THIRUVALLUVAR UNIVERSITY

VELLORE – 632 115

DEPARTMENT OF CHEMISTRY

MASTER OF SCIENCE IN CHEMISTRY

[Under Choice Based Credit System (CBCS)]

w.e.f the academic year 2023-24

SYLLABUS AND REGULATIONS
FOR UNIVERSITY DEPARTMENT

ABOUT THE DEPARTMENT

The department of chemistry was established in 2002 as post-graduate and research department. The full fledged department was started during academic year 2010-11. The department is offering the M.Sc., M.Phil. and Ph.D courses. The department consists of 6 faculty members, 1 administrative staff, 32 research scholars and 52 PG students. The faculty members have been working on the modern and thrust areas in chemistry with financial support from various national funding agencies such as DST, DRDO, BRNS, UGC etc., and continued to publish quality research papers in both national and international journals.

VISION AND MISSION

Statement of Vision

Chemistry provides immense scope for study, research andgainful employment in various sectors. The Department of Chemistry of Thiruvalluvar University is determined to educate and graduate rural students. The department is committed to prepare, compete in and contribute to the needs of modern chemical science based industries and academia. To achieve this vision, the department is dedicated to provide a course of study for post-graduate in chemistry which combines curriculum and research oriented project that are high-quality, innovative and intellectually challenging.

Statement of Mission

The mission of the Department of Chemistry of Thiruvalluvar University is to advance the chemical sciences through the education of post-graduate students in rural society by providing them with quality classroom learning and research opportunities. The department is committed to impart a high standard for excellence in all branches of chemistry by innovative and dedicated teaching at post-graduate level to produce students with good knowledge in chemistry.

THIRUVALLUVAR UNIVERSITY

Department of Chemistry

M.Sc., Chemistry (University Department)
UNDER CBCS (With effect from 2023-24)

The course of study and scheme of examinations

1.TITLE: M.Sc., Chemistry

2.YEAR OF IMPLIMENTATION: July 2023 onwards

3.COURSE DETAILS:

Total No. of Semesters	– 04 (Two semesters per year)
No. of theory papers per semester	– 04/05
No. of practical courses per semester	– 02 (upto II semester)
Total No. of Practicals	– 06
Project	– IV semester

4.PREAMBLE OF THE SYLLABUS:

Master of Science (M.Sc.) in Chemistry is a post graduation course of Thiruvalluvar University. The curriculum is prepared by following the prospectus of various national and international universities. The board of studies revised the syllabus of M.Sc.,Chemistry in 2018 and the new revised syllabus covers broad area of fundamental aspects in modern chemistry.

The syllabi are all set to meet the standard of CSIR-UGC-NET,GATE and SLET examinations. The credit system to be implemented through this curriculum would allow students to develop a strong footing in the fundamentals and specialize in the disciplines of his/her liking and abilities. The students pursuing this course would have to develop in-depth understanding of various aspects of chemistry. The conceptual understanding, development of experimental skills, designing and implementation of novel synthetic methods, developing the aptitude for academic and professional skills, acquiring basic concepts for structural elucidation with hyphenated techniques, understanding the fundamental biological processes and rationale towards computer. The project introduced in the curriculum will motivate the students to pursue the research and find a job in reputed pharmaceutical and other industries including abroad.

5. REQUIREMENT TO APPEAR FOR THE EXAMINATION

(i) Minimum 75% attendance required for both theory and practical examinations.
(ii) Attendance of less than 75% but 65% and above has to pay the condonation fee prescribed by the university.
(iii) Attendance less than 65% but 55% and above has to compensate the shortage of attendance in the subsequent semester (in the next year).
(iv) Attendance less that 55% has to rejoin / redo the semester.
(v) In the case of married woman, the minimum attendance should not be less than 55%.

6. PATTERN OF EXAMINATION

Evaluation of Students:
1. All Semester examinations both theory and practical will be of 100 marks each.
2. Student has to obtain 50% marks in all the examinations (both theory and practicals).

7.FEE STRUCTURE: As per Thiruvalluvar University norms

8.ELGIBILITY FOR ADMISSION

A candidate who has passed the B.Sc., degree examination with Chemistry as the main subject of study of this university or an examination of any other university accepted by the syndicate as equivalent thereto shall be eligible for admission to the M.Sc., degree in chemistry in the university department.

9. MEDIUM OF INSTRUCTION: English.

10.SCHEME OF EXAMINATION

• The semester examination will be conducted at the end of each semester (Both theory & practical examination), for odd semesters in the month of November/December; for even semester in April/May. All theory examination is conducted for 3 hours irrespective of total marks. However, duration of practical examinations is 6 hours.
• **Theory paper** will be of 75 marks each for university examination and 25 marks for internal evaluation.

- **Theory question pattern**

Section-A 10×2 = 20 marks
Section-B 5×5 = 25 marks (200 words; Either or type)
Section-C 3×10 = 30 marks (500 words; 3 out of 5)
Total = 75 marks

The question papers will be set by the internal and the scrutiny of the question paper will be done by external. Evaluation of answer scripts will be done by internal.

- **Internal Assessment**

Test	: 10 marks (best 2 out of 3)
Assignment	: 10 Marks
Seminar	: 05 Marks
Total	**: 25 marks**

There shall be tutorial / practical / surprise test / home assignment / referencing of research papers / seminar / industrial visit / training course as a part of internal assessment in each semester. The students are supposed to attend all the tests. The students should note that re-test will not be given to the student absent for the test/s.

- **Practical examination** will be of 75 marks each for university examination and 25 marks for internal evaluation.

Distribution of marks for practical examinations

University Examination Experiment : 75 Marks

Procedure	: 5 marks
Experiment	: 30 marks
Interpretation	: 10 marks
Result	: 10marks)
Practical viva-voce	: 10 marks
Record	: 10 Marks
Total	**: 75 marks**

Practical Internal Assessment

Number of Experiments	: 10 marks
Performance	: 10 Marks
Test	: 5 Marks
Total	**: 25 marks**

Passing Minimum in practical examinations

IA	: 12 Marks (50 %)
UE	: 38 Marks (50 %)
Total	**: 50 Marks**

All the practical examinations will be conducted for 6 hours only i.e. 10 AM – 4PM by both the internal examiners.

• For the project report

Report	: 75 marks
Viva-voce	: 25 marks
Total	**: 100 Marks**

Distribution of marks for project report (Total of 100 marks)

Project will be evaluated by the concerned project guide along with a member nominated by the Head of the Department.
Assessment will be done by the departmental committee every month. Evaluation will be on the basis of monthly progress of project work, progress report, referencing, oral, results and documentation.

Project - 75 marks
(Dissertation Format – 10 marks; Scope of the research problem – 20 marks; Methodology – 20 marks; Analysis – 10 marks, Results and findings-15 marks)

Viva-Voce examination – 25 marks
(Presentation – 10 marks; subject knowledge – 10 marks; Interaction – 5 marks)

11. Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

12. STANDARD OF PASSING
A candidate should get not less than 50% in the university examination, compulsorily, in all papers, including practicals. Also, the candidate who secures not less than 50% marks in the UE and IA examinations put together in any theory paper/practical shall be declared to have successfully passed the examination.

- Internal marks will not change. Student cannot repeat internal assessment. If student misses internal assessment examination, s/he will have to score passing minimum in the external examinations only.

Illustration: Theory – Internal Assessment -12 marks and University Examination-38 marks

OR

Internal Assessment-0 marks and University Examinaiton-50 marks.

- There shall be revaluation of answer script of end semester examination, but not of internal assessment papers.
- Internal assessment answer scripts may be shown to the concerned student but not end semester answer script.

- A candidateshall be declared to have passed the whole examination if the candidate passes in all theory and practical by earning 94 credits in core and elective subjects.

13. TRANSITORY PROVISION

This curriculum is valid for three years only (2018-19 to 2020-21), as per UGC norms. Hence, candidates who have undergone M.Sc., Chemistry course in the University department will be permitted to re-appear for next two consecutive years only. After that, he/she has to re-appear for the examinations under new curriculum, regulations, which are in force at that time.

