

APPENDIX - CK
MADURAI KAMARAJ UNIVERSITY
(University with Potential for Excellence)

M.Sc. Chemistry (Semester)

REVISED SYLLABUS

CHOICE BASED CREDIT SYSTEM

(With effect from the academic year 2018-2019 onwards)

REGULATIONS AND SYLLABUS

1. Introduction of the Programme

The M.Sc. Chemistry programme is planned to reach the present scenario to fulfill the expected needs of student community towards knowledge gaining and employability. The programme would introduce the basic foundation in chemistry followed by systematic development of the student's knowledge and skill in various aspects to fulfill himself as a competitive candidate opting for any teaching or scientific career. It would also be of high value for those preparing for NET, SET and other competitive exams.

2. Eligibility for admission

A candidate with a pass in B.Sc. Chemistry as Major subject with Physics as one of the Allied subjects. The other allied subjects may be one of the following: Chemistry, Zoology, Botany and Biochemistry. The candidate should have scored the minimum percentage of marks as per prevailing norms.

2.1. Duration of the Programme : 2 Years (four Semester)

2.2. Medium of instructions : English

3. Objectives of the Programme

1. To gain knowledge on the basic and advanced level aspects in the different disciplines of chemistry
2. To get an exposure on recent trends in Chemistry
3. To get more suitability for further research work and for teaching fields at higher degree level
4. To gain analytical and problem solving skills.
5. To gain exposure to the basics of Nanochemistry, Pharmaceutical Chemistry and computer applications in chemistry and interdisciplinary subjects.

4. Outcome of the Programme

The syllabus of M.Sc. Chemistry has been designed in such a way that the students gain the required knowledge of confidence and skill which would enable to enhance his aptitude, attitude and competing skills. Moreover peer-team teaching /learning methodology would eradicate his/her shyness and fear psychosis. Further, the programme is expected to inculcate the skill based knowledge which would help in their placement in good academic and research career.

5. Core subject papers

Core papers (CS) – 16(Theory papers 12, practicals 3 & project 1)

The programme mainly deals with core subjects viz. Organic chemistry, Inorganic Chemistry and Physical Chemistry.

6. Subject Elective Papers

Elective papers (ES) – In Major subjects – 3

The University shall provide all information related to the Elective Subject in M.Sc., Chemistry to all the students so as to enable them to choose their Elective Subjects in each semester. The list of elective Papers in each semester is displayed under the Programme structure.

7. Non – Major subject Elective Papers

Non-Major elective – 1

The University shall provide all information relating to the Non-Major Elective subject which is related to Environmental Science and Competitive examinations in M.Sc.Chemistry to all the students(including those students of other PG degree programmes) so as to enable them to choose their Elective Subjects in third semester. The list of elective Papers of third semester is displayed under the Programme structure.

8. Unitization

Each subject contains five units which are interrelated to each other. Not only core subjects, but elective and non-major elective are also contain the same.

9. Pattern of semester exam

Internal	-	25 Marks
External	-	75 Marks
Total	-	100 Marks

10. Scheme for Internal Assessment

For the M.Sc.Chemistry Degree, the internal assessment marks will be given as below

Tests	-	10 Marks (average of the best two tests)
Assignment	-	5 Marks
Seminar / Group Discussion	-	5 Marks
Peer-Team-Teaching	-	5 Marks
Total	-	25 Marks

11. External Exam

- There shall be external examinations at the end of each semester, odd semesters in the month of October / November and even semesters in April / May.
 - A candidate, who has not passed the examination, may be permitted to appear in such failed subjects in the subsequent examinations to be held in October / November or April / May. A candidate should get registered for the first semester examination. If registration is not possible, owing to shortage of attendance beyond condonation limit / regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the

next semester. Such candidates shall re-do the missed semester after the completion of the programme.

- Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance have to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance have to apply for condonation in the prescribed form with the prescribed fee alongwith the Medical Certificate.
- Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester(s) after the completion of the programme.
- The results of all the examinations will be published through the controller of examination where the students underwent the course as well as through University Website. In the case of private candidates, the results will be published through the Controller of examination in which they took the examinations as well as University Website.

12. Question Paper Pattern

Part – A

Ten questions (No choice) 10 x 1 = 10 marks

Two questions from each Unit (Objective type Multiple Choice questions)

Part – B

Five questions (either or type) 5 x 7 = 35 marks

One question from each unit

Part – C

Three questions out of five 3 x 10 = 30 marks

One question from each unit

13. Scheme of Evaluation

The performance of a student in each course is evaluated in terms of percentage of marks with a provision of conversion to grade points. Evaluation of each course shall be done by a continuous internal assessment by the concerned Course Teacher as well as by an end semester examination and both will be consolidated at the end of the course.

