipyretic activities.
- To know the activities of anesthetics and local anesthetics.
- To understand concept of clinical chemistry.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to:	
CO1	Describe the fundamental concepts of pharmaceutical chemistry, first aid procedures and medicinally important iron compounds used in therapy.	K1
CO2	Explain and apply the classification, structures, pharmacological actions, structure–activity relationships, and therapeutic uses of antibiotics.	K2, K3
CO3	Apply the principles of medicinal chemistry to distinguish narcotic and non-narcotic analgesics and antipyretics based on the mechanisms of action and therapeutic applications.	K3
CO4	Analyze the classification, characteristics, structures, synthesis, mechanisms of action and clinical applications of general and local anesthetics.	K4
CO5	Evaluate clinical chemistry methods for the diagnosis of diseases through biochemical tests and related diagnostic procedures.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT – I BASICS OF PHARMACEUTICAL CHEMISTRY:

Definitions – the terms – drugs, pharmacology, pharmacy, chemotherapy, therapeutics – pharmacologically active principles in plants – first aid – important rules of first aids, cuts, fractures, bleeding for blood, maintaining breathing burns and first aid box – tuberculosis (T.B.), jaundice, piles, typhoid, malaria, cholera – causes – symptoms, diagnosis – prevention and treatment – medicinally important compounds of iron – ferrous gluconate, ferrous sulphate and ferric ammonium citrate.

UNIT – II ANTIBIOTICS:

Definition – introduction – classification and biological actions – penicillin, chloramphenicol, streptomycin and tetracycline – structure, properties and therapeutic uses – chemical structure and pharmacological activity – effect of unsaturation, chain length, isomerism, halogens, amino groups, hydroxyl groups and acid groups.

UNIT – III ANALGESIC AND ANTIPYRETICS:

Narcotic analgesic – analgesic action of morphine – derivatives of morphine – heroin and apomorphine – synthetic analgesics – pethidine, methadone – non- narcotic analgesic – aspirin, paracetamol and phenacetin – analgin – preparation, properties and uses – ibuprofen and ketoprofen – structure and uses.

UNIT – IV ANAESTHETICS AND LOCAL ANAESTHETICS:

Characteristics of anesthetics – classification of anesthetics – general anesthetics – volatile anesthetics – ether, chloroform and halothane – advantages and disadvantages – non-volatile anesthetics (intravenous anesthetics) – methohexitone and propanidid – structure and uses – cocaine and amethocaine – structure and uses – benzocaine and procaine – structure, synthesis and uses.

UNIT – V CLINICAL CHEMISTRY:

Determination of sugar (glucose) in serum – o-toluidine method – diagnostic test for sugar in urine – Benedict's test – detection of diabetes – detection of cholesterol in urine – detection of anaemia – estimation of hemoglobin (Hb concentration) – red cell count.

UNIT – VI MOLECULAR MODELING AND COMPUTER AIDED DRUG DESIGN (For Continuous Internal Assessment Only):

Basic features of molecular modeling, Molecular mechanics, Ab initio, DFT and semi-empirical methods-Energy minimization; Local and global energy minima, saddle point-Force fields, Monte Carlo simulation; Molecular docking- Molecular Dynamics; Introduction, basic principles, Mechanics and dynamics of Bio-macromolecules.

TEXT BOOKS:

1. Wilson and Giswold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John Block and John M Beale, Lippincott Williams & Wilkins, 11th Ed., 2003.
2. G. Thomas, Fundamentals of Medicinal Chemistry, John Wiley & Sons: Chichester, 2003.
3. G.L. Patric, An introduction to Medicinal Chemistry,

Oxford University Press, USA, 3rd Edition, 2005.

4. J. Ghosh, A Text Book of Pharmaceutical Chemistry; 5th Edn, S. Chand and Company Ltd., New Delhi, 2014.

REFERENCES:

1. G. Thomas, Medicinal Chemistry: An Introduction, Wiley-Interscience, 2nd Edition, 2008.
2. S. Lakshmi; Pharmaceutical Chemistry; 1st Edn, S. Chand and Company Ltd., New Delhi, 1995.
3. Bhagavathi Sundari; Applied Chemistry; 1st Edn, MJP Publishers, Chennai, 2006.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Year: II**ENTREPRENEURSHIP /INDUSTRY
BASED COURSE****Semester: IV****Code:****INDUSTRIAL CHEMISTRY
(Theory)****Credits: 3****COURSE OBJECTIVES:**

- To know the basic ideas of an industry and industrial wastes.
- To understand the petroleum and petrochemicals.
- To understand the functions of Portland cement.
- To study the principles of pulp and paper.
- To know the preparation of soaps, detergents and perfumes.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Understand chemical process operations, process control techniques, and methods for treatment of industrial wastes and effluents.	K1
CO2	Explain the preparation, properties, and industrial applications of petroleum products and petrochemicals.	K2
CO3	Analyze the manufacture and applications of different types of cement.	K4
CO4	Understand the manufacturing processes of pulp and paper and evaluate their industrial applications.	K1
CO5	Explain the manufacture, properties, and applications of soaps, detergents, surfactants, and natural and synthetic perfumes.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 - Creating		

UNIT – I BASIC IDEAS AND INDUSTRIAL WASTES:

Basics idea about unit operation – flow chart – chemical conversion – batch versus continuous processing – chemical process selection – design – chemical process control. Types of industrial wastes – treatment of wastes or effluent with organic impurities – treatment of wastes or effluent with inorganic impurities – treatment of some important chemical wastes.