CONTENTS

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	M. Sc., Chemistry
Programme Code	
Duration	**PG – 2YEARS**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society**

	Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **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 HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Template for P.G., Programmes

Semester–I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester–IV	Credit	Hours
1.1. Core-I Organic	4	6	2.1. Core-V Organic	4	4	3.1. Core-IX Organic	5	6	4.1. Core-XIII Inorganic	4	6
1.2 Core-II Inorganic	4	6	2.2 Core-VI Physical	4	4	3.2 Core-X Inorganic	5	6	4.2 Core-XIV Physical	4	6
1.3 Core – III Organic chemistry practical-1	3	4	2.3 Core – VII Inorganic chemistry practical-2	3	4	3.3 Core – XI Analytical chemistry practical-1	4	4	4.3 Core – XV Project with viva voce	9	10
1.4 Core –IV Inorganic chemistry practical-1	3	4	2.4 Core – VIII Physical chemistry practical-1	3	4	3.4 Core XII Organic chemistry practical-2	4	5	4.4 Elective VI (Industry / Entrepreneurship) 20% theory 80% practical	3	4
1.5 Discipline Centric Elective –I Green Chemistry **or** Pharmaceutical Chemistry	3	5	2.5 Discipline Centric Elective – III Molecular spectroscopy **or** Pharmacognosy and Phytochemistry	3	4	3.5 Discipline Centric Elective - V Electrochemistry, Photochemistry & Instrumentation **or** Chemistry of Natural Products	4	5	4.5 Skill Enhancement course / Professional Competency Skill VAC: Chemistry for Life	2	2
1.6 Generic Elective-II: Nanomaterials & Technology **or** Biomolecules	3	5	2.6 Generic Elective -IV: Bioinorganic and Medicinal Chemistry **or**	3	4	3.6 Internship/ Industrial Activity	2	2	4.6 Extension Activity - USSR	1	2

and Heterocyclic compounds			Material Science								
			2.7. Skill Enhancement – I (from group G) Cosmetic Chemistry	2	2	3.7 Skill Enhancement - II (from group G) Industrial Chemistry	2	2			
			2.8 Human Rights	2	2						
			2.9 MOOC	2	2						
	20	**30**		**26**	**30**		**26**	**30**		**23**	**30**
Total Credit Points -95											

Illustration–I

ElectiveCourses

Courses are grouped (GroupA to GroupF) so as to include topics from Pure Chemistry (PC), Applied Chemistry (AC) and Industrial Components(IC) like pharmaceutical industries, Polymer lab courses for flexibility of choice by the stake holders / institutions.

Semester I: Elective1 and Elective 2

Elective I to be chosen from Group A and **Elective II** to be chosen from GroupB

Group A: (PC/AC/IC)

1. Biomolecules and Heterocyclic compounds
2. Nanomaterials and Nanotechnology

Group B:(PC/AC/IC)

1. Pharmaceutical Chemistry
2. Green Chemistry

Semester II: Elective III & Elective IV

Elective III to be chosen from **Group C** and **Elective IV** to be chosen from **Group D,**

Group C:**(PC/AC/IC)**

1. Pharmacognosy and Phytochemistry
2. Molecular Spectrosopscopy

Group D: (PC/AC/IC)

1. Bioinorganic and MedicinalChemistry
2. Material Science

Semester III: Elective V

Elective V to be chosen from GroupE.

Group E:(PC/AC/IC)

1. Chemistry of Natural Products

2. Electrochemistry, Photochemistry and Instrumentation

Semester IV: Elective VI

ElectiveVIto be chosen fromGroupF.

Group F: (PC/AC/IC)

1. Green Chemistry

2. Industry / entrepreneurship : 20% theory, 80% practical

Skill Enhancement Courses

Skill Enhancement Courses are chosen to keep in pace with the latest developments inthe academic / industrial front and provides flexibility of choice by the stakeholders /institutions.

Group G (Skill Enhancement Courses) SEC:(Practical based paper)

- Computational Chemistry
- 3D printing in Chemistry
- Preparation of Consumer products
- Chemistry in everyday life
- Cosmetic Chemistry
- Origin lab
- Industrial Chemistry
- Research Tools and Techniques

Ability Enhancement Courses

- SoftSkillcourses

Extra-Disciplinary Courses for other Departments (not for Mathematics students)

Students from other Departments may also choose any one of the following as Extra Disciplinary Course.

ED-I: Chemistry for Life Sciences

ED-II:Chemical

conservation

ED-III: Chemistry in food

preservation

ED-IV: Chemistry for Social studies

ED-V: Chemistry in consumer products

2. Instructions for Course Transaction

Courses	Lecture Hrs	Tutorial hrs	LabPractice	Total hrs
Core	75	15	--	90
Electives	75	15	--	90
ED	75	15	--	90
LabPracticeCourses	-	15	75	90
Project	20	--	70	90

3. Testing

Pattern

(25+75)

13.1 Internal Assessment

Theory Course: For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25marks.The duration of each test shall be one/one and a half hour.

Computer Laboratory Courses: For Computer Laboratory Oriented Courses, there shall be two tests in Theory part and two tests in Laboratory part. Choose one best from Theory part and other best from the two Laboratory part. The average of the best two can be treated as the CIA for a maximum of 25 marks. The duration of each test shall be one/one and a half hour. There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

14. Different Types of Courses

(i) Core Courses (Illustrative)

1. Organic Reaction mechanism I & II
2. Structure and bonding in Inorganic compounds
3. Organic Chemistry Practical
4. Physical Chemistry-I & II
5. Inorganic Chemistry Practical
6. Organic synthesis and Photochemistry
7. Coordination Chemistry-I & II
8. Physical Chemistry Practical
9. Analytical Instrumentation technique practical

(ii) Elective Courses (ED within the Department Experts) (Illustrative)

1. Pharmaceutical Chemistry
2. Nanomaterials and Nanotechnology
3. Electrochemistry
4. Molecular Spectroscopy
5. Medicinal Chemistry
6. Green Chemistry
7. Pharmacognosy and Phytochemistry
8. Biomolecules and Heterocyclic compounds
9. Bio inorganic Chemistry
10. Material Science
11. Chemistry of Natural products
12. Polymer chemistry

(iii) Elective Courses (ED from other Department Experts)

(iv) Skill Development Courses

(v) Institution-Industry-Interaction (Industry aligned Courses)

Programmes /course work/field study/Modelling the Industry Problem/Statistical Analysis/Commerce-Industry related problems/MoU with Industry and the like activities.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE EDUCATION	
Programme	**M.Sc.**
Programme Code	
Duration	**2 years for PG**
Programme Outcomes (Pos)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **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 HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Semester 1

1.1

Title of the Course	**ORGANIC REACTION MECHANISM - I**						
Paper No.	**Core I**						
Category	**Core**	**Year**	I	**Credits**	5	**Course Code**	
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	Basic concepts of organic chemistry						
Objectives of the course	To understand the feasibility and the mechanism of various organic reactions. To comprehend the techniques in the determination of reaction mechanisms. To understand the concept of stereochemistry involved in organic compounds. To correlate and appreciate the differences involved in the various types of organic reaction mechanisms. To design feasible synthetic routes for the preparation of organic compounds.						
Course Outline	**UNIT-I: Methods of Determination of Reaction Mechanism and Aromaticity:** 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. Hammett and Taft equations. Aromaticity: Hückel's 4n + 2 Rule, Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Cyclopropenyl, Cyclobutadiene and cyclooctatetraene. systems. Fulvenes and Related Systems. Ions-Cations, Anions- Cross-conjugated Polycyclic Systems: Pentalenes, Heptalenes, Azulenes.						
	UNIT-II:Aromatic and Aliphatic Electrophilic Substitution: 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.						
	UNIT-III: **Aromatic and Aliphatic Nucleophilic Substitution:**Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of Substrate, leaving group and attackingnucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer reaction, von Richter, Sommelet- Hauser and Smiles rearrangements. Aliphatic Nucleophilic Substitution: S_N1, S_N2 and						

	$S_N$imechanisms and evidences. Factors affecting Aliphatic Nucleophilic Substitution, Aliphatic nucleophilic substitutions at an allylic carbon, vinyl carbon, bridgehead and trigonal carbons, Non-classical carbocation, Ambident nucleophiles, Neighbouring Group Participation.
	UNIT-IV:Stereochemistry-I: Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicityandprostereoisomerism, 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, cyclohexane, cyclohexanone, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle.Stability of five and six-membered rings: mono-, di- and polysubstitutedcyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic: 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.
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 edition, 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 edition, 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 edition, Oxford University Press, 2014.
Reference Books	1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, 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 edition, 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 Learning Outcomes (for Mapping with POs and PSOs)

Students will be able

CLO1: To recall the basic principles of organic chemistry.