A mark statement with

$$= \frac{\quad \times \quad}{\quad}$$

where the summations cover all the papers appeared up to the current semester.

Also, the marks scored by the candidate will be given percentage.

14. Passing Minimum

A candidate declared to have passed the M. Sc. Chemistry programme provided he scores a minimum of 50% (internal + external) in each paper of the course. No minimum marks for internal assessment. External minimum for external assessment is 45% i.e., 34 out of 75.

14.1. Classification:

S. No	Range of CCPA	Class
1	50 & above but below 60	II
2	60 & Above	I

15. Model Questions

One Model question paper is displayed at the end of the regulation.

16. Teaching Methodology

Each subject is designed with lectures/ tutorials/ seminar/ Peer-Team-Teaching / PPT presentation/ assignments etc., to meet the effective teaching and the learning requirements. 10 % of the course content must be taught through peer team teaching methodology.

17. Text Books

List of all the text books is quoted at the end of the syllabus of each subject.

18. Reference Books

The list of all the reference books is followed by the list of text books. This list contains at least two books for each subject.

19. Retotaling and Revaluation Provision

Candidates may apply for retotaling and revaluation within ten days from the date of the result published in the university website along with the required forms and fees.

20. Transitory provision

The candidates of previous scheme may be permitted to write exams in their own schemes up to the examinations of April 2020 as a transitory provision.

21. Subjects and Paper related websites

All the subject details along with syllabus may be downloaded from the university website www.mkuniversity.org

TANSCHÉ 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.
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Credit Distribution for PG Programme

Semester-I	Credit	Semester-II	Credit	Semester-III	Credit	Semester-IV	Credit
1.1. Core-I	4	2.1. Core-IV	4	3.1. Core-VII	4	4.1. Core-X	4
1.2 Core-II	4	2.2 Core-V	4	3.2 Core-VII	4	4.2 Core-XI	4
1.3 Core – III	4	2.3 Core – VI	4	3.3 Core – IX	4	4.3 Core – XII	4
1.4 Elective (Generic / Discipline Centric)- I	3	2.4 Elective (Generic / Discipline Centric) – III	3	3.4 Elective (Generic / Discipline Centric) – V	3	4.4 Elective (Generic / Discipline Centric) – VI	3
1.5 Elective (Generic / Discipline Centric)-II	3	2.5 Elective (Generic / Discipline Centric)-IV	3	3.5 Core Industry Module	3	4.5 Project with Viva-Voce	3
1.6 Ability Enhancement Course- Soft Skill -1	2	2.6 Ability Enhancement Course - Soft Skill -2	2	3.6 Ability Enhancement Course- Soft Skill -3	2	4.6 Ability Enhancement Course- Soft Skill -4	2
Skill Enhancement Course SEC 1	2	2.7 Skill Enhancement Course SEC 2	2	3.7 Skill Enhancement Course – Term Paper and Seminar Presentation SEC 3	2	4.7 Skill Enhancement Course - Professional Competency Skill	2
				3.8 Internship/ Industrial Activity	2	4.8 Extension Activity	1
	22		22		24		23
	Total Credit Points						91

Core- Papers	12 x 4 = 48
Elective (Generic / Discipline Centric)	8 x 3 = 24
Ability Enhancement Course- Soft Skill -	8 x 2 = 16
Internship/ Industrial Activity	1 x 2 = 2
Extension Activity	1 x 1 = 1
Total Credits	91

ComponentwiseCreditDistribution

Credits	SemI	SemII	SemII I	SemI V	Total
PartA	18	18	18	18	72
Part B					
(i)Discipline– Centric/GenericSkill	2	2	2	2	8
(ii)SoftSkill	2	2	2	2	10
(iii)SummerInternship/Industrial Training			2		
PartC				1	1
Total	22	22	24	23	91

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree

2. Structure of Course

CourseCode	CourseName		Credits
LectureHours:(L) perweek	TutorialHours: (T)perweek	LabPractice Hours: (P)perweek	Total:(L+T+P) perweek
CourseCategory:	Year&Semester:	AdmissionYear:	
Pre-requisite			
Linksto otherCourses			
LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)			
CourseOutcomes:(forstudents:Toknowwhattheyaregoingtolearn)			
CO1:			
CO2:			
CO3:			
CO4:			
CO5:			
Recap:(notforexamination)Motivation/previouslecture/relevantportionsrequiredforthe course)[Thisisdoneduring2Tutorialhours)			
Units	Contents		RequiredHours
I			15
II			15
III			15

IV		15
V		15
Extended Professional Component (is a part of internal component only, Not to	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/other to be solved (To be discussed during the Tutorial hour)	

be included in the External Examination question paper)		
Skills acquired from the course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill	
Learning Resources: • Recommended Texts • Reference Books • Web resources		
Board of Studies Date:		

3. Learning and Teaching Activities

3.1 Topicwise Delivery method

Hour Count	Topic	Unit	Mode of Delivery

3.2 Work Load

The information below is provided as a guide to assist students in engaging appropriately with the course requirements.

