SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS)
SALEM – 16
Reaccredited with 'B++' Grade by NAAC
Affiliated to Periyar University

PG & RESEARCH DEPARTMENT OF

CHEMISTRY

Outcome Based Syllabus

M.Sc. CHEMISTRY

(For the students admitted in 2024 – 25)

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM –16

PG & RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

(*For the academic year 2023-2024 Onwards)*

Programme	**M.Sc. Chemistry**
Duration	**2 years**
Programme Outcomes (POs)	**PO1:Disciplinary Knowledge** Possess deep and extensive knowledge on the key aspects and advanced concepts in chemistry. **PO2:Analytical Reasoning** Plan, execute, record, interpret the observations and present the results of the chemical experiments. **PO3:Problem solving skills** Have relevant knowledge, critical thinking, problem solving skills so as to enable them to face competitive exams and pursue research. **PO4: Decision Making Skill** Foster analytical and critical thinking abilities for decision- making. **PO5:Research and Development** Have gate way to varied avenues like research laboratories, industries and academic sectors. **PO6: Contribution to Society** Design and perform interdisciplinary projects to meet the requirements related to the society. **PO7: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO8: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO9: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.
Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will

	facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement novel practices grounded in research that comply with ethics leading to growth and development. **PSO4 – Individual and Leadership Skill** To produce employable, ethical and innovative professionals with team skills in the dynamic world. **PSO5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM –16

PG & RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

PROGRAMME STRUCTURE

(*For the academic year 2023-2024 Onwards)*
Total Credits: 92 + Extra Credits (Maximum- 16)

FIRST SEMESTER

Course	Course Title	Code	Hours per week	Credits
Core Course–I	Organic Reaction Mechanism-I	24PCHCC1	7	5
Core Course –II	Structure and Bonding in Inorganic Compounds	24PCHCC2	7	5
Core Course III	Organic Chemistry Practical	24PCHCCQ1	6	4
Elective – I	Nanomaterials and Nanotechnology/ Pharmaceutical Chemistry	24PCHDSEC1A/ 24PCHDSEC1B	5	3
Elective –II	Molecular Spectroscopy/ Electrochemistry	24PCHDSEC2A/ 24PCHDSEC2B	5	3
	Total		**30**	**20**
Extra Skills	•Value Education •Physical Fitness Practice •Productive Preparation for CSIR – UGC NET/SET/JRF/TRB Competitive examinations – I (24PCHSC1) (Self Study – 1 Extra Credit)	24PCHSC1		
Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL				

SECOND SEMESTER

Course	Course Title	Code	Hours per week	Credits
Core Course–IV	Organic Reaction Mechanism-II	24PCHCC3	5	5
Core Course –V	Physical Chemistry-I	24PCHCC4	5	5
Core Course VI	Inorganic Chemistry Practical	24PCHCCQ2	6	4
Elective – III	Cheminformatics/ Green Chemistry	24PCHDSEC3A/ 24PCHDSEC3B	4	3
Elective –IV	Bioinorganic Chemistry/Material Science	24PCHDSEC4A/ 24PCHDSEC4B	4	3
Extra Disciplinary course-I	Therapeutical Chemistry	24PCHEDC1	4	2
Common subject	Human Rights	24PHRSC	2	1
	Total		**30**	**23**
Extra Skills	•Value Education •Physical Fitness Practice •Productive Preparation for CSIR –UGC NET/SET/JRF/TRB Competitive examinations– II (24PCHSC2) (Self Study –1 Extra Credit)	24PCHSC2		
Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL				

*** Internship/Field visit/ Industrial visit will be carried out during the summer vacation of the first year and 2 credits will be included in the Third Semester Mark Statement.**

THIRD SEMESTER

Course	Course Title	Code	Hours per week	Credits
Core Course–VII	Organic synthesis and Photochemistry	24PCHCC5	6	5
Core Course – VIII	Coordination Chemistry-I	24PCHCC6	6	5
Core Course IX	Textile and Dye Chemistry (Industry Module)	24PCHCC7	5	4
Core Course-X	Physical Chemistry Practical	24PCHCCQ3	6	5
Elective – V	Biomolecules and heterocyclic compounds/Pharmacognosy and Phytochemistry	24PCHDSEC5A/ 24PCHDSEC5B	4	3
Extra Disciplinary Course-II	Chemistry in Consumer Products	24PCHEDC2	3	2
	Internship/Industrial Visit-Vacation Activity	24PCHI		2
	Total		**30**	**26**
Extra Skills	• Value Education • Physical Fitness Practice • Productive Preparation for CSIR –UGC NET/SET/JRF/TRB Competitive examinations– III (24PCHSC3) (Self Study –1 Extra Credit)	24PCHSC3		
Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL				

*** Internship/Field visit/ Industrial visit was carried out during the summer vacation of the first year and 2 credits are included in the Third Semester Mark Statement.**

FOURTH SEMESTER

Course	Course Title	Code	Hours per week	Credits
Core Course–XI	Coordination chemistry – II	24PCHCC8	6	5
Core Course –XII	Physical chemistry-II	24PCHCC9	6	5
Elective – VI	Analytical instrumentation technique Practical (industry entrepreneurship)	24PCHDSECQ	4	3
Core Project	Core Project with Viva voce	24PCHPC	10	7
Professional Competency Skill	Chemistry for Advanced Research Studies Practical	24PCHPCSQ	4	2
Extension Activity	Extension Activity	24PCHEX	-	1
	Total		**30**	**23**
Extra Skills	• Value Education • Physical Fitness Practice • Productive Preparation for CSIR –UGC NET/SET/JRF/TRB Competitive examinations– IV (24PCHSC4) (Self Study – 1 Extra Credit)	24PCHSC4		
Extra credits are given for extra skills and courses qualified in MOOC/ NPTEL				

<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 Course-I</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>24PCHCC1</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>7</td><td></td><td colspan="3">-</td><td colspan="2">7</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 techniques in the determination of reaction mechanisms.
• To understand the feasibility and the mechanism of various organic reactions.
• 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.
• To understand the concept of stereochemistry involved in organic compounds.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: Methods of Determination of Reaction Mechanism: Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.</td></tr>
<tr><td colspan="7">UNIT-II: Aromatic and Aliphatic Electrophilic Substitution: Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.</td></tr>
</table>

	UNIT-III: **Aromatic and Aliphatic Nucleophilic Substitution:** Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements. S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.S_N1, S_N2, S_Ni, and S_E1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.
	UNIT-IV: Stereochemistry-I: Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. 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. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation. D, L system, Cram's and Prelog's rules: R, S-notations, Cahn-Ingold- Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereoisomerism, proR, proS, si phase and re phase, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.
	UNIT-V: Stereochemistry-II: Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, 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.
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, 8th Ed., New Age International Publishers, **2015**. 4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, **2013**. 5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd Ed., Oxford University Press, **2014**.
Reference Books	1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th Ed., Kluwer Academic / Plenum Publishers, **2007**.
	2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, **2001**. 3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, **1987**. 4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, **2000**. 5. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th Ed., Pearson Education Asia, **2004**.
Website and e-learning source	1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/

Course Outcomes (for Mapping with POs and PSOs)

Students will be able to

CO1: relate the effect of structure on reactivity, examine the stability of various conformers and correlate them to reactivity.

CO2: explain the requirements of reactions, concept of aromaticity, reaction mechanism, factors affecting organic reactions and concepts in stereochemistry.

CO3: predict the mechanism, major and minor products of organic reactions with appropriate stereochemistry and regiochemistry.

CO4: identify the configuration, prochirality, chirality, topical relationship, the reagents, reactants and design synthetic routes for newer organic compounds.

CO5: determine the reaction mechanism, configuration of molecules, stereochemistry of reactions.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**	**M**	**S**
CO 2	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**	**M**	**S**
CO 3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.05.2023

<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 Course- II</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">24PCHCC2</td></tr>
<tr><td></td><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">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 colspan="2">7</td><td colspan="2"></td><td colspan="2">-</td><td>7</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 features of main group compounds and clusters.
• To gain fundamental knowledge on ionic crystals.
• To evaluate the structural aspects of solids.
• To familiarize various diffraction and microscopic techniques.
• To study the defects in solids.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Structure of main group compounds and clusters:
VB theory –Effect of lone pair and electronegativity of atoms (Bent’s rule) on the geometry of the molecules; 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, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade’s rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.
UNIT-II: Solid state chemistry – I: Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.
UNIT-III: Solid state chemistry – II: Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.
UNIT-IV: Techniques in solid state chemistry: X-ray diffraction technique: Bragg’s law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.</td></tr>
</table>

	UNIT-V: Band theory and defects in solids Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.
Extended Professional Component (is apart 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, 2ndEd. (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, 4thEd., 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**.
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 Ed., Wiley Publication, **2013**. 3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Ed., Cambridge University Press, **1997**. 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	https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Course Outcomes (for Mapping with POs and PSOs)
Students will be able to:
CO1: predict the structures of main group compounds and clusters.
CO2: explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.
CO3: analyse the various types of ionic crystal systems and their structuralfeatures.
CO4: describe the principles of diffraction techniques and microscopic techniques.
CO5: assess the crystal defects in solids.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**M**	**M**	**S**
CO 3	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO 5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Level of Correlation between PSO's and CO's

CO /PO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	2
CO2	3	3	3	3	2
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	13
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.05.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core Course III: Core Practical-I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">24PCHCCQ1</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td colspan="2">-</td><td colspan="2">6</td><td colspan="2">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 understand the concept of separation, qualitative analysis and preparationof organic compounds.
• To develop analytical skill in the handling of chemical reagents for separationof binary and ternary organic mixtures.
• To analyze the separated organic components systematically and derivatizethem suitably.
• To construct suitable experimental setup for the organic preparationsinvolving two stages.
• To experiment different purification and drying techniques for the compound processing.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Separation and analysis:
a. Two component mixtures.
b. Three component mixtures.
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 Ascorbic acid (iodimetry)
f) Estimation of Aromatic nitro groups (reduction)
g) Estimation of Glycine (acidimetry)
h) Estimation of Formalin (iodimetry)
i) Estimation of Acetyl group in ester (alkalimetry)
j) Estimation of Hydroxyl group (acetylation)
k) Estimation of Amino group (Acetylation)
UNIT-III: Two stage preparations:
a) p-Bromoacetanilide from aniline
b) p-Nitroaniline from acetanilide
c) 1,3,5-Tribromobenzene from aniline
d) Acetyl salicyclic acid from methyl salicylate
e) Benzilic acid from benzoin
f) m-Nitroaniline from nitrobenzene
g) m-Nitrobenzoic acid from methyl benzoate</td></tr>
</table>