CLO2: To understand the formation and detection of reaction intermediates of organicreactions.

CLO3: To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.

CLO4: To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.

CLO5:To design and synthesize new organic compounds by correlating the stereochemistryof organic compounds.

CO-PO Mapping (Course Articulation Matrix)

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

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

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	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

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions.	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview.	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain.	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge.	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons.	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations.	

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.
The S, M, L is based on the course outcome. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your course outcome.

- Remember and Understanding – Lower level
- Apply and Analyze – Medium Level
- Evaluate and Create – Strong Level

1.2

<table>
<tr><td>Title of the Course</td><td colspan="7">STRUCTURE AND BONDING IN INORGANIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td>Course Code</td><td></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>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Inorganic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To determine the structural properties of main group compounds and clusters.
To gain fundamental knowledge on the structural aspects of ionic crystals.
To familiarize various diffraction and microscopic techniques.
To study the effect of point defects and line defects in ionic crystals.
To evaluate the structural aspects of solids.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I:Structure of main group compounds and clusters: VB theory – Effect of lone pair and electronegativity of atoms (Bent’s rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade’s rule to predict the structure of borane cluster; main group clusters –zintl ions and mno rule.</td></tr>
<tr><td></td><td colspan="7">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.</td></tr>
<tr><td></td><td colspan="7">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.</td></tr>
<tr><td></td><td colspan="7">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,</td></tr>
</table>

	instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.
	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 a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014. 2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001. 3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012. 4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977. 5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.
Reference Books	1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994. 2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013. 3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199. 4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982. 5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.
Website and e-learning source	https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/
Course Learning Outcomes (for Mapping with POs and PSOs)	

Students will be able

CO1: Predict the geometry 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: Understand the various types of ionic crystal systems and analyze their structural features.
CO4: Explain the crystal growth methods.
CO5:To understand the principles of diffraction techniques and microscopic techniques.

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

1.3

<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 III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td></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>1</td><td colspan="3">3</td><td colspan="2">4</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 preparation of organiccompounds.
To develop analytical skill in the handling of chemical reagents for separation of binary and ternaryorganic mixtures.
To analyze the separated organic components systematically and derivatize them suitably.
To construct suitable experimental setup for the organic preparations involving two stages.
To experiment different purification and drying techniques for the compound processing.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Separation and analysis:
Two component mixtures.</td></tr>
<tr><td colspan="7">UNIT-II:

Three component mixtures.</td></tr>
<tr><td colspan="7">UNIT-III: Single stage preparations:
a) Preparation of p-benzoquinone from hydroquinone
b) p-Nitrobenzoic acid from p-nitrotoluene
c) Preparation of 4,6-dimethyl coumarin
d) Benzhydrol from benzophenone
e) Preparation of 2,5-di-t-butylhydroquinone
f) 1,2,3,4 - Tetrahydrocarbazole from cyclohexanone
g) Preparation of dibenzylidene acetone
h) 2,3 - Dimethylindole from phenyl hydrazine and 2 - butanone</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. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014. 2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001. 3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
Reference Books	1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994. 2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013. 3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.
Website and e-learning source	https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

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

CO1: To recall the basic principles of organic separation, qualitative analysis and preparation.
CO2: To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.
CO3: To determine the characteristics of separation of organic compounds by variouschemical reactions.
CO4: To develop strategies to separate, analyze and prepare organic compounds.
CO5:To formulate a method of separation, analysis of organic mixtures and design suitableprocedure 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	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

1.4

Title of the Course	**INORGANIC CHEMISTRY PRACTICAL**						
Paper No.	**Core IV**						
Category	**Core**	**Year**	I	**Credits**	4	**Course Code**	
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	-	1	3			4	
Prerequisites	**Basic principles of gravimetric and qualitative analysis**						
Objectives of the course	To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions. To recall the principle and theory in preparing standard solutions. To train the students for improving their skill in estimating the amount of ion accurately present in the solution To estimate metal ions, present in the given solution accurately without using instruments.						

	To determinetheamount of ions, present in a binary mixture accurately.
Course Outline	**UNIT-I: Analysis of mixture of cations:**Analysis of a mixture of four cations containing two common cations and two rare cations.Cations to be tested. Group-I : W, Tl and Pb. Group-II : Se, Te, Mo, Cu, Bi and Cd. Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U. Group-IV : Zn, Ni, Co and Mn. Group-V : Ca, Ba and Sr. Group-VI : Li and Mg.
	UNIT-II: Preparation of metal complexes: Preparation of inorganic complexes: a)Preparation of tristhioureacopper(I)sulphate b)Preparation of potassium trioxalate chromate(III) c)Preparation of tetramminecopper(II) sulphate d)Preparation of Reineck's salt
	UNIT-III: Complexometric Titration: a) Estimation of zinc, nickel, magnesium, and calcium. b) Estimation of mixture of metal ions-pH control, masking and demasking agents.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021. 2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rded.,The National Publishing Company, Chennai, 1974. 3. *Vogel's Text book of Inorganic Qualitative Analysis,* 4thed., ELBS, London.
Reference Books	1. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965. 2. W. G. Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To identify the anions and cations present in a mixture of salts.

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

CO3: To acquire the qualitative analytical skills by selecting suitable confirmatory tests andspot tests.

CO4: To choose the appropriate chemical reagents for the detection of anions and cations.

CO5:To synthesize coordination compounds 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**	**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

1.5

Title of the Course	**GREEN CHEMISTRY**						
Paper No.	**Elective I**						
Category	**Elective**	**Year**	I	**Credits**	3	**Course Code**	
		Semester	I				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	4	1	-			5	
Prerequisites	**Basic knowledge of general chemistry**						
Objectives of the course	To discuss the principles of green chemistry. To propose green solutions for chemical energy storage and conversion. Propose green solutions for industrial production of Petroleum and Petrochemicals. Propose solutions for pollution prevention in Industrial chemical and fuel production,Automotive industry and Shipping industries. Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.						
Course Outline	**UNIT-I:** 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.						
	UNIT-II: 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.
	UNIT-III: Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.
	UNIT-IV: Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.
	UNIT-V: Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005. 2. W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7thedition, McGraw-Hill, NewDelhi,2005. 3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall,1974. 4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi,2001. 5. A. K. De, Environmental Chemistry, New Age Publications, 2017.
Reference Books	1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001 3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000 4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002. 5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.
Website and	2. https://www.organic-chemistry.org/

e-learning source	3. https://www.studyorgo.com/summary.php

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

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

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

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

CO4: To apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organicsynthesis.

CO5: To 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

1.6

<table>
<tr><td>Title of the Course</td><td colspan="7">NANO MATERIALS AND NANO TECHNOLOGY</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></td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of crystallography and material science</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the concept of nano materials and nano technology.
To understand the various types of nano materials and their properties.
To understand the applications of synthetically important nano materials.
To correlate the characteristics of various nano materials synthesized by new technologies.
To design synthetic routes for synthetically used new nano materials.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="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.</td></tr>
<tr><td colspan="7">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, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.</td></tr>
<tr><td colspan="7">UNIT-III:Mechanical properties of materials, theories relevant to mechanical properties.Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterialsNanoparticles: gold and silver, metal oxides: silica, iron oxide andalumina - synthesisandproperties.</td></tr>
<tr><td colspan="7">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</td></tr>
</table>

	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-shellnanoparticles-types,synthesis,andproperties.Nanocomposites-metal-,ceramic-andpolymer-matrixcomposites-applications. Characterization–SEM, TEM and AFM- principle,instrumentationand applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Reference Books	1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP Publishers, 2016. 2. Arumugam, Materials Science, Anuradha Publications,2007. 3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010 4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012. 5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
Website and e-learning source	1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: **CO1**: To explain methods of fabricating nanostructures. **CO2**: To relate the unique properties of nanomaterials to reduce dimensionality of the	

material.
CO3: To describe tools for properties of nanostructures.
CO4: To discuss applications of nanomaterials.
CO5:To understand 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**	**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

Semester 2

2.1

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC REACTION MECHANISM-II</td></tr>
<tr><td>Paper No.</td><td colspan="7">CoreV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</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>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
To understand the mechanism involved in various types of organic reactions with evidences.
To understand the applications of synthetically important reagents.
To correlate the reactivity between aliphatic and aromatic compounds.
To design synthetic routes for synthetically used organic reactions.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: 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.Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.</td></tr>
<tr><td colspan="7">UNIT-II: Oxidation and Reduction Reactions: Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine: PCC and PDC. DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide-dicyclohexyl carbodiimide (DMSO-DCC). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides. Homogeneous hydrogenation, MPV and Bouveault-Blanc reduction.</td></tr>
<tr><td colspan="7">UNIT-III: Rearrangements: Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and</td></tr>
</table>

	stereochemistry, Wagner-Meerwein, Dienone-phenol, Baker-Venkataraman and Wolff rearrangements.Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation.Rearrangements to electron rich atom: Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements.
	UNIT-IV: Addition to Carbon Multiple Bonds: Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, halogens, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, Oxymercuration-Reduction Hydroboration-Oxidation, Addition to conjugated diene, Michael reaction (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, Addition of Grignard reagents to aldehydes, ketones, acids, esters and nitrites. Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions. organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Darzens Glycedic Ester condensation, Stobbe reaction, Benzoin condensation.
	UNIT-V: Reagents and Modern Synthetic Reactions: Lithium diisopropylamide (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dicyclohexycarbodiimide (DCC), Dimethyl aminiopyridine (DMAP), n-Bu_3SnH, Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB). Diazomethane and Zn-Cu. Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction. Robinson annulation, Stork-enamine reaction, Biginelli reaction.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed., John-Wiley and Sons.2001.