Activity	Quantity	Workload periods
Lectures	60	60
Tutorials	15	15
Assignments	5	5

Cycle Test or similar	2	4
Model Test or similar	1	3
University Exam	1	3
Total		90periods

TutorialActivities

Tutorial Count	Topic

4. LaboratoryActivities

5. Field StudyActivities

6. AssessmentActivities

6.1 AssessmentPrinciples:

Assessmentforthiscourseis basedonthefollowingprinciples

1. Assessment must encourageandreinforcelearning.
2. Assessment mustmeasureachievementofthestatedlearningobjectives.
3. Assessmentmustenablerobustandfair judgmentsaboutstudent performance.
4. Assessmentpracticemustbefairandequitabletostudentsandgivethemthe opportunitytodemonstratewhattheylearned.
5. Assessmentmustmaintainacademicstandards.

6.2 AssessmentDetails:

AssessmentItem	DistributedDueDate	Weightage	Cumulative Weightage
Assignment1	3 rd week	2%	2%
Assignment2	6 th Week	2%	4%
CycleTest–I	7 th Week	6%	10%
Assignment3	8 th Week	2%	12%
Assignment4	11 th Week	2%	14%

CycleTest–II	12 th Week	6%	20%
Assignment5	14 th Week	2%	22%
ModelExam	15 th Week	13%	35%
Attendance	Allweeks as perthe AcademicCalendar	5%	40%
UniversityExam	17 th Week	60%	100%

- a. AcademicSchedule
- b. StudentsNameList
- c. TimeTable
- d. Syllabus
- e. LessonPlan
- f. StaffWorkload

CONTENTS

- g. CourseDesign(content,CourseOutcomes(COs),Deliverymethod,mappingofCOswithProgrammeOutcomes(POs), AssessmentPatternintermsofRevisedBloom'sTaxonomy)
- h. SampleCOAssessmentTools.
- i. FacultyCourseAssessment Report(FCAR)
- j. CourseEvaluationSheet
- k. TeachingMaterials(PPT,OHPetc)
- l. Lecture Notes
- m. HomeAssignmentQuestions
- n. TutorialSheets
- o. RemedialClassRecord,ifany.
- p. Projectsrelated tothe Course
- q. LaboratoryExperimentsrelatedto the Courses
- r. InternalQuestionPaper
- s. ExternalQuestionPaper
- t. SampleHomeAssignmentAnswerSheets
- u. Threebest,threemiddlelevelandthreeaverageAnswersheets
- v. ResultAnalysis(COwiseandwholeclass)
- w. QuestionBank
forHigherstudiesPreparation(GATE/Placement)
- x. Listofmenteesandtheiracademicachievements

Credit Distribution for PG Programme in Chemistry

M.Sc. Chemistry

First Year Semester-I

	Courses	Credit	Hours per Week (L/T/P)
Part A	Core Courses 3 (CC1, CC2, CC3)	12	15
	Elective Courses 2 (Generic/Discipline Specific) EC1, EC2	6	10
Part B	Skill Enhancement Course- SEC1 (One from Group G)	2	3
	Ability Enhancement Compulsory Course (AECC1) Soft Skill-1	2	2
		22	30

Semester-II

	Courses	Credit	Hours per Week (L/T/P)
Part A	Core Courses 3 (CC4, CC5, CC6)	12	15
	Elective Course 2 (Generic/Discipline Specific) EC3, EC4	6	10
Part B	Skill Enhancement Course- SEC2 (One from Group G)	2	3
	Ability Enhancement Compulsory Course (AECC2) Soft Skill-2	2	2
		22	30

Second Year-Semester-III

	Courses	Credit	Hours per Week (L/T/P)
Part A	Core Courses 3 (CC7, CC8, CC9)	12	15
	Elective Course 1 (Generic/Discipline Specific) EC5	3	5
	Core Industry Module	3	4
Part B	Skill Enhancement Course- SEC3 Professional Communication Skill (Term Paper & Seminar Presentation)	2	4
	Ability Enhancement Compulsory Course (AECC3) Soft Skill-3	2	2
	Internship/Industrial Activity (Carried out in Summer Vacation at the end of Year – 30 hours)	2	

		24	30
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Semester-IV

Part	Courses	Credit	Hours per Week(L/T/P)
PartA	CoreCourses3(CC10,CC11,CