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. **PSO 5 – 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: 91+ Extra Credits (Maximum-16)

FIRST SEMESTER

Course	Course Title	Code	Hours per week	Credits
Core Course–I	Organic Reaction Mechanism-I	23PCHCC1	7	5
Core Course –II	Structure and Bonding in Inorganic Compounds	23PCHCC2	7	5
Core Course III :	Organic Chemistry Practical	23PCHCCQ1	6	4
Elective – I	Nanomaterials and Nanotechnology/ Pharmaceutical Chemistry	23PCHDSEC1A/ 23PCHDSEC1B	5	3
Elective –II	Molecular Spectroscopy/ Electrochemistry	23PCHDSEC2A/ 23PCHDSEC2B	5	3
	Total		**30**	**20**
Extra Skills	•Value Education •Physical Fitness Practice •Productive Preparation for CSIR – UGC NET/SET/JRF – I (23PCHSC1) (Self Study – 1 Extra Credit)	23PCHSC1		
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	23PCHCC3	5	5
Core Course –V	Physical Chemistry-I	23PCHCC4	5	5
Core Course VI :	Inorganic Chemistry Practical	23PCHCCQ2	6	4
Elective – III	Cheminformatics/ Green Chemistry	23PCHDSEC3A/ 23PCHDSEC3B	4	3
Elective –IV	Bioinorganic Chemistry/ Material Science	23PCHDSEC4A/ 23PCHDSEC4B	4	3
Extradisciplinary course	Therapeutical Chemistry	23PCHEDC	4	2
Common subject	Human Rights	23PHRSC	2	1
	Total		**30**	**23**
Extra Skills	• Value Education • Physical Fitness Practice • Productive Preparation for CSIR – UGC NET/SET/JRF/TRB Competitive examinations– II (23PCHSC2) (Self Study –1 Extra Credit)	23PCHSC2		
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.**

<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 rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23PCHCC1</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></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="4">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>
<tr><td colspan="7">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.</td></tr>
<tr><td colspan="7">UNIT-IV: Stereochemistry-I: Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical</td></tr>
</table>

	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="8">STRUCTURE AND BONDING IN INORGANIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="8">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 colspan="2" rowspan="2">23PCHCC2</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 colspan="2">Total</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2">-</td><td colspan="2">7</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic concepts of Inorganic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• 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="8">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>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td>23PCHCCQ1</td></tr>
<tr><td></td><td></td><td>Semester</td><td>I</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">6</td><td>6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To 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>
<tr><td>Extended Professional Component (is a part of</td><td colspan="7">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)</td></tr>
</table>

internal 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">23PCHDSEC1A</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>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>Objectives the 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 by new technologies.
• To design synthetic routes for synthetically used new nano materials.</td></tr>
<tr><td>Course Outline</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="8">PHARMACEUTICAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="8">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 colspan="2" rowspan="2">23PCHDSEC1B</td></tr>
<tr><td>Semester</td><td>I</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>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge on drugs and doses</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">To understand the advanced concepts of pharmaceutical chemistry.
To recall the principle and biological functions of various drugs.
To train the students to know the importance as well the consequences of various drugs.
To have knowledge on the various analysis and techniques.
To familiarize on the drug dosage and its structural activities.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="8">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 andnon-Newtonian system.</td></tr>
<tr><td colspan="8">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="8">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>
<tr><td colspan="8">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,</td></tr>
</table>

	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="7">MOLECULAR SPECTROSCOPY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective II</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>23PCHDSEC2A</td></tr>
<tr><td></td><td></td><td>Semester</td><td>I</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td colspan="2">4</td><td colspan="2">1</td><td colspan="2">-</td><td>5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of spectroscopy</td></tr>
<tr><td>Objectives ofthe course</td><td colspan="7">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="7">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.

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.
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 influencing</td></tr>
</table>

	chemical 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 and inorganic 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>Credits</td><td>3</td><td>Course Code</td><td>23PCHDSEC2B</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="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="4">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>
<tr><td colspan="7">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</td></tr>
</table>

	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>23PCHCC3</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>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.
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.
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</td></tr>
</table>

	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>Credits</td><td>5</td><td>Course Code</td><td>23PCHCC4</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>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></td><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></td><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>
<tr><td></td><td colspan="7">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,</td></tr>
</table>

	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">23PCHCCQ2</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 analytical tool for the quantitative estimation of ions.
● To recall the principle and theory in preparing standard solutions.
● To train the students for improving their skill in estimating the amount of ion present in the solution.
● To estimate metal ions, present in the given solution accurately without using instruments.
● To determine the amount of ions, present in a binary mixture accurately.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="8">UNIT – I 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 component only, Not to be included in the external examination question paper)</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>

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 radicals and 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">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">23PCHDSEC3A</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>4</td><td>-</td><td colspan="2">-</td><td colspan="3">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.
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 portal</td></tr>
</table>

	computational resources for drug discovery- a thorough surfing of the web page-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 rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23PCHDSEC3B</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>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 rowspan="5">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 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 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 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 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>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination</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>
</table>

question paper)	
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="8">BIOINORGANIC CHEMISTRY</td></tr>
<tr><td>Course No.</td><td colspan="8">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 colspan="2" rowspan="2">23PCHDSEC4A</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>3</td><td>1</td><td colspan="3">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="8">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">● 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 rowspan="5">Course Outline</td><td colspan="8">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 colspan="8">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 colspan="8">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 colspan="8">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 colspan="8">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>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external</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>

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 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">23PCHDSEC4B</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 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 rowspan="5">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 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 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>
<tr><td colspan="7">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 $LiNbO_3$.</td></tr>
<tr><td colspan="7">UNIT – V 12 Hours</td></tr>
</table>

	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 Crystallography*, 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</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">23PCHEDC</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>
<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. 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>23PHRSC</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>
<tr><td>Recommended Text</td><td colspan="7">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.</td></tr>
</table>