	2. E. S. Gould, *Mechanism and Structure in Organic Chemistry,* Holt, Rinehart and Winston Inc.,1959. 3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8th edn, New Age International Publishers,2015. 4. P. Y.Bruice, *Organic Chemistry*, 7th edn.,Prentice Hall, 2013. 5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee*Organic Chemistry*, 7th edn., Pearson Education,2010.
Reference Books	1. S. H. Pine, *Organic Chemistry*, 5th edn, McGraw Hill International Editionn,1987. 2. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay,2000. 3. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.,1959. 4. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989. 5. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4th ed., John-Wiley,2010.
Website and e-learning source	1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: **CO1**: To recall the basic principles of aromaticity of organic and heterocyclic compounds. **CO2**: To understand the mechanism of various types of organic reactions. **CO3**: To predict the suitable reagents for the conversion of selective organic compounds. **CO4**: To correlate the principles of substitution, elimination, and addition reactions. **CO5**:Todesign new routes to synthesis organic compounds.	

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

2.2

Title of the Course	**PHYSICAL CHEMISTRY-I**						
Paper No.	**Core VI**						
Category	**Core**	**Year**	I	**Credits**	4	**Course Code**	
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	**Basic concepts of physical chemistry**						
Objectives of the course	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-Boltzman, Fermi-Dirac and Bose-Einstein To correlate the theories of reaction rates for the evaluation of thermodynamic parameters. To study the mechanism and kinetics of reactions.						
Course Outline	**UNIT-I: Classical Thermodynamics:** Partial molar properties-Chemical potential, Gibb's-Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity bygraphicalmethod.Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states - determination-vapourpressure,EMFandfreezing point methods.						
	UNIT-II: Statistical thermodynamics: Introduction of statistical thermodynamicsconcepts of thermodynamic and mathematical robabilities-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. Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.
	UNIT-III: Irreversible Thermodynamics: Theories of conservation of mass and energyentropy production in open systems by heat, matter and current flow, force and flux concepts.Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.
	UNIT-IV: Kinetics of Reactions: Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis-molecular beams,collision cross sections, effectiveness of collisions,Potential energy surfaces. Transition state theory-evaluation of thermodynamicparameters 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, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.
	UNIT-V: Kinetics of complex and fast reactions: Kinetics of complex reactions, reversiblereactions, 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 Herzfeldmechanism.Study of fast reactions-relaxation methods-temperature and pressure jump methods electric and magnetic field jump methods -stopped flow flash photolysis methods and pulse radiolysis.Kinetics of polymerization-free radical, cationic,anionic polymerization - Polycondensation.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986. 2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A.BenjaminPublishers, California, 1972. 3. M.C. Gupta, Statistical Thermodynamics, New Age International,

	Pvt. Ltd., New Delhi,1995. 4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013. 5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,Macmillan India Ltd, Reprint - 2011.
Reference Books	1. D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999. 2.R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990. 3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974 4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996. 5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.
Website and e-learning source	1. https://nptel.ac.in/courses/104/103/104103112/ 2. https://bit.ly/3tL3GdN

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: To explain the classical and statistical concepts of thermodynamics.
CO2: To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.
CO3: To discuss the various thermodynamic and kinetic determination.
CO4: To evaluate the thermodynamic methods for real gases ad mixtures.
CO5:To compare the theories of reactions rates and fast reactions.

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

2.3

Title of the Course	**INORGANIC CHEMISTRY PRACTICAL**						
Paper No.	**Core VII**						
Category	**Core**	**Year**	I	**Credits**	4	**Course Code**	
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	-	1	5			6	
Prerequisites	**Basic principles of gravimetric and qualitative analysis**						
Objectives of the course	To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions. To recall the principle and theory in preparing standard solutions. To train the students for improving their skill in estimating the amount of ion accurately present in the solution To estimate metal ions, present in the given solution accurately without using instruments. To determinetheamount of ions, present in a binary mixture accurately.						
Course Outline							
	UNIT-I: Preparation of metal complexes: Preparation of inorganic complexes: a)Preparation of hexathioureacopper(I) chloridedihydrate b) Preparation of *cis*-Potassium tri oxalate diaquachromate(III) c)Preparation of sodium trioxalatoferrate(III) d)Preparation of hexathiourealead(II) nitrate						
	UNIT-II: Complexometric Titration: 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.						
Extended Professional Component (is a part of internal	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)						

component only, Not to be included in the external examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021. 2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rded.,The National Publishing Company, Chennai, 1974. 3. *Vogel's Text book of Inorganic Qualitative Analysis,* 4thed., ELBS, London.
Reference Books	1. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965. 2. W. G. Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To identify the anions and cations present in a mixture of salts.

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

CO3: To acquire the qualitative analytical skills by selecting suitable confirmatory tests andspot tests.

CO4: To choose the appropriate chemical reagents for the detection of anions and cations.

CO5:To synthesize coordination compounds 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**	**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

2.4

Title of the Course	**PHYSICAL CHEMISTRY PRACTICAL**						
Paper No.	**Core VIII**						
Category	**Core**	**Year**	I	**Credits**	4	**Course Code**	
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	-	1	3			4	
Prerequisites	Basic knowledge of physical chemistry						
Objectives of the course	To understand the principle of conductivity experiments through conductometric titrations. To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics. To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions. To determine the kinetics of adsorption of oxalic acid on charcoal. To develop the potential energy diagram of hydrogen ion, charge density distribution and Maxwell's speed distribution by computational calculation.						
Course Outline	**UNIT-I:** 1. Distribution Law – Study of Association of Benzoic Acid in Benzene. 2. Study of the equilibrium constant of the reaction between KI and I_2.						
	UNIT-II:Kinetics 1. Study the kinetics of acid hydrolysis of an ester, determine the						

	temperature coefficient and also the activation energy of the reaction. 2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone. 3. Kinetics – Persulphate – Iodide Reaction – Determination of order, effect of Ionic strength on rate constant. 4. Primary salt effect for the reaction between persulphate and iodide. 5. Study of inversion of cane sugar in the presence of acid using polarimeter.
	UNIT-III: Phase diagram Construction of phase diagram for a simple binary system 1. Naphthalene-phenanthrene 2. Benzophenone- diphenyl amine **Adsorption** Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009. 2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996. 3. V.D. Athawale and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008. 4. E.G. Lewers, Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Ed., Springer, New York, 2011.
Reference Books	1. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. 2. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009. 3. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987. 4. Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014. 5. F. Jensen, Introduction to Computational Chemistry, 3rd Ed., Wiley-

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

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the principles associated with various physical chemistry experiments.

CO2: To scientifically plan and perform all the experiments.

CO3: To observe and record systematically the readings in all the experiments.

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

CO5: To interpret the experimental data scientifically to improve students' efficiency for societal developments.

CO-PO Mapping (Course Articulation Matrix)

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

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

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

3 – Strong, 2 – Medium, 1 - Low

2.5

Title of the Course	**MOLECULAR SPECTROSCOPY**

<table>
<tr><td>Paper No.</td><td colspan="7">Elective III</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></td></tr>
<tr><td></td><td></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of spectroscopy</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
To highlight the significance of 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.</td></tr>
<tr><td></td><td colspan="7">UNIT-II:Vibrational Spectroscopy: Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution.Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation.Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.</td></tr>
<tr><td></td><td colspan="7">UNIT-III:Electronic spectroscopy and IR Spectroscopy: UV-Visible spectroscopy: Introduction- Woodward-Fieser rules for conjugated dienes, carbonyl compounds and enones, ultraviolet spectra of aromatic and heterocyclic compounds.
IR spectroscopy: Introduction- finger print region – Far IR region Applications of IR spectroscopy to identify alkane, alkene, alkyne,</td></tr>
</table>

	aromatic compounds, nitrile and aromatic residues, Identification of alcohols, ethers, phenols, amines and carbonyl compounds such as ketones, aldehydes, esters, amides, acids, conjugated carbonyls compounds and other functional groups- Effect of hydrogen bonding and effect of solvent on vibrational frequencies.
	UNIT-IV:NMR spectroscopy: Introduction-Nuclear spin states-Nuclear Magnetic moments-Absorption of Energy-Resonance-Instrumentation (Principle only): Continuous wave method, FT NMR-chemical shift and its measurements, factors affecting the chemical shift including anisotropic effect-relaxation processes-Spin-spin coupling-Coupling constant –Multiplicity-Spin systems-NOE effects-1H NMR of simple aliphatic and aromatic compounds. Principles of ^{13}C NMR,- proton decoupled and off – resonance ^{13}C NMR spectra – DEPT methods- factors affecting 13C chemical shift - ^{13}C NMR spectra of simple organic molecules. Problem solving (for molecules with a maximum number of C10). Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR.
	UNIT-V:Mass Spectrometry, EPR and Mossbauer Spectroscopy: Introduction- Principles- Instrumentation-Ionization techniques such as Chemical ionization, Electron ionization, ESI, FD, FAB, MALDI. Applications of mass spectra to elucidate molecular formula and structure. Mc. Lafferty rearrangement-Nitrogen rule-Interpretation of fragmentation pattern of aliphatic alcohols, aldehydes, esters, ethers, hydrocarbons, carboxylic acids, amines, halogen compounds and simple aromatic compounds. Appearance and significance of isotopic peaks. Effect of isotopes on the appearance of mass spectrum.EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. 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	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)

question paper)	
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.
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*, PartB: 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 and e-learning source	1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview 2. https://www.digimat.in/nptel/courses/video/104106122/L14.html

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the importance of rotational and Raman spectroscopy.

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

CO3: To evaluate different electronic spectra of simple molecules using electronic spectroscopy.

CO4: To outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}FNMR and ESR spectroscopic techniques.

CO5:To develop the knowledge on principle, instrumentation and structural elucidation ofsimple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopytechniques.

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

2.6

<table>
<tr><td>Title of the Course</td><td colspan="7">BIO-INORGANIC AND MEDICINAL CHEMISTRY</td></tr>
<tr><td>Paper 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>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the role of trace elements.
To understand the biological significance of iron, sulpur.
To study the toxicity of metals in medicines.
To have knowledge on diagnostic agents.
To discuss on various metalloenzymes properties.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Essential trace elements: Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signallingproteins.Metalloenzymes: Zinc enzymes–carboxypeptidase and carbonic anhydrase. Ironenzymes–catalase, peroxidase. Copperenzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.Enzyme kinetics: Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.</td></tr>
<tr><td colspan="7">UNIT-II: Transport Proteins: Oxygen carriers-Hemoglobin and myoglobin - Structure and oxygenation. Bohr Effect. Binding of CO, NO, CN– to Myoglobin and 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.Introductionto Nitrogen fixation, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase-redox property - Dinitrogen complexestransition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia.</td></tr>
<tr><td colspan="7">UNIT-III: Introduction to receptors: Introduction, targets, Receptors, Receptor types, Drug – receptor interactions, Neurotransmission-Neurotransmitters.
History of drug discovery, Strategies in lead discovery: Ethnopharmaceutical sources, Plant sources, Animal sources, marine sources, drug metabolism studies, observation of side effects.
Lead Optimization methods: Stereochemistry, Bioisosterism, SAR studies.</td></tr>
</table>

	UNIT-IV: Drug Design: Drug design strategies-Rational drug design: Inhibitors of ACE; Structure based drug design: Anti HIV agents; Ligand based approach. Design of agonist and antagonist: β_2-Agonists and the treatment of asthma, Discovery of the H2–receptor antagonists Pro drug concept: prodrugs of ampicillin, elanapril, propranolol.
	UNIT-V:Pharmacological activity: Antibiotics: Penicillin; Antimalerials: Trimethoprim; NSAIDS: Paracetamol, Ibuprofen, Diclophenac sodium, Antidepressants: Fluoxetine, Anti-histamines, Anti-tuberclosis agents: Isoniazide, Anti-cancer agents: Vinblastine, Taxol
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Williams,D.R. –Introdution to Bioinorganic chemistry. 2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry,RoyolSoceity of Chemistry, Monograph for Teachers-31 3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co., USA. 4. G.N. Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993. 5. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, **2001**.
Reference Books	1. M.Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996) 2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London. 3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987. 4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002. 5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.
Website and e-learning source	1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html 2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html
Course Learning Outcomes (for Mapping with POs and PSOs)	

Students will be able:
CO1: The students will be able to analyses trace elements.
CO2: Students will be able to explain the biological redox systems.
CO3: Students will gain skill in analyzing the toxicity in metals.
CO4: Students will have experience in diagnosis.
CO5:Learn about the nitrogen fixation and photosynthetic 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

2.7. Skill Enhancement - I

From group G

Cosmetic Chemistry

Unit I

Classification of cosmetic and cosmeceutical products Cosmetic excipients: Surfactants, emollients, preservatives.
Classification and application Skin: Basic structure and function of skin. Oral Cavity: Common problem associated with teeth and gums.

Unit II

Principles of formulation and building blocks of skin care products: Face wash, Moisturizing cream, advantages and disadvantages. Principles of formulation and building blocks of Hair care products:
Conditioning shampoo, Hair conditioners, antidandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine-based hair dye. Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

Unit III

Sun protection, Classification of Sunscreens and SPF. Role of herbs in cosmetics: Skin Care: Aloe and turmeric Hair care: Henna and amla.
Oral care: Neem and cloveAnalytical cosmetics: BIS specification and analytical methods for shampoo, skin cream and toothpaste.

Unit IV

Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs.
Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Colour, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.

Unit V

Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis.
Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odour. Antiperspirants and Deodorants- Actives and mechanism of action.

2.8 HUMAN RIGHTS

Title of the Course	HUMAN RIGHTS						
Paper No.							
Category	Compulsory paper	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional hours per week	Lecture	Tutorial	Lab Practice			Total	
	2	-	-			-	

UNIT-I HISTORICAL DEVELOPMENT AND THEORIES

Definition of Human Rights - Nature, Content, Legitimacy and Priority - Theories on Human Rights - Historical Development of Human Rights.

UNIT-II INTERNATIONAL HUMAN RIGHTS-1

Prescription and Enforcement up to World War II - Human Rights and the UNO-Universal Declaration of Human Rights - International Covenant on Civil and Political Rights - International Covenant on Economic, Social and Cultural Rights and Optional Protocol.

UNIT-III HUMAN RIGHTS DECLARATIONS

U.N. Human Rights Declarations - U.N. Human Commissioner.

UNIT-IV INTERNATIONAL HUMAN RIGHTS-2

Amnesty International - Human Rights and Helsinki Process – Regional Developments - European Human Rights System - African Human Rights System - International Human Rights in Domestic courts.

UNIT-V HUMAN RIGHTS FOR CHILDREN AND WOMEN

Contemporary Issues on Human Rights: Children's Rights - Women's Rights - Dalit's Rights - Bonded Labour and Wages - Refugees - Capital Punishment. Fundamental Rights in the Indian Constitution - Directive Principles of State Policy - Fundamental Duties - National Human Rights Commission.

Reference Books

1. International Bill of Human Rights, Amnesty International Publication, 1988.
2. Human Rights, Questions and Answers, UNESCO, 1982
3. Mausice Cranston - What is Human Rights
4. Desai, A.R. - Violation of Democratic Rights in India

5. Pandey - Constitutional Law.
6. Timm. R.W. - Working for Justice and Human Rights.
7. Human Rights, A Selected Bibliography, USIS.
8. J.C.Johari - Human Rights and New World Order.
9. G.S. Bajwa - Human Rights in India.
10. Amnesty International, Human Rights in India.
11. P.C.Sinha-International Encyclopedia of Peace, Security
12. K. Cheous (Ed) Social Justice and Human Rights (Vols 1-7).
13. Devasia, V.V. - Human Rights and Victimology.

