M.Sc. CHEMISTRY

(Effective from the academic year 2024 - 2025)

Vision of the Department:

To inculcate a keen interest for learning Chemistry, acquiring skills in carrying out tasks systematically with perseverance and precision, motivating towards research, inspiring to lead a life with scientific approach and promote the standard of personal and societal living.

Mission:

To provide a conducive learning environment with a student-centric teaching methodologies that allow them to achieve academic excellence in various branches of chemistry.

Eligibility for admission to M.Sc. Chemistry:

A candidate who has passed the B.Sc. Degree Examination with a score of 50% and above in Chemistry of this University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to M.Sc. Degree Programme in Chemistry.

Objectives:

- To impart advanced knowledge and technical skills in Chemistry.
- To expose the students to the recent trends in Chemistry and related sciences.
- To provide training in pure and applied scientific research.
- To inculcate research interest in Chemistry and its associative fields.
- To impart professional ethics for careers in Chemistry and entrepreneurial ventures.
- To get sensitized to social and environmental realities.

Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill development modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application-oriented content wherever required.

- The Core subjects include latest developments in the education and scientific front, practical training, catering to the needs of stakeholders with research aptitude.

- The curriculum is designed to strengthen the industry-academia interface and provide more job opportunities for the students.

- The Internship during the third semester will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.

- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective and Skill enhancement courses, covering conventional topics to the application oriented.

- Human rights course allows individual in being a responsible citizen that remains as a requisite to the possibility of a just society.

- MOOC course is prescribed to reinforce self-learning and to instill the value of life-long learning in students

- Project with viva-voce component in the fourth semester enables the students to apply their conceptual knowledge to practical situations which will help to improve healthcare, nutrition and the environment

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I, II, III, IV	**Core Courses in Chemistry**	Students from Chemistry Major in Undergraduation get stronger fundamental knowledge in the subject.
I, II, III, IV	**Elective papers -** An open choice of topics categorized under Generic and Discipline Centric.	● Strengthening the domain knowledge. ● Introducing the stakeholders to the state-of the art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature. ● Emerging topics related to industry are introduced to facilitate advanced learning in the respective domains.
II, III, IV	**Skill Enhancement papers/ Professional competency skills** (Discipline centric/ Generic / Entrepreneurial)	● Industry ready graduates. ● Skilled human resource. ● Students are equipped with essential skills to make them employable. ● Entrepreneurial skill training will provide an opportunity for independent livelihood generates small scale entrepreneurs. ● Discipline centric skill will improve the technical knowhow of solving real life problems.
Semester III (Vacation activity)	Internship / Industrial Training	● Practical training at the Industry/ Educational institutions, enable the students gain professional experience and become responsible citizens.
Semester IV	Project with Viva – voce	● Self-learning, critical thinking, problem-solving and research aptitude is enhanced. ● Application of the concepts to real situation is conceived resulting in positive outcome.

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

TANSCHE BASED PROGRAMME STRUCTURE FOR M.Sc. CHEMISTRY

(For the candidates admitted from the academic year 2024-2025)

Sem	Category	Paper Code	Title	Hours/ Week	Exam		Credits	Marks
					Th	Pr		
I	Core I	PCCHA24	Organic Reaction Mechanism – I	6	3	-	5	40+60
	Core II	PCCHB24	Structure and Bonding in Inorganic Compounds	6	3	-	5	40+60
	Core III	PCCHC24	Organic Chemistry Practical	6	-	6	4	40+60
	Elective I (Discipline Centric)	PECHA24	Elective I A: Electro Chemistry	5	3	-	3	40+60
		PECHB24	Elective I B: Nanomaterials and Nanotechnology					
	Elective II (Generic)	PECHC24	Elective II A: Medicinal Chemistry	5	3	-	3	40+60
		PECHD24	Elective II B: Pharmaceutical Chemistry					
			Human Rights	1	-	-	-	-
			Value Education	1	-	-	-	-
			Total	**30**			**20**	**500**
II	Core IV	PCCHD24	Organic Reactions and Mechanisms -II	6	3	-	5	40+60
	Core V	PCCHE24	Physical Chemistry – I	6	3	-	5	40+60
	Core VI	PCCHF24	Inorganic Chemistry Practical	6	-	6	4	40+60
	Elective III (Discipline Centric)	PECHE24	Elective III A: Molecular Spectroscopy	4	3	-	3	40+60
		PECHF24	Elective IIIB: Green Chemistry					
	Elective IV (Generic)	PECHG24	Elective IV A: Material Science	4	3	-	3	40+60
		PECHH24	Elective IV B: Bioinorganic Chemistry					
	Skill Enhancement Course [SEC I]	PSCHA124	SEC: Preparation of Consumer Products	2	-	-	2	100
		PSCHB124	SEC: Chemistry in Every Day Life					
		PNHRA24	Human Rights	1	2	-	2	40+60
			Value Education	1	-	-	-	-
		POCH24	Online Course	-	-	-	1	-
			Total	**30**			**25**	**700**

Sem	Category	Paper Code	Title	Hours/ Week	Exam		Credits	Marks
					Th	Pr		
III	Core VII	PCCHG24	Organic synthesis and Photochemistry	7	3	-	5	40+60
	Core VIII	PCCHH24	Coordination Chemistry I	7	3	-	5	40+60
	Core IX	PCCHI24	Physical Chemistry Practical I	4	-	6	4	40+60
	Core X	PCCHJ24	Physical Chemistry Practical II	4	-	6	4	40+60
	Elective V (Discipline Centric)	PECHI24	Elective V A: Biomolecules and Heterocyclic compounds	5	3	-	4	40+60
		PECHJ24	Elective V B: Pharmacognosy and Phytochemistry					
	Skill Enhancement Course[SEC II]	PSCHA224	SEC: Research Tools and Techniques	2	-	-	2	100
		PSCHB224	SEC: Industrial Chemistry					
		PICH24	Internship	-	-	-	2	
			Value Education	1	-	-	-	-
			Total	**30**			**26**	**600**
IV	Core X	PCCHK24	Coordination Chemistry II	6	3	-	5	40+60
	Core XII	PCCHL24	Physical Chemistry II	6	3	-	5	40+60
	Project	PCCHM24	Project	10	-	-	7	40+60
	Elective VI	PECHK24	Elective VI A: Polymer Chemistry	4	3	-	3	40+60
		PECHL24	Elective VI B: Chemistry of natural Products					
	Professional Competency Skill	PPCH24	Professional Competency Skill in Chemical Sciences	3	-	-	2	100
			Value Education	1	-	-	-	-
			Extension Activity	-	-	-	1	-
			Total	**30**			**23**	**500**
			Grand Total	**120**			**94 +2***	**2300**

- Any one course of the following to be completed during III semester (15 hours teaching and 15 hours activities):
  i) Teaching and Research Aptitude
  ii) Artificial Intelligence Tools
  iii) Entrepreneur Skill

iv) Photography

Methods of Evaluation						
S. No.	**Category**	**Assessment Tool**	**Maximum Marks**	**Exam Theory**	**Weightage**	
1	Core Courses/Generic & Discipline Specific Electives	I Continuous Assessment (ICA)	50	1 ½ h	35	40
		II Continuous Assessment (IICA)	50	1 ½ h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	100	3 h		60
2	Skill Enhancement Course (Depending on the course)	I Continuous Assessment (ICA)	30	1 h	35	40
		II Continuous Assessment (IICA)	30	1 h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	60	2 h		60
3	HR	Continuous Assessment (IICA)	25	1 h		40
		Innovative Component (IC)	25	-		
		End Semester Examination	60	2 h		60

Activity-based Assessment for Skill Enhancement Courses:

Activity 1 for Unit I: (Nature of Activity) – 20 marks

Activity 2 for Unit II: (Nature of Activity) – 20 marks

Activity 3 for Unit III: (Nature of Activity) – 20 marks

Activity 4 for Unit IV: (Nature of Activity) – 20 marks

Activity 5 for Unit V: (Nature of Activity) – 20 marks

Nature of Activity – Field visit/Industrial visit/Project (individual or group)/Exhibits/Model making/Hands on training/Lab practice/Product making/Extempore/Block and Tackle/Debate/Report writing/Case study/Interpretation of data or results/Transcription/Quiz (LMS)/Problem solving/ Designing/Role play/Start-up proposal/Research proposal/Poster presentation/Oral presentation (live or video recorded)/Survey (Field or Online)/Group discussion/Problem solving/Problem formulation/Interviews/Concept mapping/Mind mapping /Promoting public awareness etc.

Record of Assessment will be maintained by the course instructors and verified by the Head of the department.

Taxonomy Levels of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or Overview
Application (K3)	Suggest idea/concept with examples, suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

PROGRAMME OUTCOMES (PO)

On completion of the PG Programme, students will be able to:

PO1: Attain an in-depth knowledge in the respective domains augmented through self-learning.

PO2: Assimilate and apply principles and concepts towards skill development and employability.

PO3: Apply critical and scientific approaches to address problems and find solutions.

PO4: Develop research skills through multi/inter/trans-disciplinary perspectives.

PO5: Integrate issues of social relevance in the field of study.

PO6: Persist in life-long learning for personal and societal progress.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Attain an in-depth knowledge on advanced concepts in various branches of chemistry augmented through self-learning, persist in life-long learning for personal and societal progress.

PSO2: Demonstrate an ability to conduct experiments and perform accurate quantitative measurements with an understanding of the theory and develop practical skills in handling analytical instruments.

PSO3: Interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.

PSO4: Assimilate and apply principles and concepts towards skill development, employability, critical and scientific approaches to address the problems and find solutions.

PSO5: Develop research skills through multi/inter/trans-disciplinary perspectives and to qualify CSIR-NET and other competitive examinations.

PSO6: Communicate effectively through report writing, documentation and effective presentations and integrate the knowledge in chemistry for sustainable environment.

PSO/PO	PO1	PO2	PO3	PO4	PO5	PO6
PSO1	3	3	3	3	3	3
PSO2	3	3	3	3	3	3
PSO3	3	3	3	3	3	3
PSO4	3	3	3	3	3	3
PSO5	3	3	3	3	3	3
PSO6	3	3	3	3	3	3

STRONGLY CORRELATED - 3, MODERATELY CORRELATED - 2, WEAKLY CORRELATED – 1

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC REACTION MECHANISM – I</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core I</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCCHA24</td></tr>
<tr><td></td><td></td><td>Semester</td><td>I</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>5</td><td>1</td><td colspan="3">-</td><td>6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To comprehend the feasibility and the mechanism of various organic reactions.
To evaluate the techniques in the determination of reaction mechanisms.
To apply the concept of stereochemistry involved in organic compounds.
To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.
To design feasible synthetic routes for the preparation of organic compounds.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: (18 hours) (K1, K2, K3, K4, K5 & K6)

Methods of Determination of Reaction Mechanism:
1.1 Reaction intermediates - the transition state - reaction coordinate diagrams.
1.2 Thermodynamic and kinetic requirements of reactions - Hammond postulate.
1.3 Methods of determining mechanism- non-kinetic methods - product analysis - determination of intermediates - isolation, detection, and trapping.
1.4 Cross-over experiments - isotopic labelling - isotope effects and stereo chemical evidences.
1.5 Kinetic methods - relation of rate and mechanism- effect of structure on reactivity- Hammett and Taft equations.
1.6 Linear free energy relationship- partial rate factor - substituent and reaction constants.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: (18 hours) (K1, K2, K3, K4, K5 & K6)

Aromatic and Aliphatic Electrophilic Substitution:
2.1 Aromaticity - aromaticity in benzenoid, non-benzenoid - heterocyclic compounds and annulenes.
2.2 Aromatic electrophilic substitution - orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene.
2.3 Reactions involving nitrogen electrophiles - nitration, nitrosation and diazonium coupling.
2.4 Sulphur electrophiles – sulphonation - halogen electrophiles - chlorination and bromination.
2.5 Carbon electrophiles- Friedel-Crafts alkylation, acylation and arylation reactions.
2.6 Aliphatic electrophilic substitution mechanisms - S_E2 and S_Ei, S_E1- Mechanism and evidences.</td></tr>
</table>

	UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6) **Aromatic and Aliphatic Nucleophilic Substitution:** 3.1 Aromatic nucleophilic substitution mechanisms - S_NAr, S_N1 and benzyne mechanisms - evidences. 3.2 Reactivity - effect of structure, leaving group and attacking nucleophile. 3.3 Reactions - oxygen and sulphur nucleophiles - Bucherer and Rosenmund reactions - Von Richter - Sommelet Hauser and Smiles rearrangements. 3.4 S_N1 ion pair - S_N2 mechanisms – evidences. 3.5 Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon - S_N^1, S_N^2, S_N^i, and S_E^1 mechanism and evidences. 3.6 Swain-Scott - Grunwald-Winstein relationship – Ambident nucleophiles.
	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) **Stereochemistry-I:** 4.1 Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. 4.2 Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers- optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality - chirality due to helical shape - methods of determining the configuration. 4.3 Racemic modifications - racemization by thermal, anion, cation, reversible formation- epimerization- mutarotation - D, L system - Cram's and Prelog's rules - R, S-notations - proR, proS, side phase and re phase Cahn-Ingold-Prelog rules - absolute and relative configurations. 4.4 Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds - exo-cyclic alkylidene-cycloalkanes. 4.5 Topicity and prostereoisomerism - chiral shift reagents and chiral solvating reagents. 4.6 Criteria for optical purity - resolution of racemic modifications - asymmetric transformations - asymmetric synthesis, destruction - stereoselective and stereospecific synthesis.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) **Stereochemistry-II:** 5.1 Conformation and reactivity of acyclic systems - intramolecular rearrangements - neighbouring group participation. 5.2 Chemical consequence of conformational equilibrium - Curtin-Hammett Principle. 5.3 Stability of five and six-membered rings - mono-, di- and polysubstituted cyclohexanes - conformation and reactivity in cyclohexane systems. 5.4 Fused and bridged rings - bicyclic, poly cyclic systems - decalins and Brett's rule.

	5.5 Optical rotation and optical rotatory dispersion - conformational asymmetry - ORD curves. 5.6 Octant rule - configuration and conformation - cotton effect – axial haloketone rule and determination of configuration.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommend Text	1. March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Michael B. Smith, 2020, Science. 2. P.S.Kalsi, Stereochemistry Conformation and Mechanism, 2020. 3. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959. 4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013. 5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd edition, Oxford University Press, 2014.
Reference Books	1. R. O. C. Norman & Coxon, Principles of Organic Chemistry, NY, 3rd Edition, 2017. 2. S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry. Revised Edition, Trinity Press, New Delhi, 2015. 3. Stanley H Pines, Organic Chemistry, McGraw Hill Publication, 5th Edition, Reprint 2007. 4. Francis A. Carey and Richard J. Sundberg, Part A and B, Advanced Organic Chemistry, Plenum Press, 4th Edition, Reprint 2013. 5. D. Nasipuri, Stereochemistry of Organic Compounds, New Age Publishers, 2nd Edition, Reprint 2013. 6. Ernest L. Eliel, Stereochemistry of Carbon Compounds, Tata McGraw Hill Publishing, Reprint 2007. 7. C. K. Ingold, Structure and Mechanism in Organic Chemistry, CBS Publishers and Distributors Pvt. Ltd., 2nd Edition, Reprint 2000. 8. R. K. Bansal, Organic Reaction Mechanism, Tata McGraw Hill Publishing, 4th Edition, Reprint 2013. 9. Bernard Miller, Advanced Organic Chemistry Reaction & Mechanism, Pearson Education, 2nd Edition, Reprint 2005. 10. Nimai Tewari, Advanced Organic Stereochemistry (Problems & Solutions), Books and Allied (P), 1st Edition, 2010. 11. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001. 12. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987. 13. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, Pearson Education Asia, 2011.
Website and e-learning source	1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic. 2. https://www.organic-chemistry.org/ 3. https://www.studyorgo.com/summary.php 4. https://www.clutchprep.com/organic-chemistry 5. https://nptel.ac.in/

	6. https://swayam.gov.in 7. https://www.organic-chemistry.org/ 8. https://babel.hathitrust.org/cgi/pt?id=umn.31951p01139217c&view=2up&seq=S300 9. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5 (P-01, P-05) 10. https://www.hippocampus.org/HippoCampus/Chemistry;jsessionid=D178EB9CB8034395C03D09EFC98A06CA 11. http://ocw.uci.edu/lectures/chem_51a_lecture_13_organic_chemistry_ch_4_conformations_of_cyclohexane.html

Course Outcomes

CO1: Assess the formation and detection of reaction intermediates of organic reactions. **(K1, K2, K3, K4, K5 & K6)**

CO2: Importance of feasibility and the mechanism of various organic reactions. **(K1, K2, K3, K4, K5 & K6)**