UNIT – II PETROLEUM AND PETROCHEMICALS:

Introduction – saturated hydrocarbons from natural gas – uses of saturated hydrocarbons – unsaturated hydrocarbons – acetylene, ethylene, propylene, butylene – aromatic hydrocarbons – toluene and xylene. Preparation of rectified spirit from beat – methylated spirit – preparation of absolute alcohol from rectified spirit – petrochemicals in India.

UNIT – III MANUFACTURE OF CEMENT:

Introduction – types of cement – high alumina cement, water proof cement, slag cement, acid resisting cement, white cement, coloured cement, Pozzolana cement. Setting of cement – properties of cement – testing of cement – uses of cement – concrete – cement industries in India.

UNIT – IV PULP AND PAPER AND MANUFACTURE OF PAPER:

Introduction – manufacture of pulp – types of pulp – sulphate or craft pulp, soda Pulp, Rag pulp – beating, refining, filling, sizing and colouring. Calendaring – uses – paper industries in India.

UNIT – V SOAPS, DETERGENTS AND PERFUMES:

Introduction – types of soaps – hard and soft soaps – manufacture of soap (hot and continuous process only) – cleansing action of soap – detergents – surface active agents – biodegradability of surfactants, amphoteric detergents. Introduction – production of natural perfumes – flower perfumes – jasmine, rose and lily – production of synthetic perfumes – muscone and nitro-musks.

UNIT – VI CHEMIST TO ENTREPRENEUR (For Continuous Internal Assessment Only):

Chemistry Entrepreneurship for Small and Medium Enterprises development – Business opportunities – Innovation and Technology – Commercialization – Marketing plan - Things to know to become Entrepreneur - Steps to take in Starting a New Business – Possible sources for financial assistance: Central level and state level institutions - SIDBI – NABARD – IDBI – SIDCO - Indian Institute of Entrepreneurship – DIC - Single Window - Latest Industrial Policy of Government of India.

TEXT BOOKS:

1. A.K. De, Industrial Chemistry including Chemical Engineering, New age publishers.com. 2021
2. P.C. Jain & Monika Jain, Textbook of Industrial Chemistry, 2022
3. M. Gopal Rao & Marshall Sittig, Outlines of Chemical Technology, East west press.com. 2022

REFERENCES:

1. B. K. Sharma, Industrial Chemistry; 8th Edn., Goel Publishing House, New Delhi, 2023
2. R. N. Shreve, and J. A. Brink Jr. Chemical Process Industries; 4th Edn, McGraw Hill, Toronto, 1977.
3. A. C. S. Brain, Production and Properties of Industrial Chemicals; Reinhold, New York, 1989.
4. Javier García-Martínez, Kunhao Li, Chemistry Entrepreneurship, Wiley, 2021

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low

Each candidate shall be required to take up a Project Work and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT /EVALUATION /VIVA-VOCE:

3. PROJECT REPORT EVALUATION (Both Internal & External):

- | | |
|--|------------|
| I. Plan of the Project | - 20 marks |
| II. Execution of the Plan/collection of Data / Organisation of Materials / Hypothesis, Testing etc and presentation of the report. | - 45 marks |
| III. Individual initiative | - 15 marks |

VIVA-VOCE / INTERNAL& EXTERNAL	- 20 marks
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TOTAL	- 100 marks
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PASSING MINIMUM:

	Vivo-Voce 20 Marks	Dissertation 80 Marks
Project	40% out of 20 Marks (i.e. 8 Marks)	40% out of 80 marks (i.e. 32 marks)

A candidate shall be declared to have passed in the Project work if he/she gets not less than 40% in each of the Project Report and Viva-voce but not less than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.

Code:**POLYMER CHEMISTRY
(Theory)****Credits: 2*****COURSE OBJECTIVES:**

- To know the basic concepts of polymers.
- To study the Structure and Properties of Polymers.
- To learn the applications of polymers.
- To study the stereoisomerism in polymers.
- To learn the characterization of polymers.