2.9 MOOC

Title of the Course	**Massive Open Online Course**						
Paper No.							
Category	**Compulsory paper**	**Year**	I	**Credits**	2	**Course Code**	
		Semester	II				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	2	-	-			2	

Student should undergo an online course conducted at national level, related to Chemistry

Semester 3, Year-2

3.1

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC SYNTHESIS AND PHOTOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the molecular complexity of carbon skeletons and the presence offunctional groups and their relative positions.
To study various synthetically important reagents for any successful organic synthesis.
To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
To learn the concepts of pericyclic reaction mechanisms.
To gain the knowledge of photochemical organic reactions.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I:Planning an Organic Synthesis andControlelements: Preliminary Planning – knowns and unknowns of the synthetic systemstudied, analysis of the complex and interrelated carbon framework into simple rationalprecursors, retrosynthetic analysis, alternate synthetic routes, key intermediates that wouldbe formed, available starting materials and resulting yield of alternativemethods. Linear Vs convergent synthesis. synthesis based on umpolung concepts ofSeeback, regiospecific control elements. Use of protective groups, activating groups and bridgingelements. Examples on retrosynthetic approach, calculation of yield, advantages of convergent synthesis, synthesis of stereochemistry-controlled products.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Organic Synthetic Methodology: Retrosynthetic analysis; Alternate synthetic routes. Synthesis of organic mono and bifunctional compounds via disconnection approach. Key intermediates, available starting materials and resulting yields of alternative methods. Convergent and divergent synthesis, Synthesis based on umpolung concepts of Seebach. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis. Control elements: Regiospecific control elements. Use of protective groups, activating groups, and bridging elements. Stereospecific control elements. Functional group alterations and transposition.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Pericyclic Reactions: Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO method and correlation diagrams. Cycloaddition and retrocycloaddition reactions; [2+2], [2+4],</td></tr>
</table>

	[4+4, Cationic, anionic, and 1,3-dipolar cycloadditions. Cheletropic reactions. ; Electrocyclization and ring opening reactions of conjugated dienes and trienes. Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations, degenerate rearrangements. Ionic sigmatropic rearrangements. Group transfer reactions. Regioselectivity, stereoselectivity and periselectivity in pericyclic reactions.
	UNIT-IV: Organic Photochemistry: Reactions of electronically excited ketones; $\pi \rightarrow \pi^*$ triplets; Norrish type-I and type-II cleavage reactions; photo reductions; Paterno-Buchi reactions;Photochemistry of α,β-unsaturated ketones; cis-trans isomerisation. Photon energy transfer reactions, Photo cycloadditions, Photochemistry of aromatic compounds; photochemical rearrangements; photo-stationery state; di-π-methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton's reactions.
	UNIT-V: Heterocyclics: Synthesis and reactions of furan, pyrrole, thiophene and pyridines: Furans- Fiest-Benary furan synthesis, Pyrroles and pyrrolidines-Barton. Zard reaction. Hofmann-Loffler-Freytag reaction. Thiophenes-Hinsberg synthesis of thiophene derivatives. Pyridines- Hantzsch (Dihydro)-pyridine synthesis. **Condensed heterocycles:**Synthesis and reactions of Indole, Quinolines and Isoquinolines: Indoles. Indoles - Fischer indole synthesis, Madelung indole synthesis, Nenitzescu indole synthesis. Quinolines and isoquinolines- Bischler-Napieralski reaction. Friedlander synthesis. Meth-Cohn quinoline synthesis. Pfitzinger quinoline synthesis.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5thed, Tata McGraw-Hill, New York, 2003. 2. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007. 3. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990. 4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.

	5. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.
Reference Books	1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974. 2. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004. 3. W. Caruthers, Some Modern Methods of Organic Synthesis 4thedn, Cambridge University Press, Cambridge, 2007. 4. H. O. House. Modern Synthetic reactions, W.A. Benjamin Inc, 1972. 5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.
Website and e-learning source	**1. https://rushim.ru/books/praktikum/Monson.pdf**

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the basic principles of organic chemistry and to understand the various reactions of organic compounds with reaction mechanisms.

CO2: To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions.

CO3: To implement the synthetic strategies in the preparation of various organic compounds.

CO4: To predict the suitability of reaction conditions in the preparation of tailor-made organic compounds.

CO5: To design and synthesize novel organic compounds with the methodologies learnt during the course.

CO-PO Mapping (Course Articulation Matrix)

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

3.2

Title of the Course	**COORDINATION CHEMISTRY – I**						
Paper No.	**Core X**						
Category	**Core**	**Year**	II	**Credits**	4	**Course Code**	
		Semester	III				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	Basic knowledge of inorganic chemistry						
Objectives of the course	To gain insights into the modern theories of bonding in coordination compounds. To learn various methods to determine the stability constants of complexes. To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes. To describe various substitution and electron transfer mechanistic pathways ofreactions in complexes. To evaluate the reactions of octahedral and square planar complexes.						
Course Outline	UNIT-I: **Modern theories of coordination compounds:** Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq - spectrochemical series - crystal field stabilisation energy for high spin and low spin complexes- evidences for crystal field splitting - site selections in spinels and antispinels - Jahn Teller distortions and its consequences.Molecular Orbital Theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes.						
	UNIT-II: Spectral characteristics of complexes: Term states for d ions - characteristics of d-d transitions - charge transfer spectra - selection rules for electronic spectra - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - nephelauxetic series - Racha parameter and calculation of inter-electronic repulsion parameter.						
	UNIT-III: Stability and Magnetic property of the complexes:						

	Stability of complexes: Factors affecting stability of complexes, Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, Ion exchange method, Polorographic method and Continuous variation method (Job's method)Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.
	UNIT-IV: Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: Inert and Labile complexes; Associative, Dissociative and SNCB mechanistic pathways for substitution reactions; acid and base hydrolysis of octahedral complexes; Classification of metal ions based on the rate of water replacement reaction and their correlation to Crystal Field Activation Energy; Substitution reactions in square planar complexes: Trans effect, theories of trans effect and applications of trans effect in synthesis of square planar compounds; Kurnakov test.
	UNIT-V: Electron Transfer reactions in octahedral complexes: Outer sphere electron transfer reactions and Marcus-Hush theory; inner sphere electron transfer reactions; nature of the bridging ligand in inner sphere electron transfer reactions.Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their applications.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006 2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B. N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976. 5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6thed.; Wiley Inter-science: New York, 1988.

Reference Books	1. Keith F. Purcell and John C. Kotz, Inorganic Chemistry, Saunders Publications, USA, 1977. 2. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010. 3. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn. 4. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn. 5. Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010.
Website and e-learning source	https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: Understand and comprehend various theories of coordination compounds.

CO2: Understand the spectroscopic and magnetic properties of coordination complexes.

CO3: Explain the stability of complexes and various experimental methods to determine the stability of complexes.

CO4: Predict the electronic transitions in a complex based on correlation diagrams and UV-visible spectral details.

CO5: Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes.

CO-PO Mapping (Course Articulation Matrix)

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

3.3

Title of the Course	**ANALYTICAL INSTRUMENTATION TECHNIQUES**						
Paper No.	**Core XI**						
Category	**Core**	**Year**	II	**Credits**	4	**Course Code**	
		Semester	III				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	-	1	3			4	
Prerequisites							
Objectives of the course	To design chromatographic methods for identification of species. To analyze different constituents through instrumental methods of analysis. To evaluate different contaminants in materials using turbidimetry and conductivity measurements. To design experiments for analysis of inorganic and organic materials. To analyze constituents in materials using emission and absorption techniques.						
Course Outline	**UNIT-I:** 1. Determination of the equivalent conductance of a weak acid at different concentrations and verifying Ostwald dilution law. Calculation of the dissociation constant of the acid. 2. Determination of the equivalent conductance of a strong electrolyte at different concentrations and examining the validity of the Onsager's theory as limiting law at high dilutions. 3. Conductometric titration of a mixture of HCl and CH_3COOH Vs NaOH. 4. Conductometric titration of NH_4Cl Vs NaOH. 5. Conductometric titration of CH_3COONa Vs HCl. 6. Determination of solubility of a sparingly soluble salt. 7. Acid-base titration (strong acid and weak acid vs NaOH).						
	UNIT-II: 1.Potentiometric titration of a mixture of HCl and CH_3COOH Vs NaOH						

	2. Determination of pK_a of weak acid by EMF method. 3. Potentiometric titration of FAS Vs $K_2Cr_2O_7$ 4.Potentiometric titration of KI Vs $KMnO_4$. 5.Potentiometric titration of a mixture of Chloride and Iodide Vs $AgNO_3$. 6.Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel electrode. 7. Precipitation titrations (mixture of halides only).
	UNIT-III: Interpretation and identification of the given spectra of various compounds arrived at from the following instruments 1.UV-Visible 2.IR 3.Raman 4.NMR 5.ESR 6.Mass etc.,
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	*1.* Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003. 2. G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, *Vogel's Textbook of Quantitative Chemical Analysis*; 6th ed., ELBS, 1989. 3. J. D. Woollins, *Inorganic Experiments*; VCH: Weinheim, 1995. 4. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi,2009. 5.Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.
Reference Books	1. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry – Labmanual, S. Viswanathan Co. Pvt. Ltd, 2009. 2. J. N. Gurtu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 2011. 3. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001. 4. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in

	Physical Chemistry, 8th edition, McGraw Hill, 2009. 5. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
Website and e-learning source	1. https://bit.ly/3QESF7t 2. https://bit.ly/3QANOnX

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: To recall the principles associated with various inorganic organic and physical chemistry experiments
CO2: To scientifically plan and perform all the experiments
CO3: To observe and record systematically the readings in all the experiments
CO4: To calculate and process the experimentally measured values and compare with graphical data.
CO5: To interpret the experimental data scientifically to improve students efficiency for societal developments.

CO-PO Mapping (Course Articulation Matrix)

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

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

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

3 – Strong, 2 – Medium, 1 – Low

3.4

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC CHEMISTRY PRACTICAL-II</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td>4</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>1</td><td colspan="3">3</td><td colspan="2">4</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 preparation of organiccompounds.
To develop analytical skill in the handling of chemical reagents for separation of binary and ternaryorganic mixtures.
To analyze the separated organic components systematically and derivatize them suitably.
To construct suitable experimental setup for the organic preparations involving two stages.
To experiment different purification and drying techniques for the compound processing.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: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)</td></tr>
<tr><td colspan="7">UNIT-II:Two stage preparations:
a) p-Bromoacetanilide from aniline
b) p-Nitroaniline from acetanilide
c) 1,3,5-Tribromobenzene from aniline
d) Acetyl salicyclic acid from methyl salicylate
e) Benzilic acid from benzoin
f) m-Nitroaniline from nitrobenzene
g) m-Nitrobenzoic acid from methyl benzoate</td></tr>
</table>

	UNIT-III: Interpretation and identification of the given spectra of various organic compounds arrived at from the following instruments 1.UV-Visible 2.IR 3.Raman 4.NMR 5.ESR 6.Mass etc.,
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	4. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014. 5. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001. 6. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
Reference Books	4. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994. 5. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013. 6. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.
Website and e-learning source	https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the basic principles of organic separation, qualitative analysis and preparation.

CO2: To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.

CO3: To determine the characteristics of separation of organic compounds by variouschemical reactions.

CO4: To develop strategies to separate, analyze and prepare organic compounds.

CO5:To formulate a method of separation, analysis of organic mixtures and design suitableprocedure 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**	**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

3.5

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTROCHEMISTRY, PHOTOCHEMISTRY, INTSRUMENTATION</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</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 fundamental understanding of various photophysical and photochemcial processes.
To highlight the principle and applications of chromatographic techniques</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Ionics: Arrhenius theory -limitations, van’t Hoff factor and its relation to colligative properties. Concept of ionic strength, Debye Huckel theory of strong electrolytes,activity coefficient of strong electrolytes.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.</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. 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: 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. Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH.Pourbiax and Evan’s diagrams.FuelCells:classification, alkaline fuel cells, phosphoric acid</td></tr>
</table>

	fuel cells, high temperature fuel cells.
	UNIT-IV:Photochemistry Franck-Condon principle-Jablonskii diagram-primary and secondary processes-Flourescence and phosphorescence-Quantum yield-Chemical actionometry-Photosensitization, chemiluminescence. Kinetics of photochemical processes-H_2 and Cl_2reaction-Excimers and Exciplexes. Mechanism of fluorescence quenching- Stern-Volmer equation and its applications. Photodegradation of polymers-Atmospheric photochemistry. Photo-voltaic cells-Photo-assisted electrolysis of water-Aspects of solar energy conversion.
	UNIT-V:Instrumentation: Chromatography-Classification of chromatographic methods, principles of differential migration, adsorption phenomenon, nature of adsorbents, solvent systems. Gas Chromatography-Theory and instrumentation (Block Diagram), Types of stationary phases and carrier gases (mobile phase). High performance liquid chromatography-Theory and instrumentation, stationary phases and mobile phases. Spectrophotometer-Principle, Sources of Radiations, Sampling, Block diagram of UV-Visible and FT-IR Spectrophotometer Polarography-Principle and applications. Principle of Cyclic voltammetry.
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 activitycoefficient 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

3.6 Internship / Industrial activity

3.7 Skill Enhancement – II

From group G

Industrial Chemistry

UNIT- I CHEMICAL TECHNOLOGY

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators.

UNIT –II INDUSTRIAL GASES AND INORGANIC CHEMICALS

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene. Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum.

UNIT -III INDUSTRIAL METALLURGY

Preparation of metals (ferrous and nonferrous) and ultra pure metals for semiconductor

technology: Silicon, Germanium, Indium and Tantalum.

UNIT -IV FUEL CHEMISTRY
Classification of fuels and their calorific value. Coal: Uses of coal (fuel and non fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro Gasification and Catalytic gasification), Coal liquefaction and Solvent Refining. Petrochemicals: Vinyl acetate, Propylene oxide, Toluene and Xylene. Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

UNIT -V OILS AND FATS
Classification of oils, fat splitting, distillation of completely miscible and nonmiscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.

Reference Books

1. J.P. Mukhlyonov: Fundamentals of Chemical Technology.
2. M.G. Rao, M.Sittig: Dryden's out line of Chemicals Technology.
3. G.L. Kehl: Principles of Metallographic Laboratory Practice,
4. Dr. B.K. BhaskaraRao "A Text on Petro Chemicals" 1st Edition, Khanna, Publishers.
5. Bhagan Sahay "Petroleum Exploration and Exploitation Practices" Allied Publishers Ltd., Chennai,
1994.
6. W.L Nelson "Petroleum Refinery Engineering", 4th Edition, McGraw Hill.
7. Principles of Unit Operations by A.S.Foustetal – Wiley International Edition – 1960.
8. Chemical Engineering Vol-1&II by J.M.Coulson and J.F.Richordson – Sixth Edition Butterworth –
New Delhi – 2000.

Semester 4

4.1

Title of the Course	**COORDINATION CHEMISTRY – II**						
Paper No.	**Core X111**						
Category	**Core**	**Year**	II	**Credits**	4	**Course Code**	
		Semester	IV				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	Basic knowledge of inorganic chemistry						
Objectives of the course	To recognize the fundamental concepts and structural aspects of organometallic compounds.						

	To learn reactions of organometallic compounds and their catalytic behaviour. To identify or predict the structure of coordination compounds using spectroscopic tools. To understand the structure and bonding in coordination complexes. To evaluate the spectral characteristics of selected complexes.
Course Outline	**UNIT-I: Chemistry of organometallic compounds:** Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Bonding in metal – olefin complexes (example: Ziese's salt), metal-acetylene and metal-allyl complexes; Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes; fluxional isomerism. Metal – carbonyl complexes: MO diagram of CO; Structure and bonding − bonding modes, MO approach of M-CO bonding, π-acceptor nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters – Structures based on polyhedral skeleton electron pair theory or Wade's rule.
	UNIT-II: Reactions and catalysis of organometallic compounds: Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction and metathesis reaction.Organo-metallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerisation, water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process.
	UNIT-III: Inorganic spectroscopy -I: IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds. NMR spectroscopy-Introduction, applications of 1H, 15N, 19F, 31P-NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.
	UNIT-IV: Inorganic spectroscopy-II: Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets; ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$. Mossbauer spectroscopy – Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler shift, Isomer shift, quadrupole splitting and magnetic interactions. Applications of Mössbauer spectra to Fe and Sn compounds.
	UNIT-V: Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) and polyatomic

	molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations.Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006 2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B D Gupta and A K Elias, Basic Organometallic Chemistry: Concepts, Syntheses and Applications, University Press, 2013. 5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6thed.; Wiley Inter-science: New York, 1988.
Reference Books	1. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000. 2. P Gütlich, E Bill, A X Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st edition, Springer-Verlag Berlin Heidelberg, 2011. 3. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn. 4. K. F. Purcell, J. C. Kotz, Inorganic Chemistry; Saunders: Philadelphia, 1976. 5. R. S. Drago, PhysicaI Methods in Chemistry; Saunders: Philadelphia, 1977.