Extended Professional Component (is a part of	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others tobe solved (To be discussed during the Tutorial hours)
nternal component only, Not to be included in the external examination question paper)	
Skills acquiredfrom this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Gnanaprakasam, N.S., & Ramamurthy, G., Organic Chemistry Lab Manual,Viswanathan Printers and Publishers Private Ltd. **2002**. 2. Vishnoi, N.K., Advanced Practical Organic Chemistry, Vikas Publishing House Pvt. Ltd., 2nd Reprint, **1994**.
Reference Books	1. Pavia, D. L., Lampman, G. M., Kris, G. S., Engel, R. G., A Micro scale Approach to Organic Laboratory Techniques, 6th Ed., Cengage Learning, **2016**. 2. Zubrick., J. W., The Organic Chem Lab Survival Manual A Student's Guide toTechniques, 9th Ed., John Wiley & Sons, **2014**. 3. Raj K. Bansal, Laboratory Manual of Organic Chemistry, 5th Ed., New Age International (P) Ltd., **2009**. **4.** Sathish Agarwala & Agarwala, R. C., Advanced Organic Analysis, 2nd Revised Ed.. Pragati Prakashan, Meerut, **1996.**
Website ande-learning source	1) https://www.vlab.co.in/broad-area-chemical-sciences 2) https://virtual.edu.rsc.org/ 3) https://www.olabs.edu.in/ 4) www.vlab.amrita.edu 5) https://www.chemtube3d.com/

Course Outcomes (for Mapping with POs and PSOs)

Students will be able to:

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 variouschemical 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-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L – Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

METHOD OF EVALUATION

Continuous Internal Assessment	End Semester Examination	Total	Grade
40 Marks	**60 Marks**	**100 Marks**	

Board of Studies Date: 02.05.2023

<table>
<tr><td>Title of theCourse</td><td colspan="7">NANOMATERIALS AND NANOTECHNOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective I</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">24PCHDSEC1A</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructionalhours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of nanotechnology</td></tr>
<tr><td>Objectivesthe course</td><td colspan="7">The course aims at giving an overall view of the
• 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 bynew technologies.
• To design synthetic routes for synthetically used new nano materials.</td></tr>
<tr><td></td><td colspan="7">UNIT-I: Introduction of nanomaterials and nanotechnologies, Introduction- role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top– Down, consolidation of nano powders. Features of nanostructures, background of nanostructures. Techniques of synthesis of nanomaterials, tools of the nanoscience. Applications of nanomaterials and technologies.

UNIT-II: Bonding and structure of the nanomaterials, predicting the type of bonding in a substance crystal structure. Metallic nanoparticles, surfaces of materials, nanoparticle size and properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metalloorganic,plasma enhanced, and low-pressure CVD. Microwave assisted andelectrochemical synthesis.

UNIT-III: Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials: Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties.

UNIT-IV: Electrical properties, conductivity and resistivity, classification of materials based on conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.

UNIT-V: Nano thin films, nanocomposites. Application of nanoparticles in different fields.Core-shell nanoparticles - types, synthesis, and properties.Nanocomposites - metal-, ceramic- and polymer-matrix composites- applications. Characterization – SEM, TEM and AFM - principle, instrumentation and applications.</td></tr>
</table>

Extended Professional Component (isa 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.Pradeep, A Text book of NanoScience and Nanotechnology, Tata McGraw Hill Education Pvt., Ltd., **2012**. 2. C.P.Poole, Jr.Franck J.Owens, Introduction to nanotechnology Wiley-Interscience, I st Ed., 2003. 3. M.A.ShahTokeer Ahmad, Principles of Nanoscience and Nanotechnology, Alpha Science International Ltd, 2010. 4. Manasi Karkare, Nanotechnology Fundamentals and Applications, I K International Publishing House Pvt. Ltd, 2013. 5. Y.S.Raghavan, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Arise Publishers and Distributors, 2010
Reference Books	1. Loius Theodore, Robert G Kunz, Nanotechnology :Environmental Implications and Solutions, John Wiley Publications USA, **2005**. 2. Mick Wilson, KK Geoff Smith, Michelle Simons, B.Raguse, Nanotechnology, Overseas India Pvt Ltd., New Delhi, **2008**. 3. W.R.Fahrner, Nanotechnology and Nanoelectronics, Springer publishers, **2005**. 4. Arumugam, Materials Science, Anuradha Publications, **2007**. 5. S.Mohan and V.Arjunan, Principles of Materials Science, MJP Publishers, **2016**.
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 (for Mapping with POs and PSOs)

Students will be able to:

CO1: describe methods of fabricating nanostructures.

CO2: design the unique properties of nanomaterials to reduce dimensionality of the material.

CO3: apply tools for understanding the properties of nanostructures.

CO4: examine the applications of nanomaterials to real world problems

CO5: analyse the health and safety related to nanomaterial.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**

CO 2	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**
CO 3	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**
CO 4	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**
CO 5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**

S – Strong, M – Medium, L – Low

Level of Correlation between PSO's and CO's

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	2	2	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	14	14	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Board of Studies Date: 02.05.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">PHARMACEUTICAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective I</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>24PCHDSEC1B</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>4</td><td>1</td><td colspan="2">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on drugs and doses</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">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="7">UNIT-I: Physical properties in Pharmaceuticals: Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, 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.
Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.</td></tr>
<tr><td colspan="7">UNIT-II: Isotopic Dilution analysis: principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.</td></tr>
<tr><td colspan="7">UNIT-III: Drug dosage and product development: Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.</td></tr>
</table>

	UNIT-IV: Development of new drugs: Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory,4.3 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters,lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables
	.
	UNIT-V: Computers in Pharmaceutical Chemistry: Need of computers for chemistry. Computers for Analytical Chemists-Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, 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	1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993. 2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi. 3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins. 4. Cooper and Gunn's Tutorial Pharmacy ,6th edition by S.J. Carter, CBS Publisher Ltd. 5. 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	https://www.ncbi.nlm.nih.gov/books/NBK482447/ https://training.seer.cancer.gov/treatment/chemotherapy/types.html

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able:

CO1: To identify the suitable drugs for various diseases.
CO2: To apply the principles of various drug action and drug design.
CO3: To acquire the knowledge on product development based on SAR.
CO4: To apply the knowledge on applications of computers in chemistry.
CO5: To synthesize new drugs after understanding the concepts SAR.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.05.2023

<table>
<tr><td>Title of the Course</td><td colspan="8">MOLECULAR SPECTROSCOPY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective II</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">24PCHDSEC2A</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of spectroscopy</td></tr>
<tr><td>Objectives othe course</td><td colspan="8">The course aims at giving an overall view of the
To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
To study the principle of Raman spectroscopy, ESR spectroscopy, Mossbauer spectroscopy and fragmentation patterns in Mass spectroscopy.
To highlight the significance of 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, NOESY.
To carry out the structural elucidation of molecules using different spectral techniques.</td></tr>
<tr><td>Course Outline</td><td colspan="8">UNIT-I: Rotational and Raman Spectroscopy: Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti- Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.</td></tr>
<tr><td></td><td colspan="8">UNIT-II: Vibrational Spectroscopy: Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.</td></tr>
</table>

	UNIT-III: Electronic spectroscopy: Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems. **UNIT-IV: NMR and ESR spectroscopy:** Chemical shift, Factors influencingchemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. 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. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. ^{13}CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to ^{31}P, ^{19}F NMR. ESR spectroscopy, Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. 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, ESR spectra of magnetically dilute samples. EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Applications of EPR to organic andinorganic systems. **UNIT-V: Mass Spectrometry and Mossbauer Spectroscopy:** Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of massspectrum. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.

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, 4th Ed., Tata McGraw Hill, New Delhi, **2000**. 2. R. M. Silverstein and F. X. Webster, Spectroscopic Identification of Organic Compounds, 6th Ed., John Wiley & Sons, New York, **2003**. 3. W. Kemp, Applications of Spectroscopy, English Language Book Society, **1987**. 4. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, **1988**. 5. R. S. Drago, Physical Methods in Chemistry; Saunders: Philadelphia, **1992**. **6.** D. L. Pavia, G. M. Lampman, G. S. Kriz, J. A. Vyvyan, Introduction to Spectroscopy, 5th Ed., Cengage Learning, New Delhi, **2014.**
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,**1986**. 4. K. Nakamoto, Infrared and Raman Spectra of Inorganic and coordination Compounds, Part B: 5th ed., John Wiley& Sons Inc., New York, **1997**. 5. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience, **1994**.
Website ande-learning source	1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview 2. https://www.digimat.in/nptel/courses/video/104106122/L14.html

Course Outcomes (for Mapping with POs and PSOs)

Students will be able to:

CO1: explain the theory and concepts underlying the rotational, vibrational, Raman, electronic, PES, NMR, ESR, Mass, Mossbauer Spectroscopy and Laser.

CO2: apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.

CO3: evaluate factors affecting and applications of rotational, vibrational, Raman, electronic, PES, NMR, ESR, Mass, Mossbauer Spectroscopy

CO4: outline the applications and intricacies of NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, ^{31}P, ^{19}F and ESR spectroscopic techniques.

CO5: develop the knowledge on principle and structural elucidation of simple molecules using various spectral techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**M**	**M**	**S**	**S**	**S**	**M**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**M**
CO 3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**
CO 5	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L – Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Board of Studies Date: 02.05.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTROCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective II</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">24PCHDSEC2B</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="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="2">-</td><td colspan="3">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of electrochemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">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="3">Course Outline</td><td colspan="7">UNIT-I: Ionics: Arrhenius theory -limitations, van’t Hoff factor and its relation to colligative properties. Deviation from ideal behavior. 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 Determination of activity coefficient ion solvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere. Ion association and triple ion formations.</td></tr>
<tr><td colspan="7">UNIT-II: Electrode-electrolyte interface: Interfacial phenomena - Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy-Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.</td></tr>
<tr><td colspan="7">UNIT-III: Electrodics of Elementary Electrode Reactions: Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.</td></tr>
</table>

	UNIT-IV: Electrodics of Multistep Multi Electron System: Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}. Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.
	UNIT-V: Concentration Polarization, Batteries and Fuel cells: Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. 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.

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.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.

CO2: To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations

CO3: To study different thermodynamic mechanism of corrosion,

CO4: To discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes

CO5: To have knowledge on storage devices and electrochemical reaction mechanism.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.05.2023

SECOND SEMESTER

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC REACTION MECHANISM–II</td></tr>
<tr><td>Course No.</td><td colspan="7">Core Course-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>24PCHCC3</td></tr>
<tr><td>Semester</td><td>II</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>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</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 impart knowledge about elimination, addition and rearrangement reactions.
• To understand the mechanism involved in various types of organic reactions with evidences.
• To understand the applications of synthetically important reagents and apply in organic synthesis.
• To design synthetic routes for synthetically useful organic reactions</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT – I 15 Hours
Elimination and Free Radical Reactions: Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules.
Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements.
Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.</td></tr>
<tr><td colspan="7">UNIT – II 15 Hours
Oxidation and Reduction Reactions: Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions, selenium dioxide, manganese dioxide, osmium tetroxide, oxidation of activated saturated C-H groups, alcohols and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO- Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation.
Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven’s reduction, Homogeneous hydrogenation, MPV and Bouveault-Blanc reduction.</td></tr>
</table>

	UNIT – III **15 Hours** **Rearrangements:** Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, Fries and Photo Fries rearrangement. Intramolecular rearrangements – Benzidine rearrangement
	UNIT – IV **15 Hours** **Addition to carbon-carbon multiple bond**s- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes- orientation and reactivity. Stereochemical aspects of addition reactions, addition of hydrogen halide to olefin- regiochemistry, Markovnikov and anti-Markovnikov addition, addtion of halogen to olefin, hydrogenation of double and triple bonds, Michael reaction, **Addition to carbon-hetero atom multiple bonds:** Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl compounds, Mannich reaction, Wittig reaction, Prins reaction. Mechanism of condensation reactions involving enolates –Stobbe condensation. Hydrolysis of esters.
	UNIT – V **15 Hours** **Reagents and Modern Synthetic Reactions:** Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB). Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$), $TiCl_3$, $NaIO_4$, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex**.** Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman 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. V. K Ahluwalia, R. K. Parashar, *Organic Reaction Mechanism*, 4th Ed., Narosa Publishing House, **2010**. 2. N. Tewari, *Organic Chemistry - A Modern Approach*, Volume-I & II, McGraw Hill Education (India) Private Ltd., **2017**. 3. Jagdamba Singh, Yadav L.D.S., *Organic Synthesis*, Pragati Prakashan, 8th Ed., **2012**. 4. S. N.Sanyal , *Reactions, Rearrangements and Reagents*, Bharati Bhawan Publishers, 4th Ed., **2020**.
Reference Books	1. P.Y.Bruice, *Organic Chemistry*, 7thEd., Prentice Hall, **2013**. 2. J.Clayden, N. Greeves, S. Warren, *Organic Compounds*, 2nd Ed.,Oxford University Press, **2014**. 3. J. March and M. Smith, *March's Advanced Organic Chemistry*, 6th
	Ed.,John-Wiley and Sons.**2015**. 4. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee *Organic Chemistry*, 7th Ed., Pearson Education, **2010**
Website and e-learning source	1. https://www.organic-chemistry.org/ 2. https://epgp.inflibnet.ac.in/view_f.php?category=664 3. https://epgp.inflibnet.ac.in/view_f.php?category=660 4. https://www.masterorganicchemistry.com/2011/10/03/introduction -to-addition-reactions/

Course Outcomes (for Mapping with Pos and PSOs)

Students will be able to

CO1: discuss the concepts, factors affecting various reactions and orientation in organic reactions

CO2: explain the mechanism of various types of organic reactions.

CO3: make use of appropriate reagents in organic synthesis and predict the stereochemistry and regiochemistry of products

CO4 : predict the products of the reactions and suggest suitable reagents for the transformation of organic compounds.

CO5: design synthetic route for unknown molecules using elimination, addition, molecular rearrangement, oxidation and reduction reactions

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**M**
CO2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**
CO4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**

S– Strong,M –Medium, L-Low

Level of Correlation between PSO's and CO's

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3– Strong, 2 –Medium, 1-Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSICAL CHEMISTRY-I</td></tr>
<tr><td>Course No.</td><td colspan="7">Core Course -V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">24PCHCC4</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>-</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">● 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 statistics
● 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="3">Course Outline</td><td colspan="7">UNIT – I 15 Hours
Classical Thermodynamics: Partial molar properties-Chemical potential, Gibbs- Duhem equation- Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal binary mixtures, Duhem - Margulus equation and its applications to ideal mixtures. Activity and activity coefficients - determination-vapour pressure, EMF and freezing point methods -standard states.</td></tr>
<tr><td colspan="7">UNIT – II 15 Hours
Statistical thermodynamics: Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibbs function, Helmholtz function, residual entropy, equilibrium constants and equipartition principle.</td></tr>
<tr><td colspan="7">UNIT – III 15 Hours
Irreversible Thermodynamics: Theories of conservation of mass and energy-entropy production in open systems by heat, matter and current flow-force and flux concepts. Onsager theory-validity and verification-Onsager reciprocal relationships. Electrokinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.</td></tr>
</table>

	UNIT – IV **15 Hours** **Kinetics of Reactions:** Theories of reaction rates- effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindemann and Christiansen hypothesis-molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, . Factors determine the reaction rates in solution - primary salt effect and secondary salt effect,enzyme catalysis-Michelis-Menton catalysis
	UNIT – V **15 Hours** **Kinetics of complex and fast reactions:** Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of $H_2 - Cl_2$ & $H_2 - Br_2$ reactions (Thermal and Photochemical reactions) - Rice-Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods-stopped flow, flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic and anionic polymerization.
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, J.C. Kuriacose, *Thermodynamics for Students of Chemistry*, 2nd edition,S.L.N.Chand and Co., Jalandhar, **1986**. 2. T.Engel , P.Reid, *Physical Chemistry*, 3rd edition, Pearson Education, **2006**. 3. M.C. Gupta, *Statistical Thermodynamics*, New Age International, Pvt. Ltd., New Delhi, **1995**. 4. K.J. Laidler, *Chemical Kinetics*, 3rd edition, Pearson, Reprint - **2013**. 5. J. Rajaram, J.C. Kuriokose, *Kinetics and Mechanisms of chemical transformation*, Macmillan India Ltd, Reprint - **2011**.

Reference Books	1. D.A. McQuarrie, J.D. Simon, *Physical Chemistry - A Molecular Approach*, Viva Books Pvt. Ltd., New Delhi, **1999**. 2. R.P. Rastogi, R.R. Misra, *Classical Thermodynamics*, Vikas Publishing, Pvt. Ltd., New Delhi, **1990**. 3. P.W. Atkins, J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, **2002**. 4. I. N. Levine, *Physical Chemistry*, 5th Ed., Mc-Graw-Hill, **2002**. 5. Gurdeep Raj, *Physical Chemistry*, Goel Publishing House, **2011**.
Website and e-learning source	1. https://nptel.ac.in/courses/104/103/104103112/ 2. https://bit.ly/3tL3GdN

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to

CO1: explain the classical and statistical concepts of thermodynamics.

CO2: summarize and correlate the thermodynamic concepts to study the kinetics of chemical reactions.

CO3: discuss the thermodynamic and kinetic determination of various systems.

CO4: compare the theories of reactions rates and kinetics of fast reactions.

CO5:evaluate the thermodynamic methods for real gases and mixtures.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**M**	**S**	**M**	**S**	**S**	**S**	**M**	**M**	**M**
CO 2	**S**	**S**	**S**	**S**	**S**	**M**	**M**	**S**	**S**	**M**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**M**	**S**
CO 4	**S**	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 5	**S**	**S**	**M**	**S**	**S**	**M**	**M**	**M**	**M**	**M**

M – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	2	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	2	3	3	3
Weightage	15	13	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="8">INORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Course No.</td><td colspan="8">Core Course VI -Core Practical-II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">24PCHCCQ2</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>-</td><td>1</td><td colspan="3">5</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 analyticaltool 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 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 mixtureaccurately.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT – I 30 Hours
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-II : Se, Te, Mo, Cu, Bi and Cd. Group-III
: Tl, Ce, Th, Zr, V, Cr, Fe and Ti.
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 30 Hours
Preparation of metal complexes: Preparation of inorganic complexes:
a. Preparation of trithioureacopper(I)sulphate
b. Preparation of potassium trioxalatochromate(III)
c. Preparation of tetramminecopper(II)sulphate
d. Preparation of Reineck’s salt
e. Preparation of hexathioureacopper(I)chloridedihydrate
f. Preparation of cis-Potassium trioxalatodiaquachromate(III)
g. Preparation of sodium trioxalatoferrate(III)
h. Preparation of hexathiourealead(II)nitrate</td></tr>
<tr><td colspan="8">UNIT – III 30 Hours
Complexometric Titration:
1. Estimation of zinc, nickel, magnesium, and calcium.
2. Estimation of mixture of metal ions-pH control, masking and demasking agents.
a. Determination of calcium and lead in a mixture (pH control).
b. Determination of manganese in the presence of iron.
c. Determination of nickel in the presence of iron.</td></tr>
<tr><td>Extended Professional Component (is a part of internal</td><td colspan="8">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>

component only, Not to be included in the external examination question paper)	
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 Inorganic Qualitative Analysis,* 4th ed., ELBS, London. **2.** V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*;3rd ed., The National Publishing Company, Chennai, **1974.** 3. A. Jeya Rajendran, *Microanalytical Techniques in Chemistry:Inorganic Qualitative Analysis*, United global publishers, **2021**.
Reference Books	1. G. Pass, H. Sutcliffe, *Practical Inorganic Chemistry*, 1st Ed.,Chapman Hall, **1970**. 2. W. G. Palmer, *Experimental Inorganic Chemistry*, 1st Ed., Cambridge University Press, **1954**.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to:

CO1:identify the appropriate chemical reagents for the detection of anions and cations.

CO2: apply the principles of semi-micro qualitative analysis to categorize acid radicalsand basic radicals.

CO3: infer the anions and cations present in a mixture of salts.

CO4: estimate the metal ions by quantitative analysis.

CO5: prepare coordination complexes in good quality.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**M**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3
CO2	3	3	3	2	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	2	3
Weightage	15	15	15	12	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMINFORMATICS</td></tr>
<tr><td>Course No.</td><td colspan="7">Elective -III</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Code</td><td>24PCHDSEC3A</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td>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 about computers and fundamental chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">● To understand the concepts of cheminformatics.
● To have the basic idea QSAR in drug designing.
● To have a hands on skills on various softwares used in drug designing.
● To have an overview on molecular modelling methods.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I 12 Hours
Introduction to Cheminformatics
History and evolution of cheminformatics, use and prospects of cheminformatics. Computer representations of chemical structures-graph theoretic representations of chemical structures-connection tables, SMILES notation-writing smiles for small molecules (ethane, benzene, cyclohexane, 2-methyl propane, cis and trans butene, succinic acid and acetic acid)- databases and searches- structure, reaction, patent and relational data bases. 3D DATABASES-Cambridge Structural Database (CSD), Protein Data Bank (PDB)- 3D Pharmacophores.
UNIT – II 12 Hours
Quantitative Structure Activity Relationship
QSAR Descriptors-Classification-QSAR descriptors calculated from the 2D structure-simple counts-hydrogen bond donors, hydrogen bond acceptors, rotatable bonds and molecular weight. Physicochemical properties – hydrophobicity - partition coefficient-substituent hydrophobicity constant – effect of log p on drugs- a case study of a cardiotonic drug. Electronic effects-its role in insecticidal activity of drugs, steric factors-Taft steric factor- molar refractivity. Isosteres, identification of a pharmacophore.
UNIT – III 12 Hours
Towards Drug Designing
Virtual screening-need and uses; “drug-likeness” and compound filters, Lipinski rule of 5, ADMET properties-hydrogen bonding descriptors, polar surface area, toxicity prediction. Drug optimizations and strategies in drug design: variation of substituents, extension of structure, chain extension or contraction, ring expansion /contraction, ring variations, ring fusions. Drug design by NMR - docking- a preliminary idea on automatic docking, manual docking, rigid docking.</td></tr>
</table>

	UNIT – IV **12 Hours** Computational methods for electronic structure study- an overview. Study of molecular properties—partial charges, molecular electrostatic potential, Molecular orbitals, spectroscopic charges Drawing chemical structure using chemdraw and exploring its Features - structure to name conversion, name to structure conversion, predicting NMR, chemix software for drawing lab diagrams, Chemsketch-hands-on in online drawing and editing molecules and convert structure to InChI strings - Using ZINC data base for drug searching.
	UNIT – V **12 Hours** **Softwares and their Application in Drug Designing** Calculation of molecular properties and bioactivity score using Molinspiration-hands on training on many molecules. CRDD web portalcomputational resources for drug discovery- a thorough surfing of the webpage-familiarity with freely available databases listed there-. OSIRIS property explorer, data warrior-toxicity, Log P, drug-likeness prediction, Swiss ADME – drug-likeness prediction-parameters-bioavailability radar- synthetic accessibility and lead-likeness of various molecules.
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
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A. R.,Leach, G, Valerie., *An introduction to Chemoinformatics,* Springer, **2007.** 2. G. L,Patrick, *An Introduction to Medicinal Chemistry*, 4th Ed., Oxford University Press, **2009**. 3. K,Roy, S,Kar, R. N,Das, *A Primer on QSAR/QSPR Modelling Fundamental Concepts,* Springer Cham Heidelberg, **2015**. 4. C.J, Cramer, *Essentials of Computational Chemistry: Theories and Models*, John Wiley & Sons, **2004**.

Reference Books	1. J, Leszczynski, A, K,Kedziera, , T, Puzyn, M.G,Papadopoulos, H,Reis, & M.K,Shukla, *Handbook of Computational Chemistry*, 2nd Ed., Springer International Publishing, **2017**. 2. T, Fujita, *QSAR and Drug Design: New Developments and Applications*, Elsevier, **1995**. 3. H,Kubinyi, *QSAR: Hansch Analysis and Related Approaches*, Weinheim-VCH, **1993**. 4. S.M, Bachrach, *Computational Organic Chemistry*, John Wiley & Sons, Inc. **2007**.
Website and e-learning source	1. https://nptel.ac.in/courses/102/106/102106070/ 2. http://zinc.docking.org/substances/home/ 3. https://www.molinspiration.com/cgi-bin/properties 4. http://crdd.osdd.net/ 5. http://www.swissadme.ch/index.php 6. http://media.cambridgesoft.com/support/manuals/16/ChemDrawHelp.pdf 7. https://chemix.org/ 8. https://openmolecules.org/datawarrior/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to

CO1: discuss the basic concepts of cheminformatics

CO2: infer the importance of drug optimisations and docking

CO3: apply and evaluate the role of QSAR in drug designing

CO4: explain different molecular modelling techniques

CO5: apply various softwares like Molinspiration, Swiss ADME, ZINC, Chemdraw, Chemsketch, Chemix, OSIRIS in elementary analysis of drug design

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**M**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**M**
CO 2	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO 3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO 4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO 5	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">GREEN CHEMISTRY</td></tr>
<tr><td>Course No.</td><td colspan="7">Elective III</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>24PCHDSEC3B</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></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>4</td><td>-</td><td colspan="2">-</td><td colspan="3">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 discuss the principles of green chemistry.
● To propose green solutions for chemical energy storage and conversion.
● To propose green solutions for industrial production of Petroleum and Petrochemicals.
● To propose solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries.
● To propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I 12 Hours
Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, Internationall green chemistry organizations and Twelve principles of Green Chemistry with examples.</td></tr>
<tr><td></td><td colspan="7">UNIT – II 12 Hours
Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water,Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in $scCO_2$. Green synthesis-adipic acid and catechol.</td></tr>
<tr><td></td><td colspan="7">UNIT – III 12 Hours
Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.</td></tr>
<tr><td></td><td colspan="7">UNIT – IV 12 Hours
Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.</td></tr>
<tr><td></td><td colspan="7">UNIT – V 12 Hours
Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.</td></tr>
</table>

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.K.Ahluwalia, M.R. Kidwai, *New Trends in Green Chemistry*, Anamalaya Publishers, **2005**. 2. W. L. McCabe, J.C. Smith, P. Harriott, *Unit Operations of Chemical Engineering*, 7thedition, McGraw-Hill, NewDelhi, **2005**. **3.** J. M. Swan, D. St. C. Black, *Organometallics in Organic Synthesis*, Chapman Hall, **1974.** 4. V. K. Ahluwalia, 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.** P.T, Anastas, J.K, Warner, *Oxford Green Chemistry -Theory and Practical*, University Press, **1998** 2. A.S, Matlack, *Introduction to Green Chemistry*, Marcel Dekker, **2001** **3.** M.C, Cann, M.E. Connely, *Real-World Cases in Green Chemistry*, American Chemical Society, Washington, **2000** 4. M.A.Ryan, M.Tinnes, *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 Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to:

CO1: recall the basic chemical techniques used in conventional industrial preparations and in green innovations.

CO2: understand the various techniques used in chemical industries and in laboratory.

CO3: compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.

CO4: apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organic synthesis.

CO5: design and synthesize new organic compounds by green methods.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">BIOINORGANIC CHEMISTRY</td></tr>
<tr><td>Course No.</td><td colspan="7">Elective IV</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">24PCHDSEC4A</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="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">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, sulphur etc.
● To study the toxicity of metals in medicines.
● To have knowledge on diagnostic agents.
● To discuss on various metalloenzymes properties.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I 12 Hours
Essential trace elements: Selective transport and storage of metal ions: Ferritin, Transferrin and siderophores; Sodium and potassium transport, Calcium signalling proteins. Metalloenzymes: Zinc enzymes– carboxypeptidase and carbonic anhydrase. Iron enzymes–catalase, peroxidase. Copper enzymes – superoxide dismutase, Plastocyanin, Coenzymes - Vitamin-B_{12} coenzymes.</td></tr>
<tr><td></td><td colspan="7">UNIT – II 12 Hours
Transport Proteins: Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation, Bohr Effect. Binding of CO, NO, CN– to Hemoglobin. Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.</td></tr>
<tr><td></td><td colspan="7">UNIT – III 12 Hours
Nitrogen fixation-Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase-redox property - Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function.</td></tr>
<tr><td></td><td colspan="7">UNIT – IV 12 Hours
Metals in medicine: Metal Toxicity of Hg, Cd, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer Agents. Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.</td></tr>
<tr><td></td><td colspan="7">UNIT – V 12 Hours
Enzymes -Introduction and properties -nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the external	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)
examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1.Asim K Das, *Bioinorganic Chemistry*, 2nd Ed., Books and Allied (p) Ltd., **2020**. 2. S. J. Lippard, M. J.,Berg, *Principles of Bioinorganic Chemistry*, 1st Ed., University Science Books, **1994**. 3. M.Rosette Roat-Malone, *Bioinorganic Chemistry*, 2nd Ed., John Wiley & Sons, Inc., **2002**. 4. G. N. Mugherjea and Arabinda Das, *Elements of Bioinorganic Chemistry*, 2nd Ed., U N Dhur & Sons Private Ltd.**1993**.
Reference Books	1. M. Satake and Y. Mido , *Bioinorganic Chemistry*, 1st Ed., Discovery Publishing House, New Delhi, **1996**. **2.** M. N. Hughes, *The Inorganic Chemistry of Biological Processes*, 2nd Ed., Wiley London, **1982.** 3. R. W. Hay , *Bioinorganic Chemistry*, 2nd Ed., Ellis Horwood, **1987**. 4. T. M, Loehr , *Iron carriers and Iron proteins*, 1st Ed., 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 Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to:

CO1: identify the trace elements.

CO2: interpret the biological redox systems.

CO3: analyse the nitrogen fixation and photosynthetic mechanism.

CO4: predict the therapeutic and toxicity nature of metals

CO5: compile enzymatic action and its efficiency

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO 2	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 3	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 5	**S**	**M**	**M**	**S**	**S**	**S**	**S**	**M**	**M**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">MATERIAL SCIENCE</td></tr>
<tr><td>Course No.</td><td colspan="7">Elective -IV</td></tr>
<tr><td>Category</td><td>Elective</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>24PCHDSEC4B</td></tr>
<tr><td></td><td></td><td>Semester</td><td>II</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="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of solid-state chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">● 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>Course Outline</td><td colspan="7">UNIT – I 12 Hours
Crystallography: symmetry - unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups - X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.</td></tr>
<tr><td></td><td colspan="7">UNIT – II 12 Hours
Crystal growth methods: Nucleation–equilibrium stability and metastable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growth methods- nucleation–equilibrium stability and metastable state. Single crystal–Low and high temperature, solution growth– Gel and sol-gel. Melt growth - Bridgeman-Stockbarger, Czochralski methods. Flux technique, physical and chemical vapour transport. Lorentz and polarization factor - primary and secondary extinctions.</td></tr>
<tr><td></td><td colspan="7">UNIT – III 12 Hours
Properties of crystals: Optical studies - Electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications. Dielectric studies- Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electrochemical and defect breakdown.</td></tr>
</table>

	UNIT – IV **12 Hours** **Special Materials:** Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and gian magneto resistance. Ferro, ferri and antiferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory Alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.
	UNIT – V **12 Hours**
	Materials for Renewable Energy Conversion: Solar Cells: Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO2 and N2. Manganese based photo systems for water-splitting. 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, V. Arjunan, *Principles of Materials Science*, MJP Publishers, **2016**. 2. Arumugam, *Materials Science*, Anuradha Publications, **2007**. **3.** Giacavazzo , *Fundamentals of Crystallograph*y, International Union of Crystallography. Oxford Science Publications, **2010** 4. Woolfson, *An Introduction to Crystallography*, Cambridge University Press, **2012**. 5. James F. Shackelford, 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*, John-Wiley and sons, **1987**.
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

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to

CO1: understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials.

CO2: integrate and assess the structure of different materials and their properties.

CO3: analyse and identify new materials for energy applications.

CO4: explain the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis.

CO5: design and develop new materials with improved property for energy applications.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of theCourse</td><td colspan="7">THERAPEUTICAL CHEMISTRY</td></tr>
<tr><td>Course No.</td><td colspan="7">Extra disciplinary course-I</td></tr>
<tr><td>Category</td><td>EDC</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">24PCHEDC1</td></tr>
<tr><td></td><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2"></td><td colspan="2">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of medicines and interest to learn</td></tr>
<tr><td>Objectives the course</td><td colspan="7">• To know the terms of pharmacology.
• To learn about medicinal flora in India.
• To understand the common diseases and their cure.
• To acquire knowledge about antibiotics, sulpha drugs etc., & to understand the drugs used for diabetes, cancer and hypertension.
• To have general awareness on blood grouping, first aid, vitamins and hormones.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I 12 Hours
Important terminologies used in medicinal chemistry – pharmacology, drug, pharmacognosy, pharmacy, therapeutics, toxicology, chemotherapy, pharmacopoeia, viruses, bacteria, vaccines, therapeutic index, encapsulation. Routes of drug administration.
UNIT – II 12 Hours
Medicinal Flora in India:
Some Indian healers and their significance – neem, adathoda vasica, amla, turmeric, thulasi, thoothuvalai, kizhanelli, shoe flower-Cancer curing plants. Medicinal plants in the kitchen garden-Spices as medicine-Ayurveda and siddha medicines.
UNIT – III 12 Hours
Common diseases and Drugs (Reason and treatment)
Common air borne diseases – common cold, influenza, measles, mumps, diphtheria, whooping cough, tuberculosis, Common water borne diseases – dysentery, cholera, typhoid, jaundice-Common insect-borne diseases – malaria, elephantiasis, Some other common diseases – asthma, epilepsy.
UNIT – IV 12 Hours
Classification of Drugs
Sulpha drugs, antibiotics, analgesics, antiseptics and disinfectants, anaesthetics, psychopharmacology.
Life-style diseases and treatment- obesity, diabetes, cardiovascular diseases including blood pressure, cancer, AIDS. [Reason, drugs (Structure not needed), prevention].
UNIT – V 12 Hours
Miscellaneous topics
Blood groups, Rh factor, composition of blood, types of anaemia and drugs. Accidents and first aids-Poisons and antidotes-Vitamins and hormones. Analysis of blood and urine.</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem solving, awareness of fundamental rights and duties
Recommended Text	1. S.Lakshmi, *Pharmaceutical Chemistry*, Sultan Chand & Sons, 3rd Ed., **2004**. 2. Jayashree Ghosh, *Fundamental Concepts of Applied Chemistry*, 1st Ed., S. Chand, **2006**. 3. G.L, Patrick, *An Introduction to Medicinal Chemistry*, 4th Ed., Oxford University Press, **2009**.
Website e-learning source	1. https://www.pharmapproach.com/routes-of-drug-administration/ 2. https://www.drugs.com/drug-class/analgesics.html 3. https://academic.oup.com/bjaed/article/14/3/106/340726

Course Learning Outcomes

Students will be able to

CO1: relate the terminologies of therapeutical chemistry
CO2: explain the different diseases and their treatment
CO3: classify diseases and various types of drugs
CO4: choose the appropriate medicinal herbs for healing
CO5: justify the role of various factors on health and diseases

Board of Studies Date: 02.11.2023

<table>
<tr><td>Title of the Course</td><td colspan="7">HUMAN RIGHTS</td></tr>
<tr><td>Course No.</td><td colspan="7"></td></tr>
<tr><td>Category</td><td>Common subject</td><td>Year</td><td>I</td><td>Credit</td><td>1</td><td>Course Code</td><td>24PHRSC</td></tr>
<tr><td></td><td></td><td>Semester</td><td>II</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>2</td><td colspan="2">0</td><td colspan="2">-</td><td colspan="2">2</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic desire to learn about rights</td></tr>
<tr><td>Objectives the course</td><td colspan="7">To enlighten the students about the different rights.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT – I
Human rights- Definition- characteristics of human rights- classification of rights- The Universal declaration of human rights- international covenants on economic, social and cultural rights
UNIT – II
Constitutional guarantee on human rights - Fundamental rights -Part III of constitution- Directive principles Part IV of the constitution.
UNIT – III
Civil and political rights- right to work, right to personal freedom, right to freedom of expression, right to property, right to education, right to equality, right to religion, right to form association and unions, right to family, right to contract, right to constitutional remedies, right to contest in election, right to hold public office, right to petition, right to criticize government.
UNIT – IV
Economic rights: Right to work, right to adequate wages, right to reasonable hours of work, right to self-government in industry.
UNIT – V
Women’s rights: Right to inheritance, right to divorce, right to remarry, right to education, right to employment and career advancement.</td></tr>
<tr><td>Extended Professional Component (isa part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC /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, awareness of fundamental rights and duties</td></tr>
</table>

Recommended Text	**1.** *Human rights*-UNESCO, **1982** 2. Desai, A.R- *Violation of democratic rights in India, **1986**.* *3.* Pandey-*Constitutional Law.* 4. *Human rights*- A selected bibliography, USIS. *5.* Singh, K.S, *Indian Social Institution, **1983**.*

Board of Studies Date: 02.11.2023

<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 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">24PCHCC5</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>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 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="3">Course Outline
,</td><td colspan="7">UNIT-I: Planning an Organic Synthesis and Control Elements: Preliminary planning – knowns and unknowns of the synthetic system studied, analysis of the complex and interrelated carbon framework into simple rational precursors, alternate synthetic routes, key intermediates that would be formed, available starting materials and resulting yield of alternative methods. Linear Vs convergent synthesis. Synthesis based on umpolung - concepts of Seebach - Control elements - Regiospecific control elements and stereospecific control elements.</td></tr>
<tr><td colspan="7">UNIT-II: Organic Synthetic Methodology: Retrosynthetic Analysis: Alternate synthetic routes - Synthesis of organic mono and bifunctional compounds via disconnection approach - Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups - Illustration of protection and deprotection in synthesis - Use of protective groups, activating groups and bridging elements - Functional group alterations and transposition.</td></tr>
<tr><td colspan="7">UNIT-III: Pericyclic Reactions:
Woodward Hoffmann Rules, The Mobius and Huckel concept, FMO, PMO method and correlation diagrams - cycloaddition and retro cycloaddition reactions - [2+2], [2+4], [4+4], cationic, anionic, and 1,3-dipolar cycloadditions - cheletropic reactions - electrocyclization and ring opening reactions of conjugated dienes and trienes - sigmatropic rearrangements - (1,3), (1,5), (3,3) and (5,5) - carbon migrations, degenerate rearrangements, ionic sigmatropic rearrangements, group transfer reactions - regioselectivity, stereoselectivity and periselectivity in pericyclic reactions.</td></tr>
</table>

	UNIT-IV: Organic Photochemistry-I: Photochemical excitation – experimental techniques - electronic transitions - Jablonskii diagrams - intersystem crossings, energy transfer processes, Stern-Volmer equation. Reactions of electronically excited ketones - $\pi \rightarrow \pi^*$ triplets, Norrish type-I and type-II cleavage reactions, photo reductions, Paterno-Buchi reactions.
	UNIT-V: Organic Photochemistry-II: Photochemistry of α, β-unsaturated ketones - cis-trans isomerization, photon energy transfer reactions, photo cycloadditions, photochemistry of aromatic compounds, photochemical rearrangements, photo-stationery state, di-π methane rearrangement, r eaction 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, 5th Ed., 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, 2nd Ed., 2016. 5. M. B. Smith, Organic Synthesis 3rd Ed., McGraw Hill International Edition, 2011.
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 4th Ed., 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.
Website and e-learning source	https://rushim.ru/books/praktikum/Monson.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able to:
CO1: recall the basic principles of organic chemistry and to understand the variousreactions of organic compounds with reaction mechanisms.
CO2: understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions.
CO3: implement the synthetic strategies in the preparation of various organic compounds.
CO4: predict the suitability of reaction conditions in the preparation of tailor-made organic compounds.
CO5: design and synthesize novel organic compounds with the methodologies learnt during the course.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	M	S	S	M	S	S	M	S	S
CO 2	S	M	S	S	S	S	S	M	S	S
CO 3	S	S	S	S	S	S	S	S	S	S
CO 4	S	S	S	S	S	S	S	S	S	S
CO 5	S	S	S	S	S	S	S	S	S	S

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 23.04.2024

<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>Credits</td><td>5</td><td>Course Code</td><td colspan="2">24PCHCC6</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>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 gain insights into the modern theories of bonding in coordination compounds.
To construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
To learn various methods to determine the stability constants of complexes.
To evaluate the substitution reactions mechanisms of octahedral and square planar complexes.
To describe various electron transfer mechanistic pathways of reactions in complexes.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT-I: Modern theories of coordination compounds:

Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq - spectrochemical series - crystal field stabilisation energy for high spin and low spin complexes- evidences for crystal field splitting - site selections in spinels and antispinels - Jahn-Teller distortions and its consequences.

Molecular orbital theory and energy level diagrams-concept of weak and strong fields - sigma and pi bonding in octahedral, square planar and tetrahedral complexes.</td></tr>
<tr><td colspan="8">UNIT-II:Spectral characteristics of complexes:

Term states for d ions - characteristics of d-d transitions - charge transfer spectra - selection rules for electronic spectra - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - nephelauxetic series - Racah parameter and calculation of inter-electronic repulsion parameter.</td></tr>
<tr><td colspan="8">UNIT-III:Stability and Magnetic property of the complexes:
Stability of complexes- factors affecting stability of complexes- Thermodynamic aspects of complex formation- Stepwise and overall formation constants- Stability correlations, statistical factors and chelate effect,
Determination of stability constant and composition of the complexes: Formation curves and Bjerrum’s half value point method, potentiometric method, ion-exchange method, polorographic method and spectrophotometric method-continuous variation method (Job’s method).
Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.</td></tr>
</table>

	UNIT-IV:Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: Inert and labile complexes- Associative, Dissociative and SNCB mechanistic pathways for substitution reactions- acid and base hydrolysis of octahedral complexes- classification of metal ions based on the rate of water replacement reaction and their correlation to Crystal Field Activation Energy. Substitution reactions in square planar complexes- Trans effect- theories of trans effect and applications of trans effect in synthesis of square planar compounds- Kurnakov test.
	UNIT-V:Electron Transfer reactions in octahedral complexes: Outer sphere electron transfer reactions and Marcus-Hush theory- inner sphere electron transfer reactions- nature of the bridging ligand in inner sphere electron transfer reactions. Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their 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. Huheey,J. E., Keiter,E. A., Keiter R. L., and Medhi,O. K., *Inorganic Chemistry – Principles of Structure and Reactivity*, 4th Ed., Pearson Education Inc., 2006 2. Miessler, Gary L., Fischer, Paul J. and Tarr, Donald A., *Inorganic Chemistry*, 5th Ed.,Pearson Education Inc., 2014. 3. Banerjea. D., *Coordination Chemistry*" 2nd Ed., Asian Books, 2009. 4. Figgis, B. N., *Introduction to Ligand Fields*, Wiley Eastern Ltd., New York, 1976. 5. Cotton, F. A., Wilkinson. G., Murillo, C. A. and Bochmann,M. *Advanced Inorganic Chemistry*, 6th Ed., John Wiley & Sons, Inc., New York, 1988.
Reference Books	1. Keith F. Purcell and John C. Kotz, *Inorganic Chemistry*, Saunders College Publications, USA, 2010. 2. Peter Atkins and Tina Overton, *Shriver and Atkins' Inorganic Chemistry*, 5th Ed., Oxford University Press, 2010. 3. Cotton, F. A., Wilkinson, G., Guas, P. L., *Basic Inorganic Chemistry*, John Wiley, 2002, 3rd Ed. 4. Douglas, B.McDaniel, D.,Alexander,J., *Concepts and Models of Inorganic Chemistry*, John Wiley, 1994, 3rd Ed. 5. D. F. Shriver, P. W. Atkins, *Inorganic Chemistry*, W. H. Freeman and Co.,New York, 2010.
Website and e-learning source	https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/ https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/07.inorga

	nic_chemistry-ii/12._electronic_spectra_of_coordination_complexes-iv/et/7436_et_et.pdf https://chem.libretexts.org/Courses/East_Tennessee_State_University/CHEM_3110%3A_Descriptive_Inorganic_Chemistry/10%3A_Coordination_Chemistry-_Reactions_and_Mechanisms/10.05%3A_Electron_Transfer_Reactions https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000658/M019076/ET/1515586760CHE_P3_M26_etext_final.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able to:
CO1:classify various theories of coordination compounds.
CO2:solve the spectroscopic and magnetic properties of coordination complexes. CO3:explain the stability of complexes and various experimental methods to determine the stability of complexes.
CO4:predict the electronic transitions in complexes based on correlation diagrams.
CO5:summarize the kinetics and mechanism of substitution reactions in octahedral and square planar complexes.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	S	S	S	S	S	M	S	M	S	S
CO 3	S	S	S	S	S	S	S	S	S	S
CO 4	S	S	S	S	S	M	S	S	S	M
CO 5	S	S	S	S	S	M	S	M	S	M

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	2
CO5	3	3	3	3	3
Weightage	15	15	15	14	14
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Board of Studies Date: 23.04.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">TEXTILE & DYE CHEMISTRY (INDUSTRY MODULE)</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IX</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td>24PCHCC7</td></tr>
<tr><td></td><td></td><td>Semester</td><td>III</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>4</td><td>1</td><td colspan="3">-</td><td>5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of dye chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the manufacturing process and properties of natural and man made fibres.
To comprehend the techniques in the process of dyeing
To know the concept of colours and synthesis of various dyes.
To learn the Pollution Control regulations in Textile Industry.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Fibre Science
Definition of textile fibres, essential and desirable properties of textile fibres- textile fibre classifications.
Natural fibres: cotton, wool, silk, flax (Linen), jute - physical & chemical properties - fine structure - chemical structure and applications.
Regenerated cellulosic fibres: viscose, lyocell, cuprammonium rayon.
Manmade fibres: raw materials - manufacturing process - physical and chemical properties and applications of polyester, polyamides, acrylic & polyolefins.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Process of Dyeing and Bleaching
Objective of scouring – process of caustic scouring on open kier machine with sine diagram, scouring with NaOH and Na_2CO_3 - desizing using malt extract – merits and demerits of acid and enzyme desizing - objects of singeing – impurities present in grey cotton and cotton fabric – process of singeing on gas singeing machine – precautions to be taken during gas singeing.
Bleaching: principles of wetting and mechanism of detergency – synthetic detergents – surface active agents - bleaching processes – bleaching agents - H_2O_2, NaOCl, bleaching powder and bio-bleaching and their properties - bleaching of cotton, rayon, wool and synthetic fibres.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Fundamental Concepts of Dye Chemistry
Colour and constitution: colour of substances - complementary colours – theories of colour and constitution - Otto - Witt theory - chromophores, auxochromes, bathochromic shift, hypsochromic shift - quinonoid theory - valence bond theory and molecular orbital theory.
Classification of dyes based on application- acid, base, azo, vat and reactive dyes - anthroquinone and mordant Dyes- synthesis and applications of Alizarin
Azo Dyes - principles of azo coupling - mechanism of diazotization – coupling with amines and phenols - Monoazo and diazo dyes - synthesis and applications - tautomerism in azo dyes</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Classification of dyes based on chemical constituents
Diphenylmethane Dyes- synthesis and application of Auramine-Triphenylmethane Dyes- malachite green, crystal violet, pararosaniline-preparation and applications. indigo dyes-preparation and application of indigo. derivatives of indigo-synthesis and uses of indigosol and</td></tr>
</table>

	tetrabromo indigo-(ciba blue) Phthalein Dyes – phenolphthalein – preparation and applications. Xanthein Dyes – Rhodamine B, Rhodamine-G; Fluorescein – Preparation and applications. Acridine dyes- synthesis and application of Acriflavin and proflavin. Reactive dyes – synthesis and applications of procion Blue HB. Application of dyes in other areas - medicine, chemical analysis, cosmetics, colouring agents, food and beverages.
	UNIT-V: Pollution Control in Textile Industry Textile Effluent: characteristics and determination of BOD, COD, TDS, pH and toxicity modern textile effluent- effect of untreated effluent, degradability of wastes. Treatment process -primary, secondary, tertiary & membrane technology-concept of zero discharge and its importance. Effluent treatment technologies: sizing and desizing technology, filtration technologies, colour removal technologies, remediation of textile effluents. effluent treatment plants-aerated lagoon, photo oxidation process.
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. Chatwal G.R, "*Synthetic Dyes*" Himalaya Publishing House, New Delhi, 2009. 2. Shenai, V.A., *Chemistry of dyes and principles of dyeing*, 1983. 3. Mishra SP., *A text book of fibre science and technology*. New Age International, 2000. 4. N. Manivasakam, *Treatment of Textile Processing Effluents*, Sakhi Publications, 1995.
Reference Books	1 Venkataraman K, "The Chemistry of Synthetic Dyes", Elsevier, India, 2009. 2 Singh R, "A Handbook of Synthetic Dyes", Mittal Publications, NewDelhi, 2016. 3. Horrocks A R, Anand S C, *Handbook of Technical Textiles: Technical Textile Processes*, Woodhead Publishing, 2015. 4. Sadov, F.I., Korchagin, M.V. and Matetskii, A.I., *Chemical technology of fibrous materials*, MIR Publishers, Moscow, 1978.
Website and e-learning source	https://archive.nptel.ac.in/courses/116/104/116104045/ https://archive.nptel.ac.in/courses/116/104/116104046/

Course Outcomes (for Mapping with POs and PSOs)

Students will be able to
CO1: compare the application of synthetic fibres with natural fibres.
CO2: describe the preparatory process of dyeing.
CO3: illustrate the principles of colour and its relation with compound's structure.
CO4: classify dyes based on their chemical structure and its applications.
CO5: analyze the problems connected with textile technological processes.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

Strong - 3 **Medium-2** **Low-1**

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	2
CO5	3	3	3	3	3
Weightage	15	15	15	14	14
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Board of Studies Date: 23.04.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSICAL CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">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">5</td><td rowspan="2">Course Code</td><td rowspan="2">24PCHCCQ3</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>1</td><td colspan="3">5</td><td colspan="2">6</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 understand the principle of conductivity experiments through conductometric titrations.
To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
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.
To develop the potential energy diagram of hydrogen ion, charge density distribution and Maxwell’s speed distribution by computational calculation.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Conductivity Experiments
1. Determination of equivalent conductance of a strong electrolyte & the verification of DHO equation.
2. Verification of Ostwald’s Dilution Law & Determination of pKa of a weak acid.
3. Verification of Kohlrausch’s Law for weak electrolytes.
4. Determination of solubility of a sparingly soluble salt.
5. Acid-base titration (strong acid and weak acid vs NaOH).
6. Precipitation titrations (mixture of halides only).</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.</td></tr>
<tr><td colspan="7">UNIT-III: Phase diagram
Construction of phase diagram for a simple binary system
1. Naphthalene-phenanthrene
2. Benzophenone- diphenyl amine
Adsorption
Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).</td></tr>
<tr><td>Extended Professional Component</td><td colspan="7">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>
<tr><td>Recommended</td><td colspan="7">1. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry,</td></tr>
</table>

Text	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.
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.
Website and e-learning source	https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able to:
CO1: recall the principles associated with various physical chemistry experiments.
CO2: scientifically 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.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 23.04.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">BIOMOLECULES AND HETEROCYCLIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective V</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">24PCHDSEC5A</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></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 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 of biomolecules and natural products.
To extract and construct the structure of new alkaloids and terpenoids from different methods.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Chemistry and metabolism of carbohydrates: Definition, classification and biological role of carbohydrates. Monosaccharides- Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose. Disaccharides- Ring structures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose. Polysaccharides- Starch, glycogen and cellulose – structure and properties, glycolysis of carbohydrates. Muta rotation and interconversion</td></tr>
<tr><td colspan="7">UNIT-II: Steroids and Hormones-Steroids-Introduction, occurrence, nomenclature, configuration of substituents. Diels' hydrocarbon, stereochemistry, classification, biological importance, colour reactions of sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene. Hormones-Introduction, classification, functions of sex hormones- androgens and estrogens, adrenocortical hormones-cortisone and cortisol - structure and functions of non-steroidal hormones-adrenaline and thyroxin.</td></tr>
<tr><td colspan="7">UNIT-III: Proteins and nucleic acids- Separation and purification of proteins – dialysis, gel filtration and electrophoresis. Catabolism of amino acids - transamination, oxidative deamination and decarboxylation. Biosynthesis of proteins-Role of nucleic acids. Amino acid metabolism and urea cycle. Structure, methods for the synthesis of nucleosides - direct combination, formation of heterocyclic base and nucleoside modification, conversion of nucleoside to nucleotides.
Primary and secondary structure of RNA and DNA, Watson-Crick model, solid phase synthesis of oligonucleotides.</td></tr>
</table>

	UNIT-IV: Vitamins-Introduction, Classification, Sources and deficiency diseases. Structure and Properties of fat soluble vitamins-A,D,E,K and water soluble vitamins-B1, B2, B3, B5, B6, Biotin, folic acid, B12, C-Synthesis of Vitamin A and $B_{1.}$, physiological importance of fat soluble vitamins and water soluble vitamins, hypervitaminosis, fortification of vitamins, Deterrmination of vitamin C in food.
	UNIT-V: Fused Ring Heterocyclic Compounds- Benzofused five membered rings- Indole- Preparation (Fischer Indole synthesis, Madelung's Synthesis) and properties., isoindole- Preparation , benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings- Quinoline and isoquinoline- Preparation by ring closure reactions (Skraup's synthesis and Friedlander's synthesis for quinoline and Pomeranz Fritsch synthesis for isoquinoline), Reactions:electrophilic, 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. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi, 2009. 3. I. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia 1975. 4. V.K.Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000. 5. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014.
Reference Books	1. I. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia,2004. 2. S.W.Pelletier, Chemistry of Alkaloids,Van NostrandReinhold Co,2000. 3. Charles W. 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.
Website and	www.organic-chemistry.org/

e-learning source	www.studyorgo.com/summary.php www.clutchprep.com/organic-chemistry https://chemlab.truman.edu/chemical-principles/determination-of-vitamin-c/ https://egyankosh.ac.in/bitstream/123456789/15079/1/Unit-4.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able to:
CO1: Comprehend the basic concepts of biomolecules and natural products.
CO2: Compare the different methods of preparation of structurally different biomolecules and natural products.
CO3: Illustrate the applications of biomolecules and their functions in the metabolism of living organisms.
CO4: Analyse the structure and synthesis of heterocyclic compounds.
CO5: Rationalise the biological relevance of heterocycles, steroids, hormones, vitamins, carbohydrates, amino acids and proteins.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	S	S	S	M	S	M
CO 2	S	S	S	S	S	M	S	S	S	M
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	S	S	S	S	S	M	S	S	S	M
CO 5	S	S	M	S	S	M	S	M	S	S

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 23.04.2024

<table>
<tr><td>Title of the Course</td><td colspan="8">PHARMOCOGNOSY AND PHYTOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">Elective V</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 colspan="2" rowspan="2">24PCHDSEC5B</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="3">Total</td></tr>
<tr><td>4</td><td>-</td><td colspan="3">-</td><td colspan="3">4</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: Pharmacognosy and Standardization of Herbal drugs: Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine,and plant tissue cultures. Study of pharmacognosy of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs.WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.</td></tr>
<tr><td colspan="8">UNIT-II:Extraction Techniques: General methods of extraction, types –maceration, Decoction, percolation, Immersion and soxhlet extraction. Advanced techniques- counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process.</td></tr>
<tr><td colspan="8">UNIT-III:Drugs containing Terpenoids and volatile oils,Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications.</td></tr>
</table>

	UNIT-IV: Drugs containing alkaloids: Occurrence,function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties,structure and uses.
	UNIT-V: Plant Glycosides and Marine drugs: Glycosides, Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiacglycosides-Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride.Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.
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, 2 nd edition, New age international (P) limited, New Delhi.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1:To recall the sources of natural medicines and analysis of crude drugs.

CO2: To understand the methods of evaluation based on various parameters.

CO3:To analyze the isolated drugs

CO4:To apply various techniques to discover new alternative medicines.

CO5:To evaluate the isolated drugs for various pharmacological activities

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 23.04.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY IN CONSUMER PRODUCTS</td></tr>
<tr><td>Paper No.</td><td colspan="7">EDC-II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">EDC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td><td>24PCHEDC2</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>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Consumer Products</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To provide basic knowledge in consumer products in chemistry and modern trend in Industry.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Inorganic consumer productS
Ceramic materials – Preparation, Properties and Uses.
Glass- Preparation, Properties and Uses.
Graphite- Preparation, Properties and Uses.
Silica Aerogel- Preparation, Properties and Uses.</td></tr>
<tr><td colspan="7">UNIT-II:Soaps and detergents
Saponification of oils and fats. Manufacture of soaps. Formulation of toilet soaps. Different ingredients used. Their functions. Mechanism of action of soap. ISI specifications. Testing procedures/limits.
Anionic detergents: Manufacture of LAB (linear alkyl benzene). Sulphonation of LAB preparation of acid slurry. Different ingredients in the formulation of detergent powders and soaps. Liquid detergents. Foam boosters. AOS (alpha olefin sulphonates. cationic detergents: examples. Manufacture and applications. Mechanism of action of detergents Comparison of soaps and detergents. Biodegradation – environmental effects. ISI specifications / limits.</td></tr>
<tr><td colspan="7">UNIT-III:Shampoos
Manufacture of SLS and SLES. Ingredients. Functions. Different kinds of shampoos – anti-dandruff, anti-lice, herbal and baby shampoos. Hair dye. Manufacture of conditioners. Coco betaines or coco diethanolamides – ISI specifications. Testing procedures and limits.</td></tr>
</table>

	UNIT-IV:Skin preparations Face and skin powders. Ingredients, functions. Different types. Snows and face creams. Chemical ingredients used. Anti perspirants. Sun screen preparations. UV absorbers. Skin bleaching agents. Depilatories. Turmeric and Neem preparations. Vitamin oil. Nail polishes: nail polish preparation, nail polish removers. Article removers. Lipsticks, roughes, eyebrow pencils. Ingredients and functions – hazards. ISI specifications.
	UNIT-V: Regulations in consumer products Leading firms, brand names, choosing the right product. Packing regulations. Marketing. Licensing – drug license – legal aspects. GMP – ISO 9000/12000 – consumer education. Evaluation of the product – advertisements.
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 /TNPSCothers 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.Gobala Rao.S , Outlines of chemical technology, Affiliated EastWest press,1998 2. Kafaro, Wasteless chemical processing, Mir publishers, 1995. 3.Sawyer.W, Experimental cosmetics,Dover publishers, New york,2000.

Course Learning Outcomes

Students will be able to

CO1: c omprehend the preparations of inorganic consumer products

CO2: apply various manufacturing methods of soaps and detergents

CO3: synthesize different kinds of shampoos and conditioners

CO4: make different types of skin preparations such as snows, face creams, bleaching agents etc.,

CO5:explain the policies and regulations in consumer products

Board of Studies Date: 23.04.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">COORDINATION CHEMISTRY – II</td></tr>
<tr><td>Paper No.</td><td colspan="7">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">24PCHCC8</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="7">Basic knowledge of Inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To know the fundamental concepts and structural aspects of organometallic complexes.
To learn reactions and catalytic behaviour of organometallic complexes.
To analyse the spectral characteristics of selected complexes.
To predict the structure of coordination compounds using spectroscopic tools.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Chemistry of organometallic compounds:

Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Bonding in metal – olefin complexes (example: Ziese’s salt), metal-acetylene and metal-allyl complexes; Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes; fluxional isomerism.

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).

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="7">UNIT-II: Reactions and catalysis of organometallic compounds: Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction and metathesis reaction.
Organo-metallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerisation, water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Inorganic spectroscopy -I:
IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds.</td></tr>
</table>

	NMR spectroscopy- Introduction, applications of ^{1}H, ^{15}N, ^{19}F, ^{31}P-NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.
	UNIT-IV: Inorganic spectroscopy-II: Introductory terminologies: g and A parameters - definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets; ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$. Mossbauer spectroscopy – Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler shift, Isomer shift, quadrupole splitting and magnetic interactions. Applications of Mössbauer spectra to Fe and Sn compounds.
	UNIT-V:Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations. 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	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. Huheey J E, Keiter E A, Keiter R L & Medhi O K, *Inorganic Chemistry – Principles of Structure and Reactivity*, 4th ed., Pearson Education Inc., 2006. 2. Meissler G L & Tarr D A, *Inorganic Chemistry*, 3rd ed., Pearson Education Inc., 2008. 3. Bannerjea D, *Co-ordination Chemistry*, TATA Mcgraw Hill, 1993. 4. Gupta B D & Elias A K, *Basic Organometallic Chemistry: Concepts, Syntheses and Applications*, University Press, 2013. 5. Cotton F A, Wilkinson G, Murillo C A, Bochmann M, *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. Gütlich P, Bill E, & Trautwein A X, *Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications*, 1st ed., Springer-Verlag Berlin Heidelberg, 2011. 3. Douglas B, McDaniel D, & Alexander J, *Concepts and Models of Inorganic Chemistry*, 3rd ed., John Wiley, 1994. 4. Purcell K F, & Kotz J C, *Inorganic Chemistry;* Saunders: Philadelphia, 1976. 5. Drago R S, *PhysicaI Methods in Chemistry*; Saunders: Philadelphia, 1977.

Website and e-learning source	https://archive.nptel.ac.in/courses/104/101/104101100/
	https://www.youtube.com/watch?v=eCyTvhk4rLQ
	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
	//efaidnbmnnnibpcajpcglclefindmkaj/https://www.ias.ac.in/article/fulltext/jcsc/102/03/0379-0393
	//efaidnbmnnnibpcajpcglclefindmkaj/https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/11.inorganic_chemistry-iii/29._metal-metal_bonds_and_their_evidences/et/9108_et_et_29.pdf

Course Outcomes:

Students will be able to:

CO1: analyse and apply 18 and 16 electron rule & structure and bonding in olefin, allyl, cyclopentadienyl and carbonyl containing organometallic complexes.

CO2: assess the catalytic cycles of organometallic complexes.

CO3: identify the functional groups and structure of coordination complexes using spectroscopic tools such as IR and NMR.

CO4: explain the theory behind ESR & Mossbauer spectroscopy and predict the structure of coordination complexes.

CO5: examine and interpret the structure of molecules using PES and to assign the CD and ORD techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	S	S	S	M	S	M
CO 2	S	S	S	S	S	S	S	S	S	S
CO 3	S	S	S	S	S	S	S	S	S	S
CO 4	S	S	S	S	S	S	S	S	S	S
CO 5	S	S	S	S	S	S	S	S	S	S

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	2
CO2	3	3	3	3	3
CO3	3	3	3	3	3

CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	14	14
Weighted percentage of Course Contributionto POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 04.11.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSICAL CHEMISTRY-II</td></tr>
<tr><td>Paper No.</td><td colspan="7">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 rowspan="2">24PCHCC9</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td>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>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 physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">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 and, hybridization using the concepts of group theory.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Introduction

Introduction to quantum mechanics-black body radiation, photoelectric effect,Wave particle duality, Uncertainty principle, hydrogen spectrum. Need for quantum mechanics, Postulates of Quantum Mechanics, Schrodinger wave equation-Time independent and time dependent, wave function, properties of wave function. Normalized, Orthogonal, orthonormal, Eigen values, Eigen functions, Operators.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Quantum models

Particle in a box-1D, two dimensional and three-dimensional, degeneracy. Harmonic Oscillator-wave equation and solution, anharmonicity, force constant and its significance. Rigid Rotor-wave equation and solution, calculation of rotational constants and bond length of diatomic molecules.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Applications to Hydrogen and Poly electron atoms: Hydrogen atom and hydrogen like ions, Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions.Approximation methods –variation methods: trial wave function, variation integral and application to particle in 1D box. Perturbation method - first order applications. Hatreefock self-consistent field method, Hohenberg-Kohn theorem and Kohn-Sham equation, Helium atom-electron spin, Pauli's exclusion principle-symmetric and antisymmetric wave function and Slater determinant.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Group theory:
Groups, sub groups, symmetry elements, operations, classification-axial and non-axial. Point groups- C_n,C_{nh}, D_n, D_{nh}, D_{nd}, T_d and O_h. Matrix representation and classes of symmetry operations, Reducible, irreducible and direct product representation. The Great orthogonality theorem– irreducible-representation construction of character table for C_{2v}, C_{2h}, C_{3v} and D_{2h} point groups and reduction formula.</td></tr>
</table>

	UNIT-V: Applications of quantum and group theory: Molecular orbital theory and Heitler London (VB) Treatment for Hydrogen molecule and molecular ion; Use of linear variation function and LCAO methods. Electronic conjugated system:Huckel method to Ethylene, butadiene, cyclopropenyl, cyclo butadiene and Benzene. Applications of group theory to molecular vibrations, hybridisation and 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. Prasad R K, *Quantum Chemistry*, 4th ed., New Age International Publishers, New Delhi, 2010. 2. Cotton, F. A.*Chemical Applications of Group Theory*, 2nd ed, John Wiley & Sons, 2003. 3. Vincent, A *Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications*, ,2nd Ed, John and Willy & Sons Ltd, 2013. 4. Veera Reddy, K, *Symmetry and Spectroscopy of Molecules*, 2nd ed., New Age International Ltd., 2009. 5. Bhattacharya, P.K, *Group Theory and Its Chemical Applications*, 1st ed., Himalaya Publishing House, 1986. 6. Puri B. R., Sharma L. R., *Principles of Physical Chemistry*, 48th ed., Vishal Publishing Company, Jalandhar. 2023.
Reference Books	1. N. Levine, Quantum Chemistry, 4th Ed., Allyn& Bacon Inc, 1983, . 2. D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012. 3. Chandra, A.K., *Introduction to Quantum Chemistry*, 4th Ed., Tata McGraw Hill, 1994. 4. Gurudeep Raj, Ajay Bhagi, Vinod Jain, *Group theory and symmetry in Chemistry*, First Ed., Krishna Prakashan Media Ltd.,1998
Website and e-learning source	1. https://nptel.ac.in/courses/104101124 2. https://ipc.iisc.ac.in/~kls/teaching.html 3. https://onlinecourses.nptel.ac.in/noc21_cy16/preview 4. http://vallance.chem.ox.ac.uk/pdfs/SymmetryLectureNotes.pdf 5. https://vlab.amrita.edu/?sub=2 6. https://chem.libretexts.org

Course Outcomes

Students will be able to:

CO1: discuss the characteristics of wave functions and symmetry functions.

CO2: classify the symmetry operation and wave equations.

CO3: apply the concept of quantum mechanics and group theory to predict the electronic structure.

CO4: specify the appropriate irreducible representations for group theoretical applications.

CO5: develop skills in evaluating the symmetries of vibrational modes and hybridisation

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	M	S	M	M	S	S	M	M	M
CO 2	M	S	S	M	M	M	S	M	M	M
CO 3	S	S	S	M	S	S	S	M	M	M
CO 4	S	S	S	M	M	M	S	M	M	M
CO 5	S	S	S	M	S	M	S	M	M	M

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Board of Studies Date: 04.11.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">ANALYTICAL INSTRUMENTATION TECHNIQUE PRACTICAL(Industry Entrepreneurship)</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective VI</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">3</td><td rowspan="2">Course Code</td><td rowspan="2">24PCHDSECQ</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>-</td><td></td><td colspan="3">4</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7"></td></tr>
<tr><td>Objectives of thecourse</td><td colspan="7">To analyze different constituents through instrumental methods ofanalysis.
To evaluate different contaminants in materials using turbidimetry and conductivity measurements.
To analyze constituents in materials using absorption techniques.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I:
1. Conductometric titration of a mixture of HCl and CH_3COOH VsNaOH.
2. Conductometric titration of NH_4Cl Vs NaOH.
3. Conductometric titration of CH_3COONa Vs HCl.
4. Potentiometric titration of a mixture of HCl and CH_3COOH VsNaOH
5. Determination of pK_a of weak acid by EMF method.
6. Potentiometric titration of FAS Vs $K_2Cr_2O_7$
7. Potentiometric titration of KI Vs $KMnO_4$.
8. Potentiometric titration of a mixture of Chloride and Iodide Vs$AgNO_3$.
9. Determination of the pH of buffer solution by EMF methodusing Quinhydrone and Calomel electrode.
10. Determination of solubility, solubility product of AgX - half cell method, concentration method.
11. Study of the inversion of cane sugar in the presence of acid by Polarimetric method.
12. Determination of the optimized geometries, bond parameters, HOMO-LUMO energy gap, IR and Raman frequencies and its graphical representation for selected molecules
13. Compute the transition state for 4+2 cycloaddition and S_N2 reaction . Also compute the thermodynamic and kinetic parameters.
14. Compute NMR chemical shift for some molecules represent them as spectra and compare the chemical shift with the literature values.</td></tr>
</table>

	UNIT-II 1. Determination of spectrophotometrically the mole ratio of the ferrithiocyanate complex and equilibrium constant for the complex formation. 2. Determination of the amount (mol/L) of ferricyanide present inthe given solution using cyclic voltammetry. 3. Determination of the diffusion coefficient of ferricyanide using cyclic voltammetry. 4. Determination of the standard redox potential of ferri-ferrocyanide redox couple using cyclic voltammetry. 5. Estimation of the amount of sulphate present in the given solution using Nephelometric turbidimeter. 6. Estimation of the amount of nitrate present in the given solutionusing spectrophotometric method. 7. Heavy metal analysis in textiles and textile dyes by AAS 8. Determination of caffeine in soft drinks by HPLC 9. Analysis of water quality through COD, DO, BOD measurements. 10. Assay of Riboflavin and Iron in tablet formulations by spectrophotometry 11. Estimation of chromium in steel sample by spectrophotometry 12. Determination of Stern-Volmer constant of Iodine quenching by fluorimetry 13. Determination of ascorbic acid in real samples using DifferentialPulse Voltammetry and comparing with specifications 14. Separation of (a) mixture of Azo dyes by TLC (b) mixture ofmetal ions by Paper chromatography 15. Estimation of chlorophyll in leaves and phosphate in waste water by colorimetry
	UNIT-III: Interpretation and identification of the given spectra of various organic compounds arrived at from the following instruments 1. UV-visible 2. IR 3 Raman 4. NMR 5.ESR 6.Mass etc.,
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommen dedText	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. J. D. Woollins, *Inorganic Experiments*; VCH: Weinheim,1995. 4. B. Viswanathan and P.S.Raghavan, *Practical Physical Chemistry*,Viva Books, New Delhi,2009. 5. Sundaram, Krishnan, Raghavan, *Practical Chemistry (Part II)*, S. Viswanathan Co. Pvt., 1996.
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, E*xperiments 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 3. www.arguslab.com 4. www.Gaussian.com

Course Outcomes :

Students will be able to:

CO1: recall the principles associated with various physical chemistry experiments

CO2: scientifically plan and perform all the experiments both in laboratory and in computers

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 forsocietal developments.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Board of Studies Date: 04.11.2024

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY FOR ADVANCED RESEARCH STUDIES</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Professional Competency Skill Course</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">24PCHPCSQ</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></td><td>2</td><td colspan="3">2</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To provide an introductory training to begin a Chemistry research</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT I
Chemistry Research - Broad areas of research - an overview ; Research Methods - Experimental and Computational Methods; types of research-fundamental and applied research, interdisciplinary and trans disciplinary research-case studies of researches.

UNIT II
Sources of Chemical information-Primary, secondary and tertiary; Tools for Data collection and referencing, indexing-Citation index, impact factor, H index-Chemspider, Chemdoodle, Mendely, Pubchem, CSD, PDB, Crystallography open database, e-EROS (Encyclopedia of reagents for organic synthesis).

UNIT III
Techniques for research article writing-Structure and organisation of a thesis/research paper-First draft, revising the drafts and fine tuning a research paper.
Research ethics and quality-plagiarism- tools to detect plagiarism-IPR as relevant to research.
UNIT IV
Data Analysis- Interpretation of chemical data and spectra - UV, IR, NMR and Mass spectra.

UNIT V
AI tool for Chemistry research-chemistry assistant, chemintelligence, chemical.ai</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Conversant with the tools and techniques relating to research in Chemistry</td></tr>
<tr><td>References</td><td colspan="7">References:
1. H, D. Brynn, Data Analysis for Chemistry: An Introductory Guide for Students and Laboratory Scientists, 1st Ed., Oxford University press, 2006.
2. R M. Silverstein, F.X. Webster, D.Kiemle, Spectrometric Identification of Organic Compounds, 7th Ed., Wiley, 2005.
3. B. Robert and J P. Schaefer, Research Techniques in Organic Chemistry, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1971.</td></tr>
</table>

Websites	1. https://guides.lib.uci.edu/c.php?g=333122&p=2247810 2. https://www.acs.org/careers/chemical-sciences/areas.html 3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/chemical-method 4. https://www.chemspider.com/AdvancedSearch 5. https://web.chemdoodle.com/ 6. https://cds.dl.ac.uk/ 7. https://onlinelibrary.wiley.com/doi/10.1002/047084289X.ra001 8. https://chem.libretexts.org/Courses/Athabasca_University/Chemistry_350%3A_Organic_Chemistry_I/12%3A_Structure_Determination-_Mass_Spectrometry_and_Infrared_Spectroscopy/12.02%3A_Interpreting_Mass_Spectra 9. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Nuclear_Magnetic_Resonance/NMR%3A_Experimental/NMR_-_Interpretation 10. https://www.sciencedirect.com/science/article/pii/S2949747724000332 11. https://www.hyperwriteai.com/aitools/chemistry-assistant 12. https://www.chemicalai.cn/ 13. https://libguides.library.cityu.edu.hk/researchmethods/ethics#:~:text=Research%20ethics%20provides%20guidelines%20for%20the%20responsible,Honestly%20report%20data%2C%20results%2C%20methods%20and%20procedures%2C

Course Outcomes:

Students will be able to:

CO1: describe the fundamentals and scope for chemistry research

CO2: plan, utilize the various sources of the research work and analyse the results

CO3: draft a model research proposal

CO4: interpret the spectra of chemical molecules

CO5: employ various AI based tools and other tools for data collection

CO-PO Mapping (Course Articulation Matrix)

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CO 2	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 3	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO 4	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**M**	**S**
CO 5	**M**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium

Level of Correlation between PSO's and CO's

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CO4	3	3	3	3	3
CO5	3	3	3	3	3
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Weighted percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium

Board of Studies Date: 04.11.2024