Course Outcomes (CO)		Knowledge Level
CO. No.	CO-Statements	
	On successful completion of this course, students will be able to	
CO1	Describe the fundamental concepts of polymers, their classification, chemical structures, polymerization mechanisms, and polymerization techniques.	K1
CO2	Explain and apply the concepts of stereoisomerism, tacticity, stereoregularity, and stereochemical aspects of polymer structures to distinguish different classes of polymers.	K2, K3
CO3	Analyze the relationship between polymer structure and properties, including crystallinity, morphology, glass transition temperature (T _g), melting temperature (T _m), molecular architecture, and their influence on polymer behaviour.	K4
CO4	Apply and analyze various polymer characterization techniques for determining molecular weight, chemical composition, thermal behaviour, and structural properties using analytical methods.	K3, K4
CO5	Evaluate the properties, applications, and performance of commercial, natural, specialty, biodegradable, biomedical, composite, and nanocomposite polymers for industrial and technological applications.	K5
K1 - Remembering; K2 - Understanding; K3 - Applying; K4 - Analysing; K5 - Evaluating; K6 – Creating		

UNIT- I CONCEPTS IN POLYMERS:

Introduction to polymers and polymerization - Classification – Addition- condensation -Linear, branched and cross-linked polymers. Thermoplastic and thermosetting polymers - Elastomers, Fibers and Resins -Chemical and geometrical structure of polymers. Techniques of polymerization - emulsion, bulk, solution and suspension.

UNIT – II STEREOISOMERISM IN POLYMERS:

Types of stereoisomerism in polymers – Monosubstituted ethylenes (Site of steric isomerism, Tacticity). Disubstituted ethylenes (1,1-disubstituted ethylenes, 1,2-disubstituted ethylenes), 1,3-Butadiene and 2-Substituted 1,3-Butadienes (1,2- and 3,4-Polymerizations, 1,4-Polymerizations). Stereoregular polymers: Significance of stereoregularity (isotactic, syndiotactic, and atactic polypropenes), Cis- and trans-1,4-poly-1,3-dienes, Cellulose and amylose.

UNIT – III STRUCTURE AND PROPERTIES OF POLYMERS:

Morphology and order in crystalline polymers- Configurations of polymer chains. Crystal structures of polymers - Strain-induced morphology. Crystalline melting point, T_m - melting points of homogeneous series, effect of chain flexibility and other steric factor, entropy and heat of fusion. The glass transition temperature, T_g , relationship between T_m and T_g - Effect of molecular weight, diluents, chemical structure, chain topology, branching and crosslinking.

UNIT – IV CHARACTERIZATION METHODS:

Average molecular weight concept - Number, weight and viscosity average molecular weights. Measurement of molecular weights - End group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers- Chemical analysis, spectroscopic methods, thermal Analysis.

UNIT – V COMMERCIAL, NATURAL AND SPECIALITY POLYMERS:

Commercial Polymers: Polyethylene, Polyvinyl chloride, Polyamides, Polyesters, Phenolic resins, Epoxy resins and silicone polymers. Natural Polymers: Importance of natural polymers – rubber- vulcanization- Application and structures of starch, cellulose and chitosin derivatives. Specialty Polymers: Bio polymers - Biodegradable polymers – Biomedical polymers - Poly electrolytes - High temperature and fire retardant polymers- Polymer blend. Polymer composites - Polymer nanocomposites.

UNIT – VI POLYMER DEGRADATION AND STABILIZATION: (For Continuous Internal Assessment Only)

Chemical degradation, physical degradation, ageing, crazing, degradation by microorganisms, Biodegradable polymers, Mechanism of degradation, secondary chain reaction, Self-reaction, depolymerization, metal catalyzed degradation, Thermal oxidation, Photo oxidation, Mechanical degradation, Degradation by ionizing radiation, ozone attack. Degradation of special polymers: Polyolefins, PVC, PS, PMMA. Stabilization: Chain breaking antioxidants, bound antioxidants, Radiation protection, Stabilization against biodegradation.

TEXT BOOKS:

1. V. R. Gowarikar, B. Viswanathan and J. Sridhar, Polymer Science, 1st Edn. Wiley Eastern, 1986
2. F. W. Bill Meyer. Text book of polymer science, 3rd Edn, John Wiley and sons, New York.

REFERENCES:

1. G. S. Krishenbaum, Polymer Science Study Guide, 1st Edn. Gordon Breach Science publishing, New York, 1973
2. P. Bahadur and N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.
3. G. S. Misra – Introduction to Polymer Chemistry, Wiley Eastern Ltd.
4. P. J. Flory. Principles of Polymer Chemistry, Cornell Press (recent edition).
5. G. Odian, Principles of Polymerization, McGraw Hill Book Company, New York, 1973.
6. A. Rudin, The Elements of Polymer Science and Engineering, Academic Press, New York, 1973.
7. C. E. H. Brawn, The Chemistry of High Polymers, Butter worth & Co., London, 1948.

CO-PO Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
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CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	2	3	3	3	2	3

3-Strong

2-Medium

1-Low

CO-PSO Mapping

Course Outcome	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3
Overall Average	3				

3-Strong

2-Medium

1-Low