Website and e-learning source	https://archive.nptel.ac.in/courses/104/101/104101100/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: Understand and apply 18 and 16 electron rule for organometallic compounds
CO2: Understand the structure and bonding in olefin, allyl, cyclopentadienyl and carbonyl containing organometallic compounds
CO3: Understand the reactions of organometallic compounds and apply them in CO4: understanding the catalytic cycles
CO5: Identify / predict the structure of coordination complexes using spectroscopic tools such as IR, NMR, ESR, Mossbauer and optical rotatory dispersion studies to interpret the structure of molecules by various spectral techniques.

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

4.2

Title of the Course	**PHYSICAL CHEMISTRY-II**						
Paper No.	**Core XIV**						
Category	**Core**	**Year**	II	**Credits**	4	**Course**	

		Semester	IV			**Code**	
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	1	-			6	
Prerequisites	Basic knowledge of physical chemistry						
Objectives of the course	To understand the essential characteristics of wave functions and need for the quantum mechanics. To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator. To apply the quantum mechanics to hydrogen and polyelectronic systems. To familiarize the symmetry in molecules and predict the point groups. To predict the vibrational modes, hybridization using he concepts of group theory.						
Course Outline	**UNIT-I:** Wave particle duality, Uncertainty principle, Particle wave and Schrodinger wave equation, wave function, properties of wave function. Properties of wave function, Normalized, Orthogonal, orthonormal, Eigen values, Eigen functions, Hermitian properties of operators.Introduction to quantum mechanics-black body radiation, photoelectric effect, hydrogen spectrum.Need for quantum mechanics, Postulates of Quantum Mechanics, Schrodinger wave equation, Time independent and time dependent						
	UNIT-II: Quantum models: Particle in a box-1D, two dimensional and three-dimensional, degeneracy, application to linear conjugated molecular system, free particles, ring systems.Harmonic Oscillator-wave equation and solution.Rigid Rotor-wave equation and solution.						
	UNIT-III: Applications to Hydrogen and Poly electron atoms: Hydrogen atom and hydrogen like ions, Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions.Approximation methods –variation methods: trial wave function, variation integral and application to particle in 1D box. Perturbation method - first order applications.Hatrefock self-consistent field method. Helium atom-electron spin, Paulis exclusion principle and Slater determination.						
	UNIT-IV: Group theory: Groups, sub groups, symmetry elements, operations, classification-axial and non-axial. Dihedral point groups-C_n,C_{nh}, D_n, D_{nh}, D_{nd}, Tdand Oh.Matrix representation and classes of symmetry operations, reducible irreducible and direct product representation. The Great orthogonality theorem – irreduciblerepresentation and reduction formula, construction of character table for C_{2v}, and C_{3v}point groups.						
	UNIT-V: Applications of quantum and group theory: Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment, Energy level diagram, Hydrogen molecule ion; Use of linear variation function and LCAO methods.Electronic conjugated system:Huckel						

	method to Ethylene butadiene, and Benzene. Applications of group theory to molecular vibrations, electronic spectra of ethylene.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition. 2. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition. 3. A. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition. 4. T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition. 5. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001. 6. D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition.
Reference Books	1. N. Levine, Quantum Chemistry, Allyn& Bacon Inc, 1983, 4th edition. 2. D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012. 3. R. P. Rastogi & V. K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems, Oxford & IBH Publishing Co., New Delhi, 1999. 4. R.L. Flurry. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980 5. J. M. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint.

Website and e-learning source	1. https://nptel.ac.in/courses/104101124 2. https://ipc.iisc.ac.in/~kls/teaching.html

Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able:
CO1: To discuss the characteristics of wave functions and symmetry functions.
CO2: To classify the symmetry operation and wave equations.
CO3: To apply the concept of quantum mechanics and group theory to predict the electronic structure.
CO4: To specify the appropriate irreducible representations for theoretical applications.
CO5: To develop skills in evaluating the energies of molecular spectra.

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

4.3 CORE XV

PROJECT WITH VIVA

4.4 Elective VI

Industry / Entrepreneurship

<table>
<tr><td>Title of the Course</td><td colspan="7">INDUSTRY ENTREPRENEURSHIP</td></tr>
<tr><td>Paper No.</td><td colspan="7">Elective VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>1</td><td>-</td><td colspan="3">3</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7"></td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the essential requirement for chemistry related industries
To know the importance of chemical industries
To apply the knowledge on chemistry to think about startup companies
To familiarize the procedure and instrumentation involved in the synthesis in a chemical industry
To predict the prons-cons of running a small and medium chemical industry</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">Theory:
Entrepreneurship-1: Chemistry Entrepreneurship. micro, small, medium industries. Government policies and regulations</td></tr>
<tr><td colspan="7">Entrepreneurship-2: Entrepreneur: Characteristics or Attributes of an Entrepreneur. . Entrepreneurial Orientation, Entrepreneurial Competency. Entrepreneurship Development in India</td></tr>
<tr><td colspan="7">Practical: Industrial Visit and report submission</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="7">Questions related to Industry and Entrepreneurship
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving in industrial setup, Analytical ability, Professional Competency, Professional Communication.</td></tr>
<tr><td>Recommended Text</td><td colspan="7"></td></tr>
<tr><td>Reference Books</td><td colspan="7"></td></tr>
</table>

Website and e-learning source	
Course Learning Outcomes (for Mapping with POs and PSOs)	

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

4.5 Skill enhancement / Professional Competency skill (VAC)

Value-added courses offered by the Department of Chemistry imparting transferable and life skills to chemistry graduates.

Chemistry for Life

UNIT–I ENVIRONMENT

The air we breathe - composition of air - burning of hydrocarbons - fog - air quality -ozone - oxygen/ozone screen - biological effect of UV radiation - ozone formation and distribution in the atmosphere - paths of ozone destruction - chloroflurocarbons and their interactions with ozone – the Antartic ozone hole.

Unit II Environmental pollution- Water: Introduction, water pollutants: oxygen demanding wastes, pathogens, nutrients, salts, thermal pollution, heavy metals, pesticides, volatile organic compounds; characterization of wastewater, methods &equipments used in wastewater treatment. Physical, chemical and biological water quality parameters; their assessment. Water treatment processes: aeration, solid purification nanofiltration, chemical treatments, reverse osmosis, desalination. Soil & land pollution: Trace elements - pollution & control. Industrial pollution: Sugar, drug, paper and pulp sectors, thermal power plants. Disposal of waste and its management. Chemical solutions to environmental problems, principles of decomposition, biodegradability, better industrial processes.

Unit III: AGRICULTURAL CHEMISTRY

Fertilisers - classification - characteristics and uses - a brief study of additives use and abuse of additives in foods and beverages. AGROCHEMICALS: Classification of pesticides, structure, synthesis, mode of action and application of the following: Nicotine, Pyrethroids, diclone, captan, heptachlor, Melation , Parathion. Dithiocarbamates: Nabum, Ziram, structure and mode of formulation. Dry formulation of pesticides by dusts, granules, table powders and seed disinfectant. Liduid formulation of pesticides by Emulsions , suspensions, aerosols and sprays

Unit IV: CHEMISTRY IN ENERGY PRODUCTION

Solar energy – fuel from sun light – splitting of water – hydrogen from sunlight – hydrogen economy - fuel cells - batteries - photovoltaics - stealing the sun - nuclear energy - nuclear fission and fusion - production of electricity by a nuclear reactor - radioactivity and the hazards of radioactivity – living with nuclear power.

UNIT–V DYES, SOAPS AND DETERGENTS

Dyes - classification based on mode of application and structure - paints - ingredients - drying – pigments – types and properties – varnish. Soaps and detergents - classification - ingredients - solids and liquids - disinfectants (phenyl, dettol type) - perfumes - raw materials - perfumes used in soaps - cosmetics and agarbatti.

4.6 Extension activity – USSR