CO3: Predict the reaction mechanism of various organic reactions. **(K1, K2, K3, K4, K5 & K6)**

CO4: Design and synthesize new organic compounds by correlating the stereochemistry of organic compounds. **(K1, K2, K3, K4, K5 & K6)**

CO5: Compare and gain knowledge about the optical rotatory dispersion and circular dichroism. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">STRUCTURE AND BONDING IN INORGANIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCCHB24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Inorganic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To determine the structural properties of main group compounds and clusters.
To gain fundamental knowledge on the structural aspects of ionic crystals.
To familiarize various diffraction and microscopic techniques.
To study the effect of point defects and line defects in ionic crystals.
To evaluate the structural aspects of solids.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: (18 hours) (K1, K2, K3, K4, K5 & K6)

Structure of main group compounds and clusters:
1.1 VB theory – Effect of lone pair and electronegativity of atoms (Bent’s rule) on the geometry of the molecules.
1.2 Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones.
1.3 Structural and bonding features of B-N, S-N and P-N compounds;
1.4 Poly acids – types, examples and structures.
1.5 Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes.
1.6 Wade’s rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.</td></tr>
<tr><td colspan="7">UNIT-II: (18 hours) (K1, K2, K3, K4, K5 & K6)

Solid state chemistry – I:
2.1 Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing.
2.2 Voids in crystal lattice and radius ratio.
2.3 Crystal systems and Bravis lattices.
2.4 Symmetry operations in crystals, glide planes and screw axis; point group and space group.
2.5 Solid state energetics: Lattice energy – Born-Lande equation.
2.6 Kapustinski equation, Madelung constant.</td></tr>
<tr><td colspan="7">UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6)

Solid state chemistry – II:</td></tr>
</table>

	3.1 Structural features of the crystal systems: Rock salt and zinc blende. 3.2 Wurtzite, fluorite and anti-fluorite. 3.3 Rutile, anatase, cadmium iodide and nickel arsenide. 3.4 Spinels -normal and inverse types. 3.5 Perovskite structures. 3.6 Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.
	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) **Techniques in solid state chemistry:** 4.1 X-ray diffraction technique: Bragg's law, Powder diffraction method– Principle and Instrumentation. 4.2 Interpretation of XRD data – JCPDS files and Phase purity. 4.3 Scherrer formula and lattice constants calculation. 4.4 Systematic absence of reflections, Electron diffraction technique – principle, instrumentation and application. 4.5 Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation. 4.6 Sampling methods and applications of SEM and TEM.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) **Band theory and defects in solids** 5.1 Band theory – features and its application of conductors, insulators and semiconductors. 5.2 Intrinsic and extrinsic semiconductors. 5.3 Defects in crystals – point defects (Schottky and Frenkel). 5.4 Metal excess and metal deficient defects. 5.5 Defects in crystals and their effect on the electrical and optical property, laser and phosphors. 5.6 Linear defects and its effects due to dislocations.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014. 2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001. 3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012. 4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.

	5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983. 6. F.A. Cotton and G. Wilkinson - Advanced Inorganic Chemistry: A Comprehensive Text - John Wiley and Sons, 5th Edition, 1988.
Reference Books	1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994. 2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013. 3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199. 4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982. 5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.
Website and e-learning source	1. https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/ 2. https://www.youtube.com/watch?v=fWSBJuEAcdw 3. https://www.youtube.com/watch?v=ORPNkHt2rG8 4. https://www.youtube.com/watch?v=PJqWNAzA3f4 5. https://www.youtube.com/watch?v=g5cztdCmSzs 6. .https://www.khanacademy.org/science/chemistry/chemical-bonds/x822131fc:solids/v/ionic-solids

Course Outcomes

CO1: Predict the geometry of main group compounds and clusters. **(K1, K2, K3, K4, K5 & K6)**
CO2: Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations. **(K1, K2, K3, K4, K5 & K6)**
CO3: Understand the various types of ionic crystal systems and analyze their structural Features. **(K1, K2, K3, K4, K5 & K6)**
CO4: Appraise the crystal growth methods. **(K1, K2, K3, K4, K5 & K6)**
CO5: Apply the principles of diffraction techniques and microscopic techniques. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2">PCCHC24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">6</td><td colspan="3">6</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic concepts of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the concept of separation, qualitative analysis and preparation of organic compounds.
To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.
To analyze the separated organic components systematically and derivatives them suitably.
To construct suitable experimental setup for the organic preparations involving two stages.
To experiment different purification and drying techniques for the compound processing.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: Separation and analysis:
A. Two component mixtures.
B. *Three component mixtures.</td></tr>
<tr><td colspan="8">UNIT-II: Estimations:
a) Estimation of Phenol (Bromination)
b) Estimation of Aniline (Bromination)
c) Estimation of Ethyl methyl ketone (Iodimetry)
d) Estimation of Glucose (Redox)
e) Estimation of Glycine (Acidimetry)
f) *Estimation of Ascorbic acid (Iodimetry)</td></tr>
<tr><td colspan="8">UNIT-III: Two stage preparations:
a) Acetyl salicyclic acid from methyl salicylate
b) m-Nitroaniline from nitrobenzene
c) m-Nitrobenzoic acid from methyl benzoate</td></tr>
<tr><td colspan="4">Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="8">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="8">1. John C. Gilbert, Stephen F. Martin. Experimental Organic Chemistry: A Miniscale & Microscale Approach, Sixth Edition, Boston, MA, USA : Cengage Learning 2016, Reprint 2022.
2. N. S. Gnanapragasam & G. Ramamurthy, Organic Lab Manual (Semi-Micro Qualitative Analysis and Separation), S. Viswanathan Printers & Publishers Pvt., Ltd, Reprint 2009.</td></tr>
</table>

	3. Darshan V. Chaudhary, Organic Chemistry Practicals and Important Reagents, 1st Edition, Createspace Independent Pub, 2016.
Reference Books	1. S. Furniss Brain, Vogel's Textbook of Practical Organic Chemistry, Pearson Publication, 5th Edition**,** Reprint 2011. 2. Basavarajaiah S.M, Nagesh G.Y, Ramakrishna Reddy K. Advanced Practical Organic Chemistry. Preparation: Conventional and Special Techniques. S.R.L publishing group. 2021.
Website and e-learning source	1. www.epgpathshala.nic.in 2. www.nptel.ac.in 3. http:/swayam.gov.in
OER	1. https://youtu.be/Bo-0oYFCJXs 2. http://vlab.amrita.edu/?sub=2&brch=191&sim=345&cnt=1 3. https://www.brainkart.com/article/Organic-Qualitative-Analysis_38680/ 4. http://amrita.olabs.edu.in/?sub=73&brch=8&sim=141&cnt=715

Course Outcomes

CO1: Recall the basic principles of organic separation, qualitative analysis and preparation.
CO2: Explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.
CO3: Determine the characteristics of separation of organic compounds by various chemical reactions.
CO4: Develop strategies to separate, analyze and prepare organic compounds.
CO5: Formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations.

CO	**PSO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

Continuous Assessment - 40 Marks
I C.A. - 50 Marks
II C.A. - 50 Marks
Average - 25 Marks
Performance during regular practicals - 10 Marks
Regularity in submission of observation notebook and Record - 5 Marks

CA Practical Examination - 50 Marks
Record - 5 Marks
Viva - 5 Marks
Qualitative Organic Analysis - 20 Marks
Estimation - 10 Marks
Preparation - 10 Marks
(Quality - 4 Marks, Quantity - 4 Marks, Recrystallization - 2 Marks)

Semester Practical Examination - 60 marks
Record - 10 Marks
Viva - 5 Marks
Qualitative Organic Analysis - 20 Marks
Estimation - 15 Marks
Preparation - 10 Marks
(Quality - 4 Marks, Quantity - 4 Marks, Recrystallization - 2 Marks)

Quantitative Estimation
Upto 2% - 15 Marks
2 - 3% - 14 Marks
3- 4% - 13 Marks
> 4% - 12 Marks

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE I A: ELECTROCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective I A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">PECHA24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="3">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of electrochemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
To familiarize the structure of the electrical double layer of different models.
To compare electrodes between current density and over potential.
To discuss the mechanism of electrochemical reactions.
To highlight the different types of over voltages and its applications in electroanalytical techniques.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="8">UNIT-I: (15 hours) (K1, K2, K3, K4, K5 & K6)

Ionics:
1.1 Arrhenius theory -limitations, van’t Hoff factor and its relation to colligative properties. Deviation from ideal behaviour.
1.2 Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength. Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes.
1.3 Determination of activity coefficient ion solvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrum model.
1.4 Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications.
1.5 Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations.
1.6 Evidence for ionic atmosphere. Ion association and triple ion formations.</td></tr>
<tr><td colspan="8">UNIT-II: (15 hours) (K1, K2, K3, K4, K5 & K6)

Electrode-electrolyte interface:
2.1 Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces.
2.2 Electrocapillary phenomena - Lippmann equation- electro capillary curves.
2.3 Electro-kinetic phenomena electro-osmosis and electrophoresis.
2.4 Electro-kinetic phenomena streaming and sedimentation potentials, colloidal and poly electrolytes.
2.5 Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer.
2.6 Zeta potential and potential at zero charge. Applications and limitations.</td></tr>
</table>

	UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6) **Electrodics of Elementary Electrode Reactions:** 3.1 Behavior of electrodes: Standard electrodes and electrodes at equilibrium. 3.2 Anodic and Cathodic currents, condition for the discharge of ions. 3.3 Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential. 3.4 Rate of electro chemical reactions: Rates of simple elementary reactions. 3.5 Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. 3.6 Low and high field approximations. symmetry factor and transfer coefficient. Tafel equations and Tafel plots.
	UNIT-IV: (15 hours) (K1, K2, K3, K4, K5 & K6) **Electrodics of Multistep Multi Electron System:** 4.1 Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. 4.2 Transfer coefficients, its significance and determination, Stoichiometric number. 4.3 Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}. 4.4 Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. 4.5 Evolution of oxygen and hydrogen at different pH. 4.6 Pourbiax and Evan's diagrams.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) **Concentration Polarization, Batteries and Fuel cells:** 5.1 Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. 5.2 Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. 5.3 cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. 5.4 Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. 5.5 Capacitors- mechanism of energy storage, charging at constant current and constant voltage. 5.6 Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.

Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014. 2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011. 3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008. 4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007. 5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004. 6. Cynthia G. Zoski, Handbook of electrochemistry, Elsevier Science, 2007 7. Sananda Chatterjee, Advanced Electrochemistry Hardcover – Import, Discovery Publishing Home, ISBN-13 : 978-9388854252, 2020
Reference Books	1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008. 2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008. 3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010. 4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977. 5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

Website and e-learning source	1. https://www.pdfdrive.com/modern-electrochemistry-e34333229. 2. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Courseware/Analytical_Electrochemistry%3A_Potentiometry/03_Potentiometric_Theory/04_Reference_Electrodes 3. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Cyclic_Voltammetry
Course Outcomes **CO1**: Predict the behaviour of electrolytes in solution. **(K1, K2, K3, K4, K5 & K6)** **CO2**: Predict the kinetics of electrode reactions. **(K1, K2, K3, K4, K5 & K6)** **CO3**: Examine elementary electrode reactions. **(K1, K2, K3, K4, K5 & K6)** **CO4**: Discuss the electrodics of multistep multielectron system. **(K1, K2, K3, K4, K5 & K6)** **CO5**: Evaluate batteries and fuel cells. **(K1, K2, K3, K4, K5 & K6)**	

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE I B: NANO MATERIALS AND NANO TECHNOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective I B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">PECHB24</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of crystallography and material science</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the concept of nano materials and nano technology.
To understand the various types of nano materials and their properties.
To understand the applications of synthetically important nano materials.
To correlate the characteristics of various nano materials synthesized by new technologies.
To design synthetic routes for synthetically used new nano materials.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="8">UNIT-I: (15 hours) (K1, K2, K3, K4, K5 & K6)
1.1 Introduction of nanomaterials and nanotechnologies, Introduction-role of size.
1.2 Classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down.
1.3 Consolidation of Nano powders. Features of nanostructures, Background of nanostructures.
1.4 Techniques of synthesis of nanomaterials.
1.5 Tools of the nanoscience.
1.6 Applications of nanomaterials and technologies.</td></tr>
<tr><td colspan="8">UNIT-II: (15 hours) (K1, K2, K3, K4, K5 & K6)
2.1 Bonding and structure of the nanomaterials, Predicting the Type of bonding in a Substance crystal structure.
2.2 Metallic nanoparticles, Surfaces of Materials.
2.3 Nanoparticle Size and Properties.
2.4 Synthesis- Physical and chemical methods - inert gas condensation, arc discharge.
2.5 Laser ablation, sol-gel, solvothermal and hydrothermal, CVD-types.
2.6 Metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.</td></tr>
<tr><td colspan="8">UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6)
3.1 Mechanical properties of materials, theories relevant to mechanical properties.
3.2 Techniques to study mechanical properties of nanomaterials. adhesion and friction.
3.3 Thermal properties of nanomaterials.
3.4 Nanoparticles: gold and silver- synthesis and properties
3.5 Metal oxides: silica, iron oxide – synthesis and properties.
3.6 Alumina - synthesis and properties.</td></tr>
<tr><td colspan="8">UNIT-IV: (15 hours) (K1, K2, K3, K4, K5 & K6)
4.1 Electrical properties, Conductivity and Resistivity.
4.2 Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials.
4.3 Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS.</td></tr>
</table>

	4.4 Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. 4.5 Applications of semiconductors: p-n junction as transistors and rectifiers. 4.6 Photovoltaic and photogalvanic cell.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) 5.1 Nano thin films, nanocomposites. 5.2 Application of nanoparticles in different fields. 5.3 Core-shell nanoparticles - types, synthesis, and properties. 5.4 Nanocomposites - metal-, ceramic- and polymer-matrix composites-applications. 5.5 Characterization – SEM, TEM - principle, instrumentation and applications. 5.6 AFM - principle, instrumentation and applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Reference Books	1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Website and e-learning source	1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

Course Outcomes

CO1: Explain the fundamentals of nanomaterials. **(K1, K2, K3, K4, K5 & K6)**
CO2: Explain the methods of preparation of nanomaterials. **(K1, K2, K3, K4, K5 & K6)**
CO3: Describe tools for mechanical properties of nanostructures. **(K1, K2, K3, K4, K5 & K6)**
CO4: Describe tools for electrical properties of nanostructures. **(K1, K2, K3, K4, K5 & K6)**
CO5: Discuss applications of nanomaterials. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE II B: MEDICINAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective II A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">PECHC24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="3">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of medicinal chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To study the chemistry behind the development of pharmaceutical materials.
To gain knowledge on mechanism and action of drugs.
To understand the need of antibiotics and usage of drugs.
To familiarize with the mode of action of diabetic agents and treatment of diabetes.
To identify and apply the action of various antibiotics.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: (15 hours) (K1, K2, K3, K4, K5 & K6)

Introduction to receptors:
1.1 Introduction, targets, Agonist, antagonist, partial agonist.
1.2 Receptors, Receptor types.
1.3 Theories of Drug – receptor interaction.
1.4 Drug synergism - Therapeutic Strategies
1.5 Drug Resistance - Mechanisms, Clinical Impact.
1.6 Physicochemical factors influencing drug action.</td></tr>
<tr><td colspan="8">UNIT-II: (15 hours) (K1, K2, K3, K4, K5 & K6)

Antibiotics:
2.1 Introduction, Targets of antibiotics action.
2.2 Classification of antibiotics.
2.3 Enzyme-based mechanism of action, SAR of penicllins.
2.4 SAR of tetracyclins.
2.5 Clinical application of penicillins, cephalosporin.
2.6 Current trends in antibiotic therapy.</td></tr>
<tr><td colspan="8">UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6)

Antihypertensive agents and diuretics:
3.1 Classification of cardiovascular agents
3.2 Introduction to hypertension, etiology, types.
3.3 Classification of antihypertensive agents.
3.4 Classification of diuretics.
3.5 Mechanism of action of diuretics.
3.6 Key diuretics - Furosemide, Hydrochlorothiazide, Amiloride.</td></tr>
</table>

	UNIT-IV (15 hours) (K1, K2, K3, K4, K5 & K6) **Antineoplastic drugs:** 4.1 Cancer chemotherapy - terms used - types of neoplasms. 4.2 Tumor formation mechanism, causes of cancer. 4.3 Treatment of cancer - radiation, surgery, chemotherapy, actions of antitumor agents. 4.4 Cytotoxic anticancer drugs - alkylating agents (Mustards) and their modes of action, antimetabolites - folic acid antagonist, purine antagonist and their modes of action. 4.5 Pyrimidine agents and their modes of action, antitumor antibiotics and their modes of action. 4.6 Plant products, podophyllotoxins and their modes of action, endocrine agents and their modes of action, miscellaneous anticancer agents.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) **Analgesics, Antipyretics and Anti-inflammatory Drugs:** 5.1 Introduction, Mechanism of inflammation. 5.2 Classification and mechanism of action - paracetamol, Ibuprofen, Diclofenac, naproxen. 5.3 Mechanism of action -indomethacin, phenylbutazone and meperidine. 5.4 Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics. 5.5 Drugs used for the treatment of diabetics, chemical classification, Mechanism of action, Treatment of diabetic mellitus. 5.6 Chemistry of insulin, sulfonyl urea.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry, 2. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011. 3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn. 4. O. LeRoy, Natural and synthetic organic medicinal compounds, Ealemi, 1976. 5. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.

	6. V. K. Ahluwalia, Madhu Chopra, Medicinal Chemistry, ANE Books India, 2008. 7. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand Company Ltd., 2nd Edition, 2006.
Reference Books	1. Foye's Princles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012 2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010. 3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn. 4. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers.1995. 5. S. Ramakrishnan, K. G. Prasannan and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition, 2001.
Website and e-learning source	1. https://www.ncbi.nlm.nih.gov/books/NBK482447/ 2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html 3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908
Course Outcomes **CO1**: Appraise receptors. **(K1, K2, K3, K4, K5 & K6)** **CO2**: Value antibiotics. **(K1, K2, K3, K4, K5 & K6)** **CO3**: Explain antihypertensive agents and diuretics. **(K1, K2, K3, K4, K5 & K6)** **CO4**: Discuss antineoplastic drugs**. (K1, K2, K3, K4, K5 & K6)** **CO5**: Explain analgesics, antipyretics and anti-inflammatory drugs. **(K1, K2, K3, K4, K5 & K6)**	

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE II B: PHARMACEUTICAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective II B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">PECHD24</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="3">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge on drugs and doses</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the advanced concepts of pharmaceutical chemistry.
To recall the principle and biological functions of various drugs.
To train the students to know the importance as well the consequences of various drugs.
To have knowledge on the various analysis and techniques.
To familiarize on the drug dosage and its structural activities.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: (15 hours) (K1, K2, K3, K4, K5 & K6)

Physical properties in Pharmaceuticals:
1.1 Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction.
1.2 Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity.
1.3 Dielectric constant & Induced Polarization- Dielectric constant explanation & determination.
1.4 Rheology of pharmaceutical systems: Introduction, Definition, applications.
1.5 Concept of viscosity, Newton’s law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system-Plastic flow, Pseudoplastic flow, Dilatent flow.
1.6 Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.</td></tr>
<tr><td colspan="8">UNIT-II: (15 hours) (K1, K2, K3, K4, K5 & K6)

Isotopic Dilution analysis:
2.1 Principle and applications.
2.2 Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning.
2.3 Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization.
2.4 Physico Chemical Properties and drug action.
2.5 Physico chemical properties of drugs (a) Partition coefficient, (b) solubility.
2.6 (c) surface activity, (d) degree of ionization.</td></tr>
<tr><td colspan="8">UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6)

Drug dosage and product development:
3.1 Introduction to drug dosage Forms & Drug
3.2 Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature.</td></tr>
</table>

	3.3 Routes of administration of drugs products, need for a dosage form, classification of dosage forms. 3.4 Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. 3.5 Drug Regulation and control, pharmacopies formulae, sources of drug, drug nomenclature, routes of administration of drugs products. 3.6 Need for a dosage form, classification of dosage forms.
	UNIT-IV (15 hours) (K1, K2, K3, K4, K5 & K6) **Development of new drugs:** 4.1 Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. 4.2 Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isomerism, bioisomerism, spatial considerations. 4.3 Biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory. 4.4 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions. 4.5 Physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants. 4.6 Steric parameters, chelation parameters, redox potential, indicator-variables.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) **Computers in Pharmaceutical Chemistry:** 5.1 Need of computers for chemistry. Computers for Analytical Chemists. 5.2 Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices. 5.3 Information storage, software components. 5.4 Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry. 5.5 Least square fit, solution to simultaneous equations, interpolation. 5.6 Extrapolation, data smoothing, numerical differentiation and integrations.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Physical Chemistry- Bahl and Tuli. 2. Text Book of Physical Pharmaceutics, IInd edition, Vallabh Prakashan-. C.V.S. Subramanyam. 3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house. 4. Instrumental method of Analysis: Hubert H, Willard, 7th edition.

	5. Textbook of Pharmaceutical Chemistry by, Jayshree Ghosh, S. Chand & company Ltd. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan chand & Sons.
Reference Books	6. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993. 7. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi. 8. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins. 9. Cooper and Gunn's Tutorial Pharmacy ,6th edition by S.J. Carter, CBS Publisher Ltd. 10. Ansels pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

Website and e-learning source	1. https://www.ncbi.nlm.nih.gov/books/NBK482447/ 2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html

Course Outcomes

CO1: Evaluate the physical properties in pharmaceuticals. **(K1, K2, K3, K4, K5 & K6)**
CO2: Appraise the Isotopic Dilution analysis. **(K1, K2, K3, K4, K5 & K6)**
CO3: Interpret the drug dosage and product development. **(K1, K2, K3, K4, K5 & K6)**
CO4: Appraise the development of new drugs. **(K1, K2, K3, K4, K5 & K6)**
CO5: Discuss Computers in Pharmaceutical Chemistry. **(K1, K2, K3, K4, K5 & K6)**

CO	**PSO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC REACTIONS AND MECHANISMS-II</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCCHD24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
To understand the mechanism involved in various types of organic reactions with evidences.
To understand the applications of synthetically important reagents.
To correlate the reactivity between aliphatic and aromatic compounds.
To design synthetic routes for synthetically used organic reactions.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: (18 hours) (K1, K2, K3, K4, K5 & K6)

Elimination and Free Radical Reactions:
1.1 Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules.
1.2 Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination.
1.3 Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions.
1.4 Detection and stability of radicals, characteristics of free radical reactions.
1.5 Reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements.
1.6 Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.</td></tr>
</table>

	UNIT-II: (18 hours) (K1, K2, K3, K4, K5 & K6) **Oxidation and Reduction Reactions:** 2.1 Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. 2.2 Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate, lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide. 2.3 Oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation. 2.4 Allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation). 2.5 Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD). 2.6 Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.
	UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6) **Rearrangements:** 3.1 Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry. 3.2 Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. 3.3 Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann and abnormal Beckmann rearrangements. 3.4 Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. 3.5 Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. 3.6 Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements.

	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) **Addition to Carbon Multiple Bonds:** 4.1 Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles and nucleophiles. 4.2 Addition reactions involving free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds. 4.3 Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds. 4.4 Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions. 4.5 Addition to Carbon-Hetero atom Multiple bonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. 4.6 Mechanism of condensation reactions involving enolates –Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) **Reagents and Modern Synthetic Reactions:** 5.1 Lithium diisopropylamide (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$) and *meta*-Chloroperbenzoic acid (m-CPBA). 5.2 Dicyclohexycarbodiimide (DCC), Dimethyl aminiopyridine (DMAP), n-Bu_3SnH, Diazobicyclo[5.4.0]undec-7-ene (DBU) and Diisopropylazodicarboxylate (DIAD). 5.3 Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Tetramethyl piperiridin-1-oxyl (TEMPO) and Phenyltrimethylammonium tribromide (PTAB). 5.4 Diazomethane and Zn-Cu, Suzuki coupling and Heck reaction. 5.5 Negishi reaction and Baylis-Hillman reaction. 5.6 Robinson annulation, Stork-enamine reaction and Biginelli reaction.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed., John-Wiley and Sons. 2001. 2. E. S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc., 1959. 3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8thedn, New Age International Publishers, 2015. 4. P. Y.Bruice, *Organic Chemistry*, 7thedn.,Prentice Hall, 2013.

	5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee*Organic Chemistry*, 7th edn., Pearson Education, 2010. 6. Sanyal S.N. Bharathi Bhawan - Reactions, Rearrangements and Reagents - Reprint 2005. 7. S.M. Mukherji and S.P. Singh - Organic Reaction Mechanism - Mac Millan India Ltd., Chennai, 3rd Edition, Reprint 2010.
Reference Books	1. S. H. Pine, *Organic Chemistry*, 5thedn, McGraw Hill International Editionn, 1987. 2. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay, 2000. . E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc., 1959. 4. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989. 5. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4thed., John Wiley, 2010.
Website and e-learning source	1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/ 3. http://www.authorstream.com/Presentation/meera.123-1208240-oxidation- reduction- reactions/ 4. https://www.youtube.com/watch?v=I85LgmfkJ0o 5. https://www.youtube.com/watch?v=cGDNdvg-H1M 6. https://www.youtube.com/watch?v=1xKQH7uKQcc

Course Outcomes (for Mapping with POs and PSOs)

CO1: Examine the elimination and free radical reactions. **(K1, K2, K3, K4, K5 & K6)**
CO2: Appraise oxidation and reduction reactions. **(K1, K2, K3, K4, K5 & K6)**
CO3: Explain the rearrangements. **(K1, K2, K3, K4, K5 & K6)**
CO4: Interpret the addition to carbon multiple bonds. **(K1, K2, K3, K4, K5 & K6)**
CO5: Design new routes to synthesize organic compounds. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">PHYSICAL CHEMISTRY- I</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td colspan="2">PCCHE24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic concepts of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
To understand the classical and statistical approach of the functions
To compare the significance of Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein
To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
To study the mechanism and kinetics of reactions.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="8">UNIT-I: (18 hours) (K1, K2, K3, K4, K5 & K6)

Classical Thermodynamics
1.1 Partial molar properties - Chemical potential, Determination of partial molar quantities.
1.2 Gibb’s-Duhem equation - binary and ternary systems.
1.3 Thermodynamics of real gases – Fugacity - determination of fugacity by graphical and equation of state methods.
1.4 Dependence of temperature, pressure and composition.
1.5 Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margules equation, applications of ideal and non-ideal mixtures.
1.6 Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.</td></tr>
<tr><td colspan="8">UNIT-II: (18 hours) (K1, K2, K3, K4, K5 & K6)

Statistical thermodynamics:
2.1 Statistical thermodynamics: Introduction of statistical thermodynamics, concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles.
2.2 Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics-comparison and applications.
2.3 Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases.
2.4 Thermodynamic functions in terms of partition functions-calculation of equilibrium constants.
2.5 Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb’s function, Helmholtz</td></tr>
</table>

	function residual entropy, equilibrium constants and equipartition principle. 2.6 Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.
	UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6) **Irreversible Thermodynamics** 3.1 Irreversible Thermodynamics: Conservation of mass and energy. 3.2 Entropy production in open systems by heat, matter and current flow 3.3 Force and flux concepts. 3.4 Onsager theory-validity and verification - Onsager reciprocal relationships. 3.5 Electro kinetic and thermo mechanical effects. 3.6 Application of irreversible thermodynamics to biological systems.
	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) 4.1 Kinetics of Reactions: Theories of reactions - effect of temperature on reaction rates. 4.2 Collision theory of reaction rates, Unimolecular reactions –Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. 4.3 Transition state theory - evaluation of thermodynamic parameters of activation - applications of ARRT to reactions between atoms and molecules, time and true order - kinetic parameter evaluation. 4.4 Factors determine the reaction rates in solution - primary salt effect and secondary salt effect. 4.5 Homogeneous catalysis- acid-base catalysis-mechanism of acid-base catalyzed reactions-Bronsted catalysis law. 4.6 Enzyme catalysis - Michelis-Menton catalysis.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) 5.1 Complex and fast reactions. 5.2 Kinetics of complex reactions - reversible reactions, consecutive reactions, parallel reactions. 5.3 Chain reactions - chain length, kinetics of hydrogen – halogen reactions (Thermal and Photochemical reactions) 5.4 Rice Herzfeld mechanism for decomposition of acetaldehyde. 5.5 Study of fast reactions-relaxation methods- temperature and pressure jump methods. 5.6 Stopped flow method, flash photolysis method and pulse radiolysis.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986. 2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. BenjaminPublishers, California, 1972. 3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, Reprint 2017. 4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013. 5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,M acmillan India Ltd, Reprint – 2013 6. Samuel Glasstone - Thermodynamics for Chemists – East-West Press, Reprint 2017 7. T. L. Hill – An Introduction to statistical Thermodynamics – Dover Publications, First South Asian Edition -2008.
Reference Books	1. D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999. 2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990. 3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974 4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996. 5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.
Website and e-learning source	1. https://nptel.ac.in/courses/104/103/104103112/ 2. https://bit.ly/3tL3GdN 3. Gunnar Jeschke - Lecture Notes Advanced Physical Chemistry - Statistical Thermodynamics.https://ethz.ch/content/dam/ethz/special-interest/chab/physical-chemistry/epr-dam/documents/education/statistical-thermodynamics/stat_TD.pdf. 4.VictorS.Batista-http://ursula.chem.yale.edu/~batista/classes/vaa/vaa.pdf - Statistical methods and thermodynamics.

Course Outcomes

CO1: Explain the classical concepts of thermodynamics. **(K1, K2, K3, K4, K5 & K6)**

CO2: Compare and correlate the classical and statistical thermodynamic concepts and reactions. **(K1, K2, K3, K4, K5 & K6)**

CO3: Discuss irreversible thermodynamics. **(K1, K2, K3, K4, K5 & K6)**

CO4: Evaluate the kinetics of reaction rates. **(K1, K2, K3, K4, K5 & K6)**

CO5: Compare the theories of reactions rates and fast reactions. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">INORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2">PCCHF24</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">6</td><td colspan="3">6</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic principles of gravimetric and qualitative analysis</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
To recall the principle and theory in preparing standard solutions.
To train the students for improving their skill in estimating the amount of ion accurately present in the solution
To estimate metal ions, present in the given solution accurately without using instruments.
To determine the amount of ions, present in a binary mixture accurately.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I:
Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.
Group-I : W, Tl and Pb.
Group-IA : Se, Te.
Group-II : Mo, Cu, Bi and Cd.
Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U.
Group-IV : Zn, Ni, Co and Mn.
Group-V : Ca, Ba and Sr.
Group-VI : Li and Mg.</td></tr>
<tr><td colspan="8">UNIT-II:
Preparation of metal complexes: Preparation of inorganic complexes:
a. Preparation of Tristhioureacopper(I) chloride
b. Preparation of Sodium cuprousthiosulphate
c. Preparation of Tetramminecopper(II) sulphate
d. Preparation of Bis(acetylacetonato)copper(II) complex
e. Preparation of Hexamminenickel(II) chloride
f. Preparation of Tris(thiourea)copper(II) sulphate</td></tr>
<tr><td colspan="8">UNIT-III:
Complexometric Titration:
1. Estimation of zinc, nickel, magnesium, and calcium.
2. Estimation of mixture of metal ions-pH control, masking and demasking agents.
3. Determination of calcium and lead in a mixture (pH control).
4. Determination of manganese in the presence of iron.
5. Determination of nickel in the presence of iron.</td></tr>
<tr><td colspan="4">Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A. JeyaRajendran, Microanalytical Techniques in Chemistry:Inorganic Qualitative Analysis, United global publishers, 2021. 2. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; 3rd ed., The National Publishing Company, Chennai, 1974. 3. Vogel's Text book of Inorganic Qualitative Analysis, 4th ed., ELBS, London.
Reference Books	1. G. Pass, and H. Sutcliffe, Practical Inorganic Chemistry; Chapman Hall, 1965 2. W. G. Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.
Website and e-learning source	1. https://iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis.pdf 2. https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/18%3A_Solubility_and_Complex-Ion_Equilibria/18.9%3A_Qualitative_Cation_Analysis 3. https://www.coursehero.com/file/155747281/Inorganic-semi-micro-qualitative-analysis-for-Cationspdf/ 4. https://www.uou.ac.in/sites/default/files/slm/MSCCH-505L.pdf 5. https://oms.bdu.ac.in/ec/admin/contentsn/148_20220207114030143.pdf

Course Outcomes

CO1: Identify the anions and cations present in a mixture of salts.
CO2: Apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.
CO3: Acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.
CO4: Synthesize coordination compounds in good quality.
CO5: Estimate the amount of metal ion present in the given solution.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

Continuous Assessment - 40 Marks
I C.A. - 50 Marks
II C.A. - 50 Marks
Average - 25 Marks
Performance during regular practicals -10 Marks
Regularity in submission of observation note-book and Record – 5 Marks

CA Practical Examination - 50 Marks
Record - 5 Marks
Viva - 5 Marks
Short Procedure - 5 Marks
Semi micro qualitative analysis (2 rare + 2 common cations) - 15 Marks
Preparation - 10 Marks
Complexometric titration - 10 Marks

Error Percentage for Complexometric titration:
Upto 2% - 10 Marks
2 – 3% - 9 Marks
3 – 4% - 8 Marks
4 – 5% - 7 Marks
Above 5% - 5 Marks

Semester Practical Examination – 60 Marks
Record - 10 Marks
Viva – Voce - 5 Marks
Short Procedure - 5 Marks
Semi micro qualitative analysis (2 rare + 2 common cations) - 15 Marks
(Each rare cation – 4.5 Marks, Each common cation – 3 Marks)
Preparation - 15 Marks
(Quantity - 10 Marks, Quality - 5 Marks)
Complexometric titration - 10 Marks

Error Percentage for Complexometric titration:
Upto 2% - 10 Marks
2 – 3% - 9 Marks
3 – 4% - 8 Marks
4 – 5% - 7 Marks
Above 5% - 5 Marks

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE III A: MOLECULAR SPECTROSCOPY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective III A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PECHE24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>-</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of spectroscopy</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy, and fragmentation patterns in Mass spectroscopy.
To highlight the significance of the Franck-Condon principle to interpret the selection rule, intensity, and types of electronic transitions.
To interpret the first and second-order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, and NOESY.
To carry out the structural elucidation of molecules using different spectral techniques.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I (12 hours) (K1, K2, K3, K4, K5 & K6)

Rotational and Raman Spectroscopy:
1.1 Rotational spectra of diatomic and polyatomic molecules.
1.2 Intensities of rotational spectral lines, the effect of isotopic substitution. Non-rigid rotators.
1.3 Classical theory of the Raman effect, quantum theory of the Raman effect.
1.4 Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines.
1.5 Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion.
1.6 Rotational fine structure-O and S branches, Polarization of Raman scattered photons.</td></tr>
<tr><td colspan="7">UNIT-II (12 hours) (K1, K2, K3, K4, K5 & K6)

Vibrational Spectroscopy:
2.1 Vibrations of molecules, harmonic and anharmonic oscillators.
2.2 Energy level diagram, vibrational wave functions, and their symmetry, selection rules.
2.3 Expression for the energies of spectral lines, computation of intensities, hot bands, the effect of isotopic substitution.
2.4 Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation.
2.5 Vibrations of polyatomic molecules – symmetry properties, overtone, and combination frequencies.
2.6 Influence of rotation on vibrational spectra of the polyatomic</td></tr>
</table>

	molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.
	UNIT-III: (12 hours) (K1, K2, K3, K4, K5 & K6) **Electronic spectroscopy:** 3.1 Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules. 3.2 Frank-Condon principle, Dissociation and predissociation spectra. 3.3 $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. 3.4 X-ray Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules. 3.5 Lasers: Laser action, population inversion. 3.6 Properties of laser radiation, examples of simple laser systems.
	UNIT-IV: (12 hours) (K1, K2, K3, K4, K5 & K6) **NMR and Mass Spectrometry:** 4.1 Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects. 4.2 Spin systems: First-order and second-order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX_2, AB types. Vicinal, germinal, and long-range coupling-spin decoupling. 4.3 Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. ^{13}CNMR and structural correlations. A Brief Introduction to 2D NMR – COSY, NOESY. 4.4 Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI). 4.5 Isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. 4.6 Effect of isotopes on the appearance of the mass spectrum.
	UNIT-V: (12 hours) (K1, K2, K3, K4, K5 & K6) **ESR/EPR and Mossbauer Spectroscopy:** 5.1 ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. 5.2 EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. 5.3 Interpretation of ESR spectra and structure elucidation of organic

	radicals using ESR spectroscopy; Spin-orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy. 5.4 Application to biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples. 5.5 Structural elucidation of organic compounds by combined spectral techniques. 5.6 Principle of Mossbauer spectroscopy: Doppler shift, recoil energy, isomer shift, quadrupole splitting, magnetic interactions.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem-solving, Analytical ability, Professional Competency, Professional Communication, and Transferable skills.

Recommended Text	1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 5th Ed., Tata McGraw Hill, New Delhi, 2013. 2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 8th Ed., John Wiley & Sons, New York, 2014. 3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 3rd ed., reprinted (2002). 4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 6th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 2007. 5. R. S. Drago, *Physical Methods in Chemistry*; Affiliated East West Press Pvt. Ltd, 2nd 2016.
Reference Books	1. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, 2002. 2. I. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974. 3. A. Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York, 1sted., reprint 2011. 4. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, PartB: 6th ed., John Wiley& Sons Inc., New York, 2009. 5. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 2nd ed., 2007.
Website and e-learning source	1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview 2. https://www.digimat.in/nptel/courses/video/104106122/L14.html 3.https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001204/M011057/ET/1479291693P9M25eTextJuly20.pdf 4. https://tinyurl.com/mr4uh6xy 5.https://archive.nptel.ac.in/content/storage2/courses/102101007/downloads/PPT/LEC-20-PPT.pdf 6.https://kanchiuniv.ac.in/coursematerials/Mossbauer%20Spectroscopy.pdf 7.https://www.nou.ac.in/econtent/Msc%20Chemistry%20Paper%20IX/MSc%20Chemistry%20Paper-IX%20Unit-6.pdf

Course Outcomes

CO1: Explain the importance of rotational and Raman spectroscopy. **(K1, K2, K3, K4, K5 & K6)**
CO2: Apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules. **(K1, K2, K3, K4, K5 & K6)**
CO3: Evaluate different electronic spectra of simple molecules using electronic spectroscopy. **(K1, K2, K3, K4, K5 & K6)**
CO4: Outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}F NMR spectroscopic and Mass spectrometric techniques. **(K1, K2, K3, K4, K5 & K6)**
CO5: Examine the principle, instrumentation and structural elucidation of simple molecules using EPR and Mossbauer Spectroscopy techniques. **(K1, K2, K3, K4, K5 & K6)**

CO	**PSO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE III B: GREEN CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective III B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">PECHF24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>-</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of general chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To discuss the principles of green chemistry.
To propose green solutions for chemical energy storage and conversion.
Propose green solutions for industrial production of Petroleum and Petrochemicals.
Propose solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries.
Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="8">UNIT-I: (12 hours) (K1, K2, K3, K4, K5 & K6)
1.1 Introduction- Need for Green Chemistry.
1.2 Goals of Green Chemistry.
1.3 Limitations/ of Green Chemistry.
1.4 Chemical accidents, terminologies.
1.5 International green chemistry organizations.
1.6 Twelve principles of Green Chemistry with examples.</td></tr>
<tr><td colspan="8">UNIT-II: (12hours) (K1, K2, K3, K4, K5 & K6)
2.1 Choice of starting materials, reagents, catalysts and solvents in detail.
2.2 Green chemistry in day today life.
2.3 Designing green synthesis-green reagents: dimethyl carbonate.)
2.4 Green solvents: Water, Ionic liquids-criteria, general methods of preparation, effect on organic reaction.
2.5 Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in scCO_2.
2.6 Green synthesis-adipic acid and catechol.</td></tr>
<tr><td colspan="8">UNIT-III: (12 hours) (K1, K2, K3, K4, K5 & K6)
3.1 Environmental pollution.
3.2 Green Catalysis-Acid catalysts.
3.3 Oxidation catalysts.
3.4 Basic catalysts.
3.5 Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts.
3.6 Poly supported photosensitizers.</td></tr>
<tr><td colspan="8">UNIT-IV: (12 hours) (K1, K2, K3, K4, K5 & K6)
4.1 Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide.
4.2 Crown ethers-esterification.
4.3 Saponification.
4.4 Anhydride formation, Elimination reaction.
4.5 Displacement reaction.</td></tr>
</table>

	4.6 Applications in organic synthesis.
	UNIT-V: (12 hours) (K1, K2, K3, K4, K5 & K6) 5.1 Micro wave induced green synthesis-Introduction. 5.2 Instrumentation. 5.3 Principle and applications. 5.4 Sonochemistry – Instrumentation. 5.5 Cavitation theory - Ultra sound assisted green synthesis. 5.6 Applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005. 2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7thedition, McGraw-Hill, NewDelhi,2005. 3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall,1974. 4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi,2001. 5. A. K. De, Environmental Chemistry, New Age Publications, 2017.
Reference Books	1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001 3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000 4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002. 5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.
Website and e-learning source	1. https://www.organic-chemistry.org/ 2. https://www.studyorgo.com/summary.php

Course Outcomes

CO1: Explain the principles of green chemistry. **(K1, K2, K3, K4, K5 & K6)**
CO2: Choose the raw materials and solvents for green synthesis. **(K1, K2, K3, K4, K5 & K6)**
CO3: Use green catalyst. **(K1, K2, K3, K4, K5 & K6)**
CO4: Apply the principles of PTC in synthesis. **(K1, K2, K3, K4, K5 & K6)**
CO5: Design and synthesize new organic compounds by microwave and ultrasonic assisted organic synthesis. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE IV A: MATERIAL SCIENCE</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective IV A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">PECHG24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of solid-state chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the crystal structure, growth methods and X-ray scattering.
To explain the optical, dielectric and diffusion properties of crystals.
To recognize the basis of semiconductors, superconductivity materials and magnets.
To study the synthesis, classification and applications of nanomaterials.
To learn about the importance of materials used for renewable energy conversion.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: (12 hours) (K1, K2, K3, K4, K5 & K6)
Crystallography:
1.1 Symmetry - unit cell and miller indices - crystal systems.
1.2 Bravais lattices - point groups and space groups.
1.3 X-ray diffraction – Laue equations - Bragg's law.
1.4 Reciprocal lattice and its application to geometrical crystallography.
1.5 Crystal structure - powder and single crystal applications.
1.6 Electron charge density maps- neutron diffraction method and applications.</td></tr>
<tr><td colspan="8">UNIT-II: (12 hours) (K1, K2, K3, K4, K5 & K6)
Crystal growth methods:
2.1 Nucleation–equilibrium stability and metastable state.
2.2 Single crystal-low and high temperature - solution growth – gel and sol-gel.
2.3 Crystal growth methods - nucleation - equilibrium stability and metastable state.
2.4 Melt growth - Bridgeman-Stockbarger, Czochralski methods.
2.5 Flux technique, physical and chemical vapour transport.
2.6 Lorentz and polarization factor - primary and secondary extinctions.</td></tr>
<tr><td colspan="8">UNIT-III: (12 hours) (K1, K2, K3, K4, K5 & K6)
Properties of crystals:
3.1 Optical studies - electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity.
3.2 Types of luminescence – photo-, electro-, and injection luminescence.
3.3 LEDs – organic, inorganic and polymer.
3.4 LED materials - applications.
3.5 Dielectric studies- polarization - electronic, ionic, orientation, and space charge polarization - effect of temperature - dielectric constant - dielectric loss.</td></tr>
</table>

	3.6 Types of dielectric breakdown - intrinsic, thermal, discharge, electrochemical and defect breakdown.
	UNIT-IV: (12 hours) (K1, K2, K3, K4, K5 & K6) **Special Materials:** 4.1 Superconductivity - meissner effect, critical temperature and critical magnetic field type I, II superconductors. 4.2 BCS theory - Cooper pair – applications - soft and hard magnets – domain theory – hysteresis loop – applications. 4.3 Magneto and gian magneto resistance - ferro, ferri and antiferromagnetic materials – applications. 4.4 Magnetic parameters for recording applications - ferro-, piezo-, and pyro electric materials – properties and applications. 4.5 Shape memory alloys - characteristics and applications. 4.6 Non-linear optics - second harmonic generators, mixing of laser wavelengths by quartz, ruby and $LiNbO_3$.
	UNIT-V: (12 hours) (K1, K2, K3, K4, K5 & K6) **Materials for Renewable Energy Conversion:** 5.1 Solar cells - organic, bilayer, bulk heterojunction, polymer. 5.2 Perovskite based solar energy conversion. 5.3 Lamellar solids and thin films - dye-sensitized photo voltaic cells. 5.4 Coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. 5.5 Photochemical activation and splitting of water, CO_2 and N_2 - manganese based photo systems for water-splitting. 5.6 Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications, 2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010. 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Reference Books	1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001. 2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001. 3. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.

	4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998. 5. A.R. West, Solid State Chemistry and Applications, Wiley, 2nd illustrated edition May 2022.
Website and e-learning source	1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf. 3. https://bit.ly/3QyVg2R 4. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Courseware/Introduction_to_Xray_Diffraction_(XRD)/03_Basic_Theory/03_Crystallography

Course Learning Outcomes (for Mapping with POs and PSOs)

CO1: Speculate the characteristics of crystal structures and its application to geometrical crystallography. **(K1, K2, K3, K4, K5 & K6)**

CO2: Integrate and assess the structure of different materials and their properties by crystal growth methods. **(K1, K2, K3, K4, K5 & K6)**

CO3: Explore and identify the new materials (LED) for energy application. **(K1, K2, K3, K4, K5 & K6)**

CO4: Insight the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, uses, structures and synthesis. **(K1, K2, K3, K4, K5 & K6)**

CO5: Design and develop new and efficient materials with improved property for renewable energy applications. **(K1, K2, K3, K4, K5 & K6)**

CO	**PSO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE IV B: BIO-INORGANIC CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective IV B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>PECHH24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the role of trace elements.
To understand the biological significance of iron, sulpur.
To study the toxicity of metals in medicines.
To have knowledge on diagnostic agents.
To discuss on various metalloenzymes properties.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: (12 hours) (K1, K2, K3, K4, K5 & K6)

Essential trace elements:
1.1 Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores.
1.2 Sodium and potassium transport.Calcium signalling proteins.
1.3 Metalloenzymes: Zinc enzymes–carboxypeptidase and carbonic anhydrase.
1.4 Iron enzymes–catalase, peroxidase.
1.5 Copper enzymes – superoxide dismutase, Plast ocyanin, Ceruloplasmin, Tyrosinase.
1.6 Coenzymes - Vitamin-B12 coenzymes.</td></tr>
<tr><td colspan="7">UNIT-II: (12 hours) (K1, K2, K3, K4, K5 & K6)

Transport Proteins:
2.1 Oxygen carriers -Hemoglobin and myoglobin.
2.2 Structure and oxygenation Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin.
2.3 Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450.
2.4 Non-heme oxygen carriers-Hemerythrin and hemocyanin.
2.5 Iron-sulphur proteins- rubredoxin Structure and classification.
2.6 Flvodoxins and blue copper protein.</td></tr>
<tr><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3, K4, K5 & K6)

Nitrogen fixation
3.1 Introduction, types of nitrogen fixing microorganisms.
3.2 Nitrogenase enzyme - Metal clusters in nitrogenase.
3.3 Redox property - Dinitrogen complexes transition metal complexes of dinitrogen.
3.4 Nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia.</td></tr>
</table>

	3.5 Photosynthesis: photosystem-I and photosystem-II. 3.6 Chlorophylls structure and function.
	UNIT-IV: (12 hours) (K1, K2, K3, K4, K5 & K6) **Metals in medicine:** 4.1 Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. 4.2 Therapeutic Compounds: Vanadium-Based Diabetes Drugs. 4.3 Platinum-Containing Anticancer Agents. 4.4 Chelation therapy; Cancer treatment. 4.5 Diagnostic Agents: Technetium Imaging Agents. 4.6 Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.
	UNIT-V: (12 hours) (K1, K2, K3, K4, K5 & K6) **Enzymes** 5.1 Introduction and properties. 5.2 Nomenclature and classification. 5.3 Enzyme kinetics, free energy of activation and the effects of catalysis. 5.4 Michelis - Menton equation. 5.5 Effect of pH, temperature on enzyme reactions. 5.6 Factors contributing to the efficiency of enzyme.

Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Williams,D.R. –Introdution to Bioinorganic chemistry. 2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry,RoyolSoceity of Chemistry, Monograph for Teachers-31 3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co., USA. 4. G.N. Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993. 5. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, **2001**.
Reference Books	1. M.Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996) 2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London. 3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987. 4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002. 5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.
Website and e-learning source	1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html

	2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html

Course Outcomes

CO1: Analyse the importance of trace elements and metalloenzymes. **(K1, K2, K3, K4, K5 & K6)**
CO2: Explain the biological redox systems. **(K1, K2, K3, K4, K5 & K6)**
CO3: Discuss nitrogen fixation. **(K1, K2, K3, K4, K5 & K6)**
CO4: Usage of metals in medicine. **(K1, K2, K3, K4, K5 & K6)**
CO5: Evaluate the photosynthetic mechanism. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">SEC: PREPARATION OF CONSUMER PRODUCTS</td></tr>
<tr><td>Paper No.</td><td colspan="8">Skill Enhancement Course I A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">PSCHA124</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>2</td><td>-</td><td colspan="3">-</td><td colspan="3">2</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic information about the consumer products</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">This course is designed to provide knowledge on
● To appreciate the role of sensory evaluation at different stages of product development.
● To assess consumer acceptability.
● To determine shelf-life studies.</td></tr>
<tr><td>Course Outline</td><td colspan="8">Unit I: (6 hours)
Food and hygiene product
Consumer awareness – Customer protection – Types of consumers right. Consumer Products: Definition – types. Different types of food processing. Preparation of food products without fire. Preparation of fermented dairy product: Cheese and yogurt. Preparation of safety matches, agarbathis and naphthalene balls.</td></tr>
<tr><td></td><td colspan="8">Unit II: (6 hours)
Cosmetics products
Introduction – classification and properties of cosmetics. Cosmetic ingredient functions. Composition and formulation of cream - Crack cream, Anti-aging cream, Moisturizing cream, perfume and Talcum powder. Composition and formulation of deodorants, nail paint, Lipstick, shampoos, hair dyes and eyeliner.</td></tr>
<tr><td></td><td colspan="8">Unit III: (6 hours)
Soaps and detergent
Soaps – Introduction, Classification and properties. Different methods of preparation of soap. Soap powder- liquid soap. Advantages and disadvantages of soap. Detergents - Introduction, Classification and properties. Different methods of preparation of detergents. Mechanism of Cleaning Action of detergents- Advantages and disadvantages of detergents.</td></tr>
<tr><td></td><td colspan="8">Unit IV: (6 hours)
Surfactants and Cleaners
Introduction- Surfactants – Classification with an example. General method of Preparation of sanitizers, hand wash, toothpaste, lip Balm. Composition and formulations surface cleaner, glass cleaner, tiles and marble cleaner. Biodegradable cleaning products – types – advantages and disadvantages.</td></tr>
<tr><td></td><td colspan="8">UNIT V: (6 hours)
Beverages
General method for preparation of fruit juice. Beverages – Classification – uses. Preparation of nonalcoholic beverages: Natural juice, sweetened juice</td></tr>
</table>

	and blended juice. Preparation of alcoholic beverages: Wine, Beer, Brandy and Whisky. Preparation of syrup: syrups from extract and synthetic syrup.
Extended Professional component (It is a part of internal component only, not to be included in the external question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. G. Subbulakshmi, Shobha A Udipi, Pdmini S Ghugre, Food processing and preservation. New age international publishers, second edition, 2021. 2. John M. deMan, John W. Finley, W. Jefferey Hurst, Chang Yong Lee, Principles of food chemistry, Springer, Fourth edition, 2018. 3. W.Gerhartz, Ullmann's Encyclopaedia of Industrial Chemistry, Wiley Publisher, 1988.
Reference Books:	1. Jan Berry "The big book of home made products for your skin, health and home, page street publishing, 2020. 2. Dr. Kamala Pathak,"Cosmetic science, concepts and principles, Nirali Prakashan, 2020. 3. Steve Chapman, Tony Arnold, Ann Gatewood, Lloyd Clive. Introduction to Materials Management, Pearson; 8th edition, 2016. 4. *Diane M. Barrett, Laszlo Somogyi,* Processing Fruits, Science and Technology, 2nd edition, 2004
Website and e-learning source	1. www.epgpathshala.nic.in 2. www.nptel.ac.in 3. http:/swayam.gov.in
OER	1. http://solr.bccampus.ca:8001/bcc/file/ddbe3343-9796-4801-a0cb7af7b02e3191/1/Core%20Concepts%20of%20Marketing.pdf 2. https://www.ama.org/resources/Pages/Dictionary.aspx?dLetter=P#product 3. *https://en.wikipedia.org › wiki › Perfume5* 4. *https://youtu.be/R3cBzCl24bA?si=RY79koBgcGj9aMNA* 5. https://youtu.be/xwRkUy6moSEhttps://youtu.be/xwRkUy6moSE

Course Outcomes

CO1 Visualize the importance of consumer products.
CO2 Discuss the chemistry of cosmetics and perfumes.
CO3 Explain the basic requirement of soaps and detergent.
CO4 Describe surfactants and cleaners.
CO5 Explain beverages.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SEC: CHEMISTRY IN EVERYDAY LIFE</td></tr>
<tr><td>Paper No.</td><td colspan="7">Skill Enhancement Course I B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">PSCHB124</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>-</td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">This course is designed to provide knowledge on
● To study about the importance of chemistry in everyday life.
● To study of the chemistry in relation of agriculture, cosmetics, perfumes and polymer composites.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: (6 hours)
Principles of chemicals in daily life
Principles of chemistry cleanliness — soaps, detergents, household cleaning bleaches, tooth paste, shoe polish – composition and mechanism. Stains – Precautions in removal of stains, Removal of different Stains.</td></tr>
<tr><td colspan="7">UNIT-II: (6 hours)
Daily use products
Preparations of Safety matches, Agarbathis, Napthalene balls, Wax candles, Fountain pen ink, Chalk crayons. Artificial sweetening agents and food preservatives.</td></tr>
<tr><td colspan="7">UNIT-III: (6 hours)
Agricultural Chemistry
Soil - Definition, Properties – pH, Texture, Acidity, Alkalinity, Soil water, Soil minerals, Soil fertility. Pesticides- Pest control methods – Mechanical, Biological, Environmental and Chemical. Pest control methods using chemicals – Sprays, Dust, Fumings, Aerosols and internal applications.</td></tr>
<tr><td colspan="7">UNIT-IV: (6 hours)
Perfumes and cosmetics
Perfumes – Production of natural perfumes, flower perfumes – Jasmine, Lily, Rose. Fruit flavours, Artificial flavours – Apple, Banana, Grape and Pine apple compounds. Facial make up kits, Lip stick and eye cosmetics</td></tr>
<tr><td colspan="7">UNIT-V: (6 hours)
Polymers composites
Necessity of composites, Role of matrix in composites – Matrix materials, reinforcements– Types of composites – Application of fibre composites – Smart composites – Functional sensor materials.</td></tr>
<tr><td colspan="3">Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
</table>

Recommended Text	1. Industrial chemistry, B. K. Sharma 2. A Textbook of Chemical Technology, Shukla S. D and Pandey G. N 3. Chemistry of Pesticides, N.K. Rao 4. Industrial Chemsitry, Loutfy H. Madkour 5. Engineering chemistry, Jain and Jain
Reference Books	1. Industrial chemistry, B. K. Sharma 2. Introduction to Materials Management, by Steve Chapman, Ann K. Gatewood, Tony K. Arnold 3. Ullmann's Encyclopaedia of Industrial Chemistry, W. Gerhartz 4. Engineering chemistry, B.Sivashankar 5. Advanced Polymer Composites: Principles and Applications (Pdl Handbook Series), Bor Z.Jang
Website and e-learning source	1. www.epgpathshala.nic.in 2. www.nptel.ac.in 3. http:/swayam.gov.in
OER	1. https://www.toppr.com/guides/science/soil/soil-and-soil-profile/ 2. *https://www.rsc.org › organic-chemistry-case-studies* 3. *https://en.wikipedia.org › wiki › Perfume* 4. https://onlinelibrary.wiley.com/journal/15480569 5. https://www.sciencedirect.com/topics/materials-science/polymer-composite 6. https://en.wikipedia.org › wiki › Pesticide

Course Outcomes

CO1 Visualize the importance of Chemistry in daily life;
CO2 Discuss agricultural chemistry
CO3 Explain artificial sweetening agents and food preservatives;
CO4 Discuss the chemistry of cosmetics and perfumes.
CO5 Explain the chemistry of polymers composites

CO	**PSO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC SYNTHESIS AND PHOTOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VII</td></tr>
<tr><td>Category</td><td>Core</td><td>Year
Semester</td><td>II
III</td><td>Credits</td><td>5</td><td>Course Code</td><td>PCCHG24</td></tr>
<tr><td>Instructional hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td colspan="2">6</td><td colspan="2">1</td><td colspan="2">-</td><td>7</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the Course</td><td colspan="7">To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
To study various synthetically important reagents for any successful organic synthesis.
To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
To learn the concepts of pericyclic reaction mechanisms.
To gain the knowledge of photochemical organic reactions.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: (21 hours) (K1, K2, K3, K4, K5 & K6)

Planning an Organic Synthesis and Control elements:
1.1 Preliminary Planning – knowns and unknowns of the synthetic system studied, analysis of the complex and interrelated carbon framework into simple rational precursors.
1.2 Retrosynthetic analysis, alternate synthetic routes, key intermediates that would be formed.
1.3 Available starting materials and resulting yield of alternative methods. Linear Vs convergent synthesis.
1.4 Synthesis based on Umpolung concepts of Seeback.
1.5 Chemoselectivity, regioselectivity, stereoselectivity definition and examples.
1.6 Examples on retrosynthetic approach, calculation of yield, advantages of convergent synthesis.</td></tr>
<tr><td colspan="7">UNIT-II: (21 hours) (K1, K2, K3, K4, K5 & K6)

Organic Synthetic Methodology:
2.1 Retrosynthetic analysis; Synthesis of organic mono and bifunctional compounds via disconnection approach.
2.2 Protection of hydroxyl, and carboxyl groups.
2.3 Protection of carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis.
2.4 Control elements: Regiospecific control elements. Use of protective groups, activating groups, and bridging elements.
2.5 Stereospecific control elements.
2.6 Functional group alterations and transposition.</td></tr>
</table>

	UNIT-III:(21 hours) (K1, K2, K3, K4, K5 & K6) **Pericyclic Reactions:** 3.1 Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO method and correlation diagrams. 3.2 Cycloaddition and retrocycloaddition reactions; [2+2], [2+4], [4+4, Cationic, anionic, and 1,3-dipolar cycloadditions. 3.3 Cheletropic reactions, Electrocyclization and ring opening reactions of conjugated dienes and trienes. 3.4 Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations, degenerate rearrangements. Ionic sigmatropic rearrangements. 3.5 Group transfer reactions. 3.6 Regioselectivity, stereoselectivity and periselectivity in pericyclic reactions.
	UNIT-IV:(21 hours) (K1, K2, K3, K4, K5 & K6) **Organic Photochemistry-I:** 4.1 Photochemical excitation: Experimental techniques. 4.2 Electronic transitions; Jablonskii diagrams; intersystem crossings. 4.3 Energy transfer processes; Stern Volmer equation. 4.4 Reactions of electronically excited ketones; $\pi \rightarrow \pi^*$ triplets; Norrish type-I reaction. 4.5 Norrish type-II cleavage reaction and photo reductions. 4.6 Paterno-Buchi reactions.
	UNIT-V: (21 hours) (K1, K2, K3, K4, K5 & K6) **Organic Photochemistry-II:** 5.1 Photochemistry of α,β-unsaturated ketones; cis-trans isomerisation. 5.2 Photon energy transfer reactions. 5.3 Photo cycloadditions. 5.4 Photochemistry of aromatic compounds and photochemical rearrangements. 5.5 Photo-stationery state; di-π-methane rearrangement. 5.6 Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton's reaction.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5thed, Tata McGraw-Hill, New York, 2003. 2. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007. 3. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990. 4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016. 5. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011. 6. Stuart Warren, Organic Synthesis: The Disconnection Approach, Wiley Student Edition, Reprint 2007. 7. V. K. Ahluwalia, Organic Synthesis: Special Techniques, Narosa Publishing House, 2nd Edition, 2005. 8. S. N. Sanyal., Reactions, Rearrangements and reagents, Bharati Bhawan, Reprint 2003. 9. P. S. Kalsi, Stereo Chemistry, Conformations and Mechanisms, New Age International Pvt. Ltd., 10th Edition, 2019. 10. S. M. Mukherji and S. P. Singh, Organic Reaction Mechanism, Trinity Press, Revised Edition, 2017. 11. O. P. Agarwal, Organic Chemistry, Reactions and Reagents, 55th Edition, GOEL Publishing House, 2017.
Reference Books	1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974. 2. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004. 3. W. Caruthers, Some Modern Methods of Organic Synthesis 4thedn, Cambridge University Press, Cambridge, 2007. 4. H. O. House. Modern Synthetic reactions, W.A. Benjamin Inc, 1972. 5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012. 6. R. O. C. Norman, Principles of Organic Synthesis, Chapman and Hall, London, 2nd Edition, Reprint 1980. 7. E. S. Gould, Structure and Mechanism, Copyright, 1959.
Website and e-learning source	**1. https://rushim.ru/books/praktikum/Monson.pdf** **2.** https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5

Course Outcomes

CO1: Plan organic synthesis and control elements. **(K1, K2, K3, K4, K5 & K6)**
CO2: Implement the synthetic strategies in the preparation of various organic compounds. **(K1, K2, K3, K4, K5 & K6)**
CO3: Examine the pericyclic reactions. **(K1, K2, K3, K4, K5 & K6)**
CO4: Explain the fundamentals of organic photochemistry. **(K1, K2, K3, K4, K5 & K6)**
CO5: Appraise photochemical reactions. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">COORDINATION CHEMISTRY – I</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">PCCHH24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td>1</td><td colspan="3">-</td><td colspan="2">7</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To gain insights into the modern theories of bonding in coordination compounds.
To learn various methods to determine the stability constants of complexes.
To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
To evaluate the reactions of octahedral and square planar complexes.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="8">UNIT-I: (21 hours) (K1, K2, K3, K4, K5 & K6)

Modern theories of coordination compounds:

1.1 Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries.

1.2 Measurement of 10Dq - factors affecting 10Dq - spectrochemical series - crystal field stabilisation energy for high spin and low spin octahedral and tetrahedral complexes.

1.3 Applications of CFT, uses of CFSE values - site selections in spinels and antispinels, limitations.

1.4 Jahn Teller distortions – theorem, causes and consequences.

1.5 MOT - experimental evidences for metal-ligand covalent bonding in complexes, σ–bonding in O_h complexes - construction of MO diagrams.

1.6 Pi-bonding in O_h complexes, effect of π–bonding on the value of Δ_o, relation between pi bonding ability of ligands and spectrochemical series, comparison of CFT with MOT.</td></tr>
<tr><td colspan="8">UNIT-II: (21 hours) (K1, K2, K3, K4, K5 & K6)

Spectral characteristics of complexes:

2.1 Types of absorption spectra - ligand spectra, counter - ion spectra, CT spectra, ligand field spectra - R-S coupling.

2.2 Microstates - spectroscopic terms - ground state term: Hund’s rule - term states for ‘d’ - ions.

2.3 Selection rules - Laporte’s and spin selection rules, splitting of terms in octahedral and tetrahedral complexes.</td></tr>
</table>

	2.4 Correlation diagrams - Orgel diagrams and Tanabe-Sugano diagrams - important features - spectra of different d systems. 2.5 Racah parameter - nephelauxetic effect and calculation of inter-electronic repulsion parameter. 2.6 Charge transfer spectra - classification - ligand to metal, metal to ligand, inter valence and intra ligand charge transfer.
	UNIT-III: (21 hours) (K1, K2, K3, K4, K5 & K6) **Stability and Magnetic property of the complexes:** 3.1 Thermodynamic and kinetic stability - stepwise and overall stability constants - relationship between both the constants. 3.2 Trend in K-value - Irving-Williams series - classification of metals. 3.3 Factors affecting the stability of complexes. 3.4 Determination of stability constants by spectrophotometric, polarographic, Bjerrum's half, Ion exchange, continuous variation (Job's method) potentiometric methods - detection of complex formation. 3.5 Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments. 3.6 Magnetic characteristics of transition metal complexes - types of magnetic character - determination of magnetic susceptibility - Guoy and Faraday's method - magnetic properties of complex ions - magnetic criterion of bond type in complex and orbital contribution to magnetic moment.
	UNIT-IV: (21 hours) (K1, K2, K3, K4, K5 & K6) **Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes:** 4.1 Inert and Labile complexes; Mechanisms of substitutions in octahedral complexes - dissociative, associative and interchange (I_a and I_d) mechanisms. 4.2 Hydrolysis reactions - acid hydrolysis and base hydrolysis reactions of six-coordinated Co(III) ammine complexes - mechanisms - evidences. 4.3 Replacement of coordinated water - mechanisms - evidences - rates of water replacement - orbital occupation effects. 4.4 Classification of metal ions based on the rate of water replacement reaction and their correlation to Crystal Field Activation Energy. 4.5 Ligand substitution reactions in square-planar complexes - mechanism - influences of entering, leaving and central metal ion on the reactivity of square planar complexes of Pt (II), cis effect.

	4.6 Trans effect - trans effect series - theories and applications of trans effect in synthesis of square planar compounds; Kurnakov test.
	UNIT-V: (21 hours) (K1, K2, K3, K4, K5 & K6) **Electron transfer reactions:** 5.1 Electron transfer reactions (redox reactions) in octahedral complexes: Outer Sphere Mechanism - characteristics, factors influencing OSM. 5.2 Cross reactions - Marcus-Hush principle. Inner Sphere Mechanism - characteristics. 5.3 Inner Sphere Mechanism - factors influencing ISM, OSM versus ISM. 5.4 Two electron transfers, non-complementary electron transfer reactions, reactions of the coordinated ligands. 5.5 Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their applications. 5.6 Electron transfer reactions in biological systems - cytochromes, rubredoxins and ferredoxins.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006. 2. G L Meissler and D A Tarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008. 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B. N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976. 5. F. A. Cotton and G. W. Wilkinson, Advanced Inorganic Chemistry: A Comprehensive Text, John Wiley and Sons, 6th Edition, Reprint 2007.
Reference Books	1. K. F. Purcell and J. C. Kotz, Inorganic Chemistry, WB Saunders Co., USA, Indian Edition, Reprint 2012. 2. M. C. Shrivers, P. W Atkins, C. H. Langford, Inorganic Chemistry, Oxford University Press, 6th Edition, Reprint 2014. 3. B. E. Douglas DH McDaniel's and Alexander, Concepts and Models of Inorganic Chemistry, Wiley Publication, 3rd Edition, Reprint 2006. 4. D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, Inorganic Chemistry, London, 2010. 5. R. Gopalan, Concise Coordination Chemistry, Vikas Publishing House Pvt. Ltd., Reprint 2008. 6. Wahid U. Malik, G. D. Tuli, R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand and Co., New Delhi, Reprint 2010.

	7. S. F. A. Kettle, Coordination Chemistry, ELBS, Reprint 1990. 8. G. S. Manku, Theoretical Principles of Inorganic Chemistry, Tata McGraw-Hill Publishers, Reprint 2011.
Website and e-learning source	1. http://wwwchem.uwimona.edu.jm/courses/IC10Kout.html 2. https://ocw.mit.edu/courses/chemistry/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/ 3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5 (P-03, P-07) 4. https://nptel.ac.in/courses/104/101/104101116/ (Electron Transfer (ET) in living systems)

Course Outcomes

CO1: Describe various theories of coordination compounds. **(K1, K2, K3, K4, K5 & K6)**

CO2: Illustrate the spectral properties of coordination complexes. **(K1, K2, K3, K4, K5 & K6)**

CO3: Explain the stability of complexes, various experimental methods to determine the stability of complexes and the magnetic properties of the complexes. **(K1, K2, K3, K4, K5 & K6)**

CO4: Predict the kinetics and mechanisms of substitution reactions of octahedral and square planar complexes. **(K1, K2, K3, K4, K5 & K6)**

CO5: Comprehend the electron transfer reactions with mechanisms. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSICAL CHEMISTRY PRACTICAL – I</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td>PCCHI24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="2">4</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
Experiment and calculate the rate constant of ester hydrolysis and primary salt effect.
To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
To determine the kinetics of adsorption of oxalic acid on charcoal.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:
1. Compare the strengths of the given acids A and B by using them individually in the hydrolysis of methylacetate at room temperature.
2. *Determination of partial molar volume of acetic acid in aqueous solution by apparent molar volume method.
3. * Kinetics of inversion of sucrose - polarimetry.</td></tr>
<tr><td colspan="7">UNIT-II: Kinetics
1. Study the kinetics of acid hydrolysis of an ester, determine the temperature coefficient and also the activation energy of the reaction.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.
3. Determination of rate constant of the reaction between potassium iodide and potassium persulphate and study the effect of added neutral salt on the rate constant of the reaction.</td></tr>
<tr><td colspan="7">UNIT-III: Phase diagram
1. Construction of the phase diagram for a binary mixture to determine the eutectic temperature and composition and determination of the composition of the given mixture A and B by making use of the phase diagram - simple eutectic system.
Adsorption
2.Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).</td></tr>
</table>

	***Not to be given for examination**
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009. 2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996. 3. V.D. Athawale and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008. 4. V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Basic Principles of Practical Physical Chemistry, Sultan Chand and Sons Educational Publishers, Reprint 1995. .
Reference Books	1. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. 2. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009. 3. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987. 4. Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014. 5. V. K. Ahluwalia, Sunita Dhingra Adarsh Gulati, College Practical Chemistry, University Press (India) Private Limited, Reprint 2008. 6. David Shoemaker, Joseph Nibler, Carl Garland, Experiments in Physical Chemistry, 7th Edition, 2003. 7. B. D. Khosla, V. C. Garg, Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand and Co., Edition 2007.
Website and e-learning source	https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf http://vlab.amrita.edu/?sub=3&brch=208&sim=563&cnt=958

Course Outcomes

CO1: Recall the principles associated with various physical chemistry experiments.
CO2: Plan and perform all the experiments.
CO3: Observe and record systematically the readings in all the experiments.
CO4: Calculate and process the experimentally measured values and compare with graphical data.
CO5: Interpret the experimental data scientifically to improve students' efficiency for societal developments.

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CO1	H	H	H	H	H	H
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CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

Continuous Assessment - 40 Marks

I C.A. - 50 Marks

II C.A. - 50 Marks

Average - 25Marks

Performance during regular practicals - 10 Marks

Regularity in submission of observation notebook and Record - 5 Marks

CA Practical Examination - 50 Marks

Record - 5 Marks

Viva - 5 Marks

Principle and model graph - 5 Marks

Manipulation - 15 Marks

Result - 20 Marks

Semester Practical Examination - 60 Marks

Record	- 10 Marks
Viva–Voce	- 5 Marks
Principle and model graph	- 5 Marks
Manipulation	- 20 Marks
Result	- 20 Marks

1. KINETICS: (Iodination of acetone, Second order kinetics)

Error:

Upto + 0.2 - 20 Marks

>+ 0.2 to + 0.4 - 13 Marks

> + 0.4 - 7 Marks

2. PHASE DIAGRAM FOR SIMPLE EUTECTIC SYSTEM:

Eutectic temperature and composition - 20 Marks

Eutectic temperature - 10 Marks

Error:

Upto + 2°C - 10 Marks

>+ 2°C to + 4°C - 7 Marks

>+4°C - 5 Marks

Unknown composition - 10 Marks

Upto 5% - 10 Marks

>5-6% - 7 Marks

>6% - 5 Marks

3. ARRHENIUS:

Arrhenius parameter - 10 Marks

Error:

< 1% - 10 Marks

>1-2% - 7 Marks

> 2% - 5 Marks

Activation Energy - 10 Marks

Below a factor of 10 - 10 Marks

By a factor of 10 - 7 Marks

Above a factor of 10 - 5 Marks

4. PRIMARY SALT EFFECT: (Absence of electrolyte = 10 Marks; Presence =10 Marks)

Error:

Below a factor of 10 - 10 Marks

By a factor of 10 - 7 Marks

Above a factor of 10 - 5 Marks

5. ACID STRENGTH:

Error:
< 2% - 20 Marks
>2-3% - 13 Marks
> 3% - 7 Marks

6. ADSORPTION OF OXALIC ACID ON CHARCOAL:
Error:
< 2% - 20 Marks
>2-3% - 13 Marks
> 3% - 7 Marks

<table>
<tr><td>Title of the Course</td><td colspan="8">PHYSICAL CHEMISTRY PRACTICAL – II</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">PCCHJ24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">4</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8"></td></tr>
<tr><td>Objectives of the course</td><td colspan="8">Analyze different constituents through instrumental methods of analysis.
Evaluate different contaminants in materials using conductivity measurements.
Design experiments for analysis of inorganic and organic materials.
To constituents in materials using emission and absorption techniques.</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT-I:
1. Determination of the strength of given strong acid (HCl) by titrating conductometrically with a strong base (NaOH).
2. Determination of the strength of weak acid (CH_3COOH) by titrating conductometrically against a standard sodium hydroxide (NaOH) solution.
3. Titrate conductometrically the given mixture of strong and weak acids (HCl and CH_3COOH) against a standard sodium hydroxide (NaOH) solution and determine the individual strength of the two acids in the mixture.
4. Determination of the strength of given strong acid (HCl) by titrating potentiometrically with a strong base (NaOH)
5. Determination of the strength of given weak acid (CH_3COOH) by titrating potentiometrically with a strong base (NaOH) and determine dissociation constant of the weak acid to 1/4, 1/2 and 3/4 neutralization.
6. Determination of the strength of ferrous ammonium sulphate (FAS) solution by titrating against standard potassium permanganate ($KMnO_4$) potentiometrically.
7. Determination of the strength of potassium iodide (KI) by titrating against standard potassium permanganate ($KMnO_4$) potentiometrically.
8. Determination of the strength of mixture of halides (KCl & KI) Vs $AgNO_3$ by precipitation titration potentiometrically.
Determination of pH values of the given buffer solutions by potentiometric method. You are provided with a buffer of known pH.</td></tr>
<tr><td></td><td colspan="8">UNIT-II:
1. Estimation of iron by colorimetric method.
2. Determination of the amount (mol/L) of ferricyanide present in the given solution using cyclic voltammetry. (Demonstration only)</td></tr>
<tr><td></td><td colspan="8">UNIT-III: Interpretation and identification of the given spectra of various organic compounds arrived at from the following instruments
1.UV-Visible</td></tr>
</table>

	2.IR 3.Raman 4.NMR 5.ESR 6.Mass etc.,
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003. 2. G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, Vogel's Textbook of Quantitative Chemical Analysis; 6th ed., ELBS, 1989. 3. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, India, Viva Books Private Limited, 2015. 4. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996. 5. J. D. Woollins, Inorganic Experiments; VCH: Weinheim, 1995.
Reference Books	1. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd, 2009. 2. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 2011. 3. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. 4. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009. 5. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
Website and e-learning source	1. https://bit.ly/3QESF7t 2. https://bit.ly/3QANOnX

Course Learning Outcomes (for Mapping with POs and PSOs)

CO1: Demonstrate the principles associated with various inorganic, organic and physical chemistry experiments

CO2: Scientifically plan and perform all the experiments

CO3: Observe and inference the readings systematically in the record for all the experiments

CO4: Calculate and process the experimentally measured values and compare with graphical data.

CO5: Interpret the experimental data scientifically to improve students efficiency for societal developments.

CO	PSO					
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CO1	H	H	H	H	H	H
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CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

Continuous Assessment - 40 Marks
I C.A. - 50 Marks
II C.A. - 50 Marks
Average (I C.A. + II C.A.) - 25 Marks
Performance during regular practicals - 10 Marks
Regularity in submission of observation notebook and Record - 5 Marks

CA Practical Examination - 50 Marks
Spectra - 5 Marks
Experiment 1 - 17.5 Marks
Experiment 2 - 17.5 Marks
Record - 5 Marks
Viva-Voce - 5 Marks
Experiment 1&2 (each 17.5 Marks)
Tabulation, Calculation, Graph - 7.5 Marks
Result - 10 Marks

Semester Practical Examination - 60 Marks
Spectra - 5 Marks
Experiment 1 - 20 Marks
Experiment 2 - 20 Marks
Record - 10 Marks
Viva-Voce - 5 Marks

Experiment 1&2 **(each 20 Marks)**

Tabulation, Calculation, Graph - 10 Marks

Result - 10 Marks

Error:

Upto 2% - 10 Marks

2% to 4% - 8 Marks

4% to 6% - 6 Marks

>6% - 5 Marks

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE V A: BIOMOLECULES AND HETEROCYCLIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective V A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">PECHI24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the basic concepts and biological importance of biomolecules and natural products.
To explain various of functions of carbohydrates, proteins, nucleic acids, steroids, harmones and enzymes.
To understand the concepts of heterocyclic compounds.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: (15 hours) (K1, K2, K3, K4, K5 & K6)

Chemistry and metabolism of carbohydrates:
1.1 Definition, classification and biological role of carbohydrates.
1.2 Monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required).
1.3 Physical and chemical properties of glucose and fructose.
1.4 Disaccharides: Ring structures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose.
1.5 Polysaccharides: Starch, glycogen and cellulose – structure and properties.
1.6 Glycolysis of carbohydrates.</td></tr>
<tr><td colspan="7">UNIT-II: (15 hours) (K1, K2, K3, K4, K5 & K6)

Steroids and Hormones:
2.1 Steroids-Introduction, occurrence, nomenclature, configuration of substituents.
2.2 Diels’ hydrocarbon, stereochemistry, classification, Diels’ hydrocarbon, biological importance.
2.3 Colour reactions of sterols, cholesterol-occurrence, tests, physiological activity.
2.4 Biosynthesis of cholesterol from squalene.
2.5 Hormones-Introduction, classification, functions of sex hormones-androgens and estrogens.
2.6 Adrenocortical hormones-cortisone and cortisol structured functions of non-steroidal hormones-adrenaline and thyroxin.</td></tr>
<tr><td colspan="7">UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6)

Proteins and nucleic acids:
3.1 Separation and purification of proteins – dialysis, gel filtration and electrophoresis.
3.2 Catabolism of amino acids - transamination, oxidative deamination and decarboxylation.</td></tr>
</table>

	3.3 Biosynthesis of proteins: Role of nucleic acids. Amino acid metabolism and urea cycle. 3.4 Structure, methods for the synthesis of nucleosides-direct combination, formation of heterocyclic base and nucleoside modification. 3.5 Conversion of nucleoside to nucleotides. Primary and secondary structure of RNA and DNA, Watson-Crick model. 3.6 Solid phase synthesis of oligonucleotides.
	UNIT-IV: (15 hours) (K1, K2, K3, K4, K5 & K6) **Enzyme Chemistry** 4.1 Enzyme chemistry - enzyme mechanism of alpha chymotrypsin. 4.2 Immobilized enzyme technology - enzymes in synthetic organic chemistry. 4.3 Coenzyme chemistry - prosthetic groups, apo enzymes - structure, biological function and mechanism of reactions catalyzed by coenzyme A and thiamine pyrophosphate. 4.4 Structure, biological function and mechanism of reactions catalyzed by pyridoxal phosphate and NAD^+. 4.5 Structure, biological function and mechanism of reactions catalyzed by NADP and FAD. 4.6 Structure, biological function and mechanism of reactions catalyzed by lipoic acid and Vitamin B_{12}.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) **Fused Ring Heterocyclic Compounds:** 5.1 Five membered heterocycles: Preparation and properties of imidazole, oxazole, thiazole. 5.2 Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions. 5.3 Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene. Preparation and properties. 5.4 Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions. 5.5 Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions. 5.6 Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America,2007. 2. I. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975.

	3. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi,2000. 4. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014. 5. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi,2009.
Reference Books	1. I. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia,2004. 2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co,2000. 3. Shoppe, Chemistry of the steroids, Butterworthes,1994. 4. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004. 5. M. P. Singh. and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi,2005. 6. I. L. Finar, Organic Chemistry, Vol. II, ELBS Publication, 5th Edition, 2005. 7. Raj K Bansal, Heterocyclic Chemistry, New Age International, 3rd Edition, Reprint 2005. 8. Nelson and Cox (Lehninger), Principles of Biochemistry, Freeman and Company, 4th Edition, 2005. 9. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Harper's Illustrated Biochemistry, McGraw-Hill, 26th Edition, 2003. 10. Pamela C. Champe and Richard A. Harvey, Lippincott's Illustrated Reviews: Biochemistry, 3rd Edition, 2004. 11. U. Satyanarayana and U. Chakrapani, Fundamentals of Biochemistry, Books & Allied (P) Ltd., Reprint 2008. 12. Dr. R. Hannah Sulochana, Principles of Biochemistry, PBS Private Limited Chennai, 1st Edition, 2010. 13. A. C. Deb, Fundamentals of Biochemistry. New Central Book Agency (P) Ltd., 10th Edition, 2011. 14. Hermann Dugas, Bioorganic Chemistry - A Chemical Approach to Enzyme Action, Springer, 3rd Edition, Reprint 2007. 15. P. S. Kalsi and Sangeeta Jagtap, Pharmaceutical, Medicinal and Natural Product Chemistry, Narosa Publishing House, New Delhi, 2013.
Website and e-learning source	1. https://www.organic-chemistry.org/ 2. https://www.studyorgo.com/summary.php 3. https://www.clutchprep.com/organic-chemistry

Course Learning Outcomes (for Mapping with POs and PSOs)

CO1: Explain the chemistry and metabolism of carbohydrates. **(K1, K2, K3, K4, K5 & K6)**
CO2: Discuss about steroids and hormones. **(K1, K2, K3, K4, K5 & K6)**
CO3: Explain proteins and nucleic acids. **(K1, K2, K3, K4, K5 & K6)**
CO4: Describe the structure and biological role of enzymes (α-chymotrypsin) and cofactors. **(K1, K2, K3, K4, K5 & K6)**
CO5: Analyse and rationalise the structure and synthesis of heterocyclic compounds. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE V B: PHARMOCOGNOSY AND PHYTOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective V B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">PECHJ24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">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.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: (15 hours) (K1, K2, K3, K4, K5 & K6)

Pharmacognosy and Standardization of Herbal drugs:
1.1 Introduction, definition, development classification and Source of Drugs.
1.2 Biological, mineral, marine, and plant tissue cultures.
1.3 Study of pharmacognostic of a crude drug.
1.4 Biosynthesis: Shikimic acid pathway and acetate pathway.
1.5 Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug.
1.6 Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.</td></tr>
<tr><td colspan="8">UNIT-II: (15 hours) (K1, K2, K3, K4, K5 & K6)

Extraction Techniques:
2.1 General methods of extraction.
2.2 Types – maceration, Decoction, percolation.
2.3 Immersion and soxhlet extraction.
2.4 Advanced techniques- counter current, steam distillation, supercritical gases, sonication.
2.5 Micro waves assisted extraction.
2.6 Factors affecting the choice of extraction process.</td></tr>
<tr><td colspan="8">UNIT-III: (15 hours) (K1, K2, K3, K4, K5 & K6)

Drugs containing Terpenoids and volatile oils:
3.1 Terpenoids: Classification, Isoprene rule, Isolation and separation techniques.
3.2 General properties Camphor, Menthol, Eucalyptol.
3.3 Volatile Oils or Essential Oils: Method of Preparations.
3.4 Classifications of Volatile oils, Camphor oil, Geranium oil.
3.5 Citral- Structure and uses.</td></tr>
</table>

	3.6 Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications.
	UNIT-IV: (15 hours) (K1, K2, K3, K4, K5 & K6) **Drugs containing alkaloids:** 4.1 Occurrence, function of alkaloids in plants. 4.2 Pharmaceutical applications. 4.3 Isolation, Preliminary Qualitative tests and general properties. 4.4 General methods of structural elucidation. 4.5 Morphine, Reserpine, papaverine - chemical properties, structure and uses. 4.6 Papaverine - structure, chemical properties and uses.
	UNIT-V: (15 hours) (K1, K2, K3, K4, K5 & K6) **Plant Glycosides and Marine drugs:** 5.1 Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. 5.2 Pharmacological activity of Senna glycosides, Cardiac glycosides- Digoxin, digitoxin. 5.3 Steroidal saponins glycosides- Diosgenin, hecogenin. 5.4 Plant pigments: Occurrence and general methods of structure determination. 5.5 Isolation and synthesis of quercetin and cyanidin chloride. 5.6 Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House. 2. S.V.Bhat, B.A. Nagasampagi, M.Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers.
Reference Books	1. Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer. 2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2nd edition, New age international (P) limited, New Delhi.

Course Outcomes

CO1: Insight into herbal drugs. **(K1, K2, K3, K4, K5 & K6)**
CO2: Analyze the extraction techniques. **(K1, K2, K3, K4, K5 & K6)**
CO3: Evaluate the drugs containing terpenoids. **(K1, K2, K3, K4, K5 & K6)**
CO4: Analyze the drugs containing alkaloids. **(K1, K2, K3, K4, K5 & K6)**
CO5: Explain marine drugs. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SEC: RESEARCH TOOLS AND TECHNIQUES</td></tr>
<tr><td>Paper No.</td><td colspan="7">Skill Enhancement Course II A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">PSCHA224</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>-</td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of research</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">This course is designed to provide knowledge on
To study about the importance of research and understanding of the techniques.
To study the evaluation of analytical data and to understanding of various analytical methods of analysis</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">Unit I: (6 hours)

Structure of Research
Objectives and motivations in research. Research – Definition, Purpose of research, Characteristic of research. Types of research, Research Process – Steps necessary to effectively carry out research. Design – definition, purpose of research design, Characteristics of good research design. Research problem – Sources, objectives and delimiting a problem. Formulation of hypothesis</td></tr>
<tr><td colspan="7">Unit II: (6 hours)

Research Techniques
Research technique – Definition, types, purpose and applications. Different tools used for date collection. Research proposals and aspects. Literature survey and sources of information. Review, ethical issues and plagiarism. Patenting and intellectual property rights.</td></tr>
<tr><td colspan="7">Unit III: (6 hours)

Search engines
Chemspider, scifinder, Chemport, STN international, Pubchem, central and Chemistry guide, Web of Science, Scopus, ASAP alert, Science Direct, Research gate and Google scholar.</td></tr>
</table>

	Unit IV: (6 hours) **Data interpretation and analysis** Statistical treatment of finite samples – the students't' test and F test. Criteria for rejection of an observation – Q test. Significant figures and computation rules – data plotting. Correlation diagram – least square analysis. Correlation and regression analysis – correlation coefficient – bar diagram. **ANOVA:** Mean, median, mode, range and standard deviation
	Unit V: (6 hours) **Computer Related Software** Basic hardwares and softwares (MS Word, Power Point, Excel, Origin). Bits, bytes, words, CPU, memory, operating systems (DOS, WINDOWS, UNIX)**.** Scientific computer uses, algorithms and flow-charts, programming (with FORTRAN). Chemistry related software (Gaussian, Gaussview, ChemDraw). Databases (SciFinder, Scopus, Cambridge Structural Database: CSD). Tools employed in reference and citation: Endnote and zotero.
Extended Professional component (It is a part of internal component only, not to be included in the external question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Kothari, C. K. Research Methodology-Methods and Techniques, 2nd Ed., New Age International, New Delhi. 2023. 2. Dr. Prabht Pandey and Dr. Meenu Mishra Pandy. Research Methodology: Tools and Techniques, Bridge centre, 2015. 3. Wilkinson T.S. and Bhandarkar, P.L. Methodology and Techniques of Social Research, Himalaya publishing company, 2016.
Reference Books:	1. Ranjit Kaur Bhalla and Mohit Puri. Advance Research Methodology, kaniska publisher, 2013. 2. Kumar, R, Research Methodology - A Step by step guide for Beginners, Sage publisher, 2018. 3. Montgomery, D. C., Design & Analysis of Experiments, 5th Edition, John Wiley & sons, 2007.
Website and e-learning source	1. www.epgpathshala.nic.in 2. www.nptel.ac.in 3. http:/swayam.gov.in
OER	1. https://youtu.be/v74uF9P_UKM?si=O7Her3bHv3MGubJV 2. https://youtu.be/bVIOcoQKkNU?si=ZncKWbYhEPg-Wje 3. https://www.youtube.com/live/tojdIsYKDUI?si=-7KaQnmzhdbLveOb 4. https://youtu.be/6lkDpvd99_o?si=UIn2hhSvrnNc_iTY

Course Outcomes

CO1 Explain the nature and importance of research.
CO2 Discuss the role of e-resources.
CO3 Develop skills of constructing and designing tools.
CO4 Relate the statistical treatment of various tests.
CO5 Apply the skill of chemistry related software's.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SEC: INDUSTRIAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Skill Enhancement Course II B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>PSCHB224</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>-</td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">This course is designed to provide knowledge on
● To understand the importance of fertilizer, chemical explosives, leather industries and water chemistry</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT I (6 hours)
Fertilizers
Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.</td></tr>
<tr><td colspan="7">UNIT II (6 hours)

Sugar
Cane sugar manufacture, recovery of sugar from molasses, sugar estimation- sugar industries in India.</td></tr>
<tr><td colspan="7">UNIT III (6 hours)

Chemical Explosives
Preparation and chemistry of lead azide, nitroglycerine, nitrocellulose, TNT, RDX, Dynamite, cordite, picric acid, gunpowder, introduction to rocket propellants.</td></tr>
<tr><td colspan="7">UNIT IV (6 hours)

Leather Industry
Curing, preservation and tanning of hides and skins, process of dehairing and dyeing. Treatment of tannery effluents.</td></tr>
<tr><td colspan="7">UNIT V (6 hours)

Water Industry
Pollution of water by fertilizers, detergents, pesticides and industrial wastes, BOD, COD, thermal pollution. Water Treatment – Ion exchange, electrodialysis, reverse osmosis, softening of hard water</td></tr>
<tr><td colspan="4">Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. B. K. Sharma, Industrial chemistry, GOEL Publishing House, 2000 2. Shukla S. D and Pandey G. N , A Textbook of Chemical Technology, Vikas Publishing House, 2000 3. Philip J. Chenier, Survey of Industrial Chemsitry. Kluwer Acaemic /Plenum Publisher, 2003
Reference Books	1. P.P.Singh, T.M.Joesph, R.G.Dhavale, College Industrial Chemistry, Himalaya Publishing House, Bombay, 4th Ed., 1983 2. Steve Chapman, Ann K. Gatewood, Tony K. Arnold, Introduction to Materials Management, 5th edition, 2019. 3. Ullmann's Encyclopaedia of Industrial Chemistry, W. Gerhartz.
Website and e-learning source	1. www.epgpathshala.nic.in 2. www.nptel.ac.in 3. http:/swayam.gov.in
OER	1. https://youtu.be/sWyK52YSk04 2. https://onlinelibrary.wiley.com/journal/15480569. 3. https://youtu.be/lRyXlvIJFWI 4. https://youtu.be/QCe7jZN2yEA
Course Outcomes **CO1** Explain about fertilizers. **CO2** Explain the chemistry of sugar. **CO3** Discuss chemical explosives. **CO4** Illustrate the implication of leather industries. **CO5** Identify the significance of water chemistry**.**	

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">COORDINATION CHEMISTRY – II</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">PCCHK24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To recognize the fundamental concepts and structural aspects of organometallic compounds.
To learn reactions of organometallic compounds and their catalytic behaviour.
To identify or predict the structure of coordination compounds using spectroscopic tools.
To understand the structure and bonding in coordination complexes.
To evaluate the spectral characteristics of selected complexes.</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT-I: (18 hours) (K1, K2, K3, K4, K5 & K6)

Chemistry of organometallic compounds:
1.1 Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule.
1.2 Bonding in metal – olefin complexes (example: Ziese’s salt), metal-acetylene and metal-allyl complexes.
1.3 Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes.
1.4 Fluxional isomerism - definition, examples and mechanism.
1.5 Metal – carbonyl complexes: MO diagram of CO; Structure and bonding − bonding modes, MO approach of M-CO bonding, π-acceptor nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals).
1.6 Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters – Structures based on polyhedral skeleton electron pair theory or Wade’s rule.</td></tr>
<tr><td></td><td colspan="8">UNIT-II: (18 hours) (K1, K2, K3, K4, K5 & K6)

Reactions and catalysis of organometallic compounds:
2.1 Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations).
2.2 Migratory insertion reaction and metathesis reaction.
2.3 Organo-metallic catalysis: Hydrogenation of olefins (Wilkinson’s catalyst), modification of the original catalyst.
2.4 Hydroformylation of olefins using cobalt and rhodium catalyst (oxo process).
2.5 Oxidation of olefins to aldehydes and ketones (Wacker process), olefin isomerization.
2.6 Water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process.</td></tr>
<tr><td></td><td colspan="8">UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6)</td></tr>
</table>

	Inorganic spectroscopy -I: 3.1 IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro complexes. 3.2 Effect of coordination on the stretching frequency-thiocyanato, cyano, thiourea, and DMSO complexes. 3.3 IR spectroscopy of carbonyl compounds. 3.4 NMR spectroscopy- Introduction, applications of 1H, 15N-NMR spectroscopy in structural identification of inorganic complexes. 3.5 Applications of ^{19}F, ^{31}P-NMR spectroscopy in structural identification of inorganic complexes. 3.6 Fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.
	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) **Inorganic spectroscopy-II:** 4.1 Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A. 4.2 Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets. 4.3 ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$. 4.4 Mossbauer spectroscopy – Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler shift. 4.5 Isomer shift, quadrupole splitting and magnetic interactions. 4.6 Applications of Mössbauer spectra to Fe and Sn compounds.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) **Photo Electron Spectroscopy:** 5.1 Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions. 5.2 PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) – evaluation of vibrational constants of the above molecules. 5.3 PES of polyatomic molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules. 5.4 Koopman's theorem- applications and limitations. 5.5 Electron Spectroscopy for Chemical Analysis - applications of ESCA. 5.6 Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)

Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006. 2. Gary Miessler, Paul J. Fischer, Donald A. Tarr, Inorganic Chemistry, Pearson, 5th Edition, 2014. 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B D Gupta and A K Elias, Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University Press, 2013. 5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6th ed.; Wiley Inter-science: New York, 1988.
Reference Books	1. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000. 2. P Gütlich, E Bill, A X Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st Edition, Springer-Verlag Berlin Heidelberg, 2011. 3. B. E. Douglas DH McDaniel's and Alexander, Concepts and Models of Inorganic Chemistry, Wiley Publication, 2nd Edition, Reprint 2006. 4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry, W. B. Saunders Co., 1977. 5. E. A. V. Ebsworth, D. W. H. Rankin and S. Cradock, Structural Methods in Inorganic Chemistry, Blackwell Scientific Publishers, 1986. 6. M. C. Shrivers, P. W. Atkins, C. H. Langford, Inorganic Chemistry, Oxford University Press, 3rd Edition, Reprint 2002. 7. Wahid U. Malik, G. D. Tuli, R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand and Co., New Delhi, Reprint 1993. 8. S. F. A. Kettle, Coordination Chemistry, ELBS, Reprint 1975. 9. F. Basolo and RG Pearson, Mechanism of Inorganic Reactions, Wiley, 1967. 10. R. S. Drago, PhysicaI Methods in Chemistry; Saunders: Philadelphia, 1977. 11. G. Aruldhas, Molecular Structure and Spectroscopy, PHI Learning, 2nd Edition, 2009.

Website and e-learning source	1. https://archive.nptel.ac.in/courses/104/101/104101100/ 2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5 (P-03-Mechanism of substitution reactions) 3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5 (P-11-Carbonyls and nitrosyls) 4. file:///E:/E%20books/Inorganic_Chemistry__Miessler___Tarr.pdf 5. https://nptel.ac.in/courses/104/106/104106048/ (ESR Spectroscopy) 6. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5(P-08-Physical Spectroscopy)

Course Learning Outcomes (for Mapping with POs and PSOs)

CO1: Apply 18 and 16 electron rules for organometallic compounds and predict the structure and bonding in olefin, allyl, cyclopentadienyl and carbonyl containing organometallic compounds. **(K1, K2, K3, K4, K5 & K6)**

CO2: Describe the reactions and catalysis of organometallic compounds. **(K1, K2, K3, K4, K5 & K6)**

CO3: Predict the structure of coordination complexes using IR and NMR. **(K1, K2, K3, K4, K5 & K6)**

CO4: Apply the ESR and Mossbauer techniques to identify coordination complexes. **(K1, K2, K3, K4, K5 & K6)**

CO5: Interpret the photo electron spectra of selected molecules and to assign absolute configuration using ORD and CD techniques. **(K1, K2, K3, K4, K5 & K6)**

CO	**PSO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">PHYSICAL CHEMISTRY-II</td></tr>
<tr><td>Paper No.</td><td colspan="8">Core XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">PCCHL24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="3">6</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the essential characteristics of wave functions and need for the quantum mechanics.
To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
To apply the quantum mechanics to hydrogen and polyelectronic systems.
To familiarize the symmetry in molecules and predict the point groups.
To predict the vibrational modes, hybridization using the concepts of group theory.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: (18 hours) (K1, K2, K3, K4, K5 & K6)

Introduction to quantum mechanics:
1.1 Black body radiation, Photoelectric effect.
1.2 Hydrogen spectrum, Need for quantum mechanics.
1.3 Wave particle duality, Uncertainty principle.
1.4 Particle wave and Schrodinger wave equation.
1.5 Wave function, Properties of wave function, Normalized, Orthogonal, Orthonormal, Eigen values, Eigen functions, Hermitian properties of operators.
1.6 Postulates of Quantum Mechanics, Schrodinger wave equation, Time independent and time dependent.</td></tr>
<tr><td colspan="8">UNIT-II: (18 hours) (K1, K2, K3, K4, K5 & K6)

Quantum models:
2.1 Particle in a box-one dimensional, two dimensional and three dimensional.
2.2 Degeneracy, Application to linear conjugated molecular system.
2.3 Free particles, Ring systems.
2.4 Harmonic Oscillator-wave equation and solution, anharmonicity, force constant and its significance.
2.5 Rigid Rotor-wave equation and solution.
2.6 Calculation of rotational constants and bond length of diatomic molecules.</td></tr>
<tr><td colspan="8">UNIT-III: (18 hours) (K1, K2, K3, K4, K5 & K6)

Applications to Hydrogen and Polyelectron atoms:</td></tr>
</table>

	3.1 Hydrogen atom and hydrogen like ions, Hamiltonian-wave equation and solutions. 3.2 Radial and angular functions, representation of radial distribution functions. 3.3 Approximation methods –variation methods: trial wave function, variation integral and application to particle in 1D box. 3.4 Perturbation method - first order applications. 3.5 Hatree Fock Self-Consistent Field Method, Hohenberg-Kohn theorem and Kohn-Sham equation. 3.6 Helium atom-electron spin, Paulis exclusion principle and Slater determination.
	UNIT-IV: (18 hours) (K1, K2, K3, K4, K5 & K6) **Group theory:** 4.1 Groups, sub groups, symmetry elements and symmetry operations. 4.2 Classification-axial and non-axial, Dihedral point groups- C_n, C_{nh}, D_n, D_{nh}, D_{nd}, Td and Oh. 4.3 Matrix representation and classes of symmetry operations, reducible irreducible and direct product representation. 4.4 The Great orthogonality theorem – irreducible representation and reduction formula. 4.5 Construction of character table for C_{2v} and C_{2h} point groups. 4.6 Construction of character table for C_{3v} and D_{2h} point groups.
	UNIT-V: (18 hours) (K1, K2, K3, K4, K5 & K6) **Applications of quantum and group theory:** 5.1 Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment. 5.2 Energy level diagram, Hydrogen molecule ion. Use of linear variation function and LCAO methods. 5.3 Electronic conjugated system: Huckel method to Ethylene butadiene, cyclopropenyl, cyclo butadiene and Benzene. 5.4 Application of group theory to molecular vibrations for determining symmetry of normal modes of vibration in nonlinear molecules H_2O, CH_4, BF_3 and NH_3 using group theory. 5.5 Hybrid orbitals in nonlinear molecules CH_4, BF_3 and NH_3. 5.6 Electronic spectra of ethylene.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2020, 4th revised edition.

	2. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2017, 3rd edition. 3. A. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition. 4. T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition. 5. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001. 6. D.A. McQuarrie, Quantum Chemistry, Viva Books Pvt. Ltd, 2016, 2nd edition. 7. K. V. Raman, Group Theory and Its Applications to Chemistry, Tata McGraw-Hill Publishing Company Ltd., Reprint 2004. 8. M. S. Gopinathan and V. Ramakrishnan, Group Theory in Chemistry, Vishal Publishing Co., Reprint 2013. 9. A. Salahuddin Kunju and G. Krishnan, Group theory and its Applications in Chemistry, PHI Learning Pvt. Ltd., New Delhi, 2015.
Reference Books	1. Ira N. Levine, Quantum Chemistry, Allyn & Bacon Inc., 2014, 7th edition. 2. D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2019. 3. R. P. Rastogi & V. K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems, Oxford & IBH Publishing Co., New Delhi, 2017. 4. R.L. Flurry. Jr., Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980. 5. J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint. 6. R. Anantharaman, Fundamentals of Quantum Chemistry, Macmillan India Ltd., 2001. 7. Mahendra R. Awode, Quantum Chemistry, S. Chand & Company Ltd., New Delhi, 2002. 8. A. K. Chandra, Quantum Chemistry, Tata McGraw-Hill Publishing Company, New Delhi, 10th Edition, 2017.
Website and e-learning source	1. https://nptel.ac.in/courses/104101124 2. https://ipc.iisc.ac.in/~kls/teaching.html 3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA== (P-02 Physical Chemistry-1 Quantum Chemistry) 4. https://symotter.org/ (Group Theory) 5. https://nptel.ac.in/courses/104/104/104104080/

Course Outcomes

CO1: Discuss the fundamentals of quantum mechanics and characteristics of wave functions. **(K1, K2, K3, K4, K5 & K6)**

CO2: Explain the quantum mechanical models. **(K1, K2, K3, K4, K5 & K6)**

CO3: Apply the quantum mechanics to hydrogen and polyelectron atoms. **(K1, K2, K3, K4, K5 & K6)**

CO4: Classify the symmetry operation and specify the appropriate irreducible representations for theoretical applications. **(K1, K2, K3, K4, K5 & K6)**

CO5: Express the vibrational modes and hybridization using the concepts of group theory. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE VI: POLYMER CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective VI A</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">PECHK24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of general chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To learn the basic concepts and bonding in polymers.
To explain various types of polymerization reactions and kinetics.
To understand the importance of industrial polymers and their synthetic uses.
To determine the molecular weight of polymers.
To predict the degradation of polymers and conductivities.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="8">UNIT-I: (12 hours) (K1, K2, K3, K4, K5 & K6)
Characterization, Molecular weight and its Determination:
1.1 Primary bond forces in polymers.
1.2 Secondary bond forces in polymers, cohesive energy.
1.3 Molecular structure, chemical tests.
1.4 Thermal methods.
1.5 Tg, Molecular distribution, Stability.
1.6 Determination of Molecular mass of polymers: Number Average molecular mass (M_n) and Weight average molecular mass (M_w) of polymers. Molecular weight determination of high polymers by physical and chemical methods: Ebulliometry and End group analysis.</td></tr>
<tr><td colspan="8">UNIT-II: (12 hours) (K1, K2, K3, K4, K5 & K6)
Mechanism and kinetics of Polymerization:
2.1 Chain growth polymerization: Cationic polymerization.
2.2 Anionic polymerization.
2.3 Free radical polymerization.
2.4 Stereo regular polymers.
2.5 Ziegler Natta polymerization.
2.6 Reaction kinetics. Step growth polymerization, Degree of polymerization.</td></tr>
<tr><td colspan="8">UNIT-III: (12 hours) (K1, K2, K3, K4, K5 & K6)
Techniques of Polymerization and Polymer Degradation:
3.1 Bulk, Solution polymerization.
3.2 Emulsion polymerization.
3.3 Suspension, solid, interfacial and gas phase polymerization.
3.4 Types of Polymer Degradation, Thermal degradation.
3.5 Mechanical degradation.
3.6 Photodegradation, Photo stabilizers.</td></tr>
<tr><td colspan="8">UNIT-IV: (12 hours) (K1, K2, K3, K4, K5 & K6)</td></tr>
</table>

	Industrial Polymers: 4.1 Preparation of fibre forming polymers, elastomeric material. Thermoplastics: Polyethylene, Polypropylene, polystyrene. 4.2 Polyacrylonitrile, Polyvinyl Chloride, Polytetrafluoro ethylene. 4.3 Nylon and polyester. 4.4 Thermosetting Plastics: Phenol formaldehyde and epoxide resin. 4.5 Elastomers: Natural rubber and synthetic rubber - Buna-N, Buna-S and neoprene. 4.6 Conducting Polymers: Elementary ideas; examples: polysulphur nitriles, polyphenylene, polypyrrole and polyacetylene. Polymethylmethacrylate, Polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols.
	UNIT-V: (12 hours) (K1, K2, K3, K4, K5 & K6) **Polymer Processing:** 5.1 Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardants and colourants. 5.2 Processing Techniques: Calendaring, die casting, compression moulding. 5.3 Injection moulding, blow moulding and reinforcing. 5.4 Film casting, Thermofoaming, Foaming. 5.5 Catalysis and catalysts – Polymerization catalysis, catalyst support, clay compounds, basic catalyst, auto-exhaust catalysis, vanadium. 5.6 Heterogeneous catalysis and active centres.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. V.R. Gowariker, *Polymer Science*, Wiley Eastern, 2021. 2. G.S. Misra, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited, 2018. 3. M.S. Bhatnagar, A Text Book of Polymers, vol-I & II, S.Chand & Company, New Delhi, 2010. 4. Joel R. Fried, Polymer Science and Technology, Prentice Hall, India, Reprint 2014. 5. M. G. Arora and M. Singh, Polymer Chemistry, Anmol Publications, 2003. 6. R. J. Young and P. A. Lovell, Introduction to Polymers, Nelson Thornes Ltd., Reprint 2011.
Reference Books	1. F. N. Billmeyer, *Textbook of Polymer Science*, Wiley Interscience, 2007. 2. A. Kumar and S. K. Gupta, *Fundamentals and Polymer Science and Engineering*, Tata McGraw-Hill, 2019.
Website and	1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFf

e-learning source	uhs6rkiyTA== (M-31. Polymers and their classification, M-32. Concept of number average and mass average molecular weights) 2. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000831ME/P001678/M030964/ET/1526886039Module8_2.pdf 3. https://chem.libretexts.org/Bookshelves/General_Chemistry/Book%3A_Chem1_(Lower)/07%3A_Solids_and_Liquids/7.09%3A_Polymers_and_Plastics 4. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers 5. https://ocw.mit.edu/courses/chemical-engineering/10-569-synthesis-of-polymers-fall-2006/lecture-notes/

Course Learning Outcomes (for Mapping with POs and PSOs)

CO1: Understand the bonding in polymers. **(K1, K2, K3, K4, K5 & K6)**
CO2: Explain the mechanism and kinetics of Polymerization. **(K1, K2, K3, K4, K5 & K6)**
CO3: Classify the Polymerization Techniques and Polymer Degradation. **(K1, K2, K3, K4, K5 & K6)**
CO4: Summarize the importance of Industrial Polymers. **(K1, K2, K3, K4, K5 & K6)**
CO5: Elaborate Polymer Processing Techniques. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE VI B: CHEMISTRY OF NATURAL PRODUCTS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective VI B</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">PECHL24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of general chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the basic concepts and biological importance of biomolecules and natural products.
To explain various functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
To understand the functions of alkaloids and terpenoids.
To elucidate the structure determination of biomolecules and natural products.
To extract and construct the structure of new alkaloids and terpenoids from different methods.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: (12 hours) (K1, K2, K3, K4, K5 & K6)
Alkaloids:
1.1 Introduction, occurrence, isolation and functions of alkaloids.
1.2 Classification, general methods of structural elucidation.
1.3 Chemical methods of structure determination of Coniine.
1.4 Chemical methods of structure determination of Papaverine.
1.5 Chemical methods of structure determination of Cocaine.
1.6 Chemical methods of structure determination of Morphine.</td></tr>
<tr><td colspan="7">UNIT-II: (12 hours) (K1, K2, K3, K4, K5 & K6)
Terpenoids and Carotenoids:
2.1 Terpenoids - Introduction, occurrence, Isoprene rule, classification.
2.2 General methods of determining structure. Structure determination of Camphor.
2.3 Structure determination of Abietic acid.
2.4 Structure determination of Squalene.
2.5 Carotenoids - Introduction, geometrical isomerism, Structure, functions and synthesis of β-carotene.
2.6 Structure, functions and synthesis of vitamin-A.</td></tr>
<tr><td colspan="7">UNIT-III: (12 hours) (K1, K2, K3, K4, K5 & K6)
Anthocyanines and flavones:
3.1 Anthocyanines: Introduction to anthocyanines.
3.2 Structure and general methods of synthesis of anthocyanines.
3.3 Cyanidine chloride: structure and determination.
3.4 Flavones: Biological importance of flavones.
3.5 Structure and determination of flavone and flavonoids.
3.6 Quercetin: Structure determination and importance.</td></tr>
<tr><td colspan="7">UNIT-IV: (12 hours) (K1, K2, K3, K4, K5 & K6)</td></tr>
</table>

	Purines and Steroids: 4.1 Purines: Introduction, occurrence and isolation of purines. 4.2 Classification and spectral properties of steroids. 4.3 Biological importance, Structure and synthesis of Uric acid. 4.4 Steroids: Steroids-Introduction, occurrence, nomenclature, configuration of substituents, Diels' hydrocarbon. 4.5 Stereochemistry, classification, biological importance, colour reactions of sterols. 4.6 Cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene.
	UNIT-V: (12 hours) (K1, K2, K3, K4, K5 & K6) **Natural Dye**s: 5.1 Occurrence, classification. 5.2 Isolation. 5.3 Purification. 5.4 Properties, colour and constitution. 5.5 Structural determination and synthesis of indigotin. 5.6 Structural determination and synthesis of alizarin.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 1, Himalaya Publishing House, Mumbai, 2009. 2. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 2, Himalaya Publishing House, Mumbai,2009. 3. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 1, Goel Publishing House, Meerut,1997. 4. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 2, Goel Publishing House, Meerut,1997. 5. I. L. Finar, Organic Chemistry Vol-2, 5thedition, Pearson Education Asia, 1975.
Reference Books	1. I. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia,2004. 2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co,2000. 3. Shoppe, Chemistry of the steroids, Butterworthes,1994. 4. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004.
Website and e-learning source	1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic

Course Outcomes

CO1: Elucidate the structure of alkaloids. **(K1, K2, K3, K4, K5 & K6)**
CO2: Elucidate the structure of terpenoids. **(K1, K2, K3, K4, K5 & K6)**
CO3: Explain the biological importance of anthocyanins and flavones. **(K1, K2, K3, K4, K5 & K6)**
CO4: Plan and perform the isolation and synthesis of purines and cholesterol. **(K1, K2, K3, K4, K5 & K6)**
CO5: Plan and perform the isolation, purification and synthesis of natural dyes. **(K1, K2, K3, K4, K5 & K6)**

CO	PSO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	M	H	H	H	H
CO4	H	M	H	H	H	H
CO5	H	M	H	H	H	H

CO	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	H	H	H	H	M	H
CO2	H	H	H	H	M	H
CO3	H	H	H	H	M	H
CO4	H	H	H	H	M	H
CO5	H	H	H	H	M	H

H-High (3), M-Moderate (2), L-Low (1)

<table>
<tr><td>Title of the Course</td><td colspan="7">PROFESSIONAL COMPETENCY SKILL IN CHEMICAL SCIENCES</td></tr>
<tr><td>Paper No.</td><td colspan="7">Skill Enhancement Course III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td><td>PPCH24</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Inorganic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To create the opportunity for getting research fellowships through various competitive examinations in chemistry (CSIR-NET, TANSCHE, etc.,)
To create opportunity for passing the examination conducted by service commissions (UPSC, TNPSC etc.,)</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: (6 hours)
Inorganic Chemistry
Crystal systems- designation of crystal faces, lattice structure and unit cell, Bragg's law and X ray diffraction by crystals, Schottky and Frenkel defects. Electrical properties -Insulators and semiconductors. Band theory of solids. Structure and bonding of boranes, carboranes, silicones, silicates, boron nitride, borazine and phosphazenes. Industrial importance of these compounds. (K1, K2, K3, K4, K5 & K6)</td></tr>
<tr><td colspan="7">UNIT-II: (6 hours)
Organic Chemistry
Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic and radical species. Common named reactions (C-C and C=C formation). Rearrangements (anionotropic, cationotropic, intermolecular and intramolecular) - applications in organic synthesis. Common catalysts and reagents (organic). (K1, K2, K3, K4, K5 & K6)</td></tr>
<tr><td colspan="7">UNIT-III: (6 hours)
Physical Chemistry
Electrochemistry: Nernst equation, redox systems, electrochemical cells. Electrolytic conductance, Kohlrausch’s law and its applications. Ionic equilibria, conductometric and potentiometric titrations. Chemical kinetics, empirical rate laws and temperature dependence, complex reactions, steady state approximation, determination of reaction mechanisms. Collision and transition state theories of rate constants, unimolecular reactions. Enzyme kinetics and salt effects. Homogeneous catalysis and photochemical reactions. (K1, K2, K3, K4, K5 & K6)</td></tr>
<tr><td colspan="7">UNIT-IV: (6 hours)
Logical Reasoning
Comprehension, interpersonal skills including communication skills. Logical reasoning and analytical ability. Decision-making and problem solving. General mental ability. Basic numeracy (numbers and their relations, orders of magnitude, etc.). Data interpretation (charts, graphs, tables, data sufficiency etc.) (K1, K2, K3, K4, K5 & K6)</td></tr>
<tr><td colspan="7">Unit V: (6 hours)
Technology and Disaster Management
Science and Technology-Developments and their applications and effects in everyday life. Achievements of Indians in science & technology. Indigenization</td></tr>
</table>

	of technology and developing new technology. Disaster and disaster management. (K1, K2, K3, K4, K5 & K6)
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983 2. F.A. Cotton and G. Wilkinson - Advanced Inorganic Chemistry: A Comprehensive Text - John Wiley and Sons, 5th Edition, 1988. 3. P. W. Atkins, Physical Chemistry, Oxford University Press, 11th Edition, 2018. 4. Sanyal S. N. Bharathi Bhawan, Reactions, Rearrangements and Reagents, Reprint 2019. 5. S. M. Mukherji and S. P. Singh, Organic Reaction Mechanism, Mac Millan India Ltd., Chennai, 3rd Edition, Reprint 2010.

Course Outcomes

CO1: Summarize the conducting properties of electrical materials, distinguish the structure and bonding in boranes, carboranes, metallacarboranes, boron nitrides and metal clusters.
CO2: Explain the reaction mechanisms and applications of selected named reactions and rearrangement reactions.
CO3: Discuss the concepts and kinetics of homogeneous and heterogeneous catalysis.
CO4: Understand logical reasoning and data interpretation.
CO5: Discuss about technology and disaster management.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

H-High (3), M-Moderate (2), L-Low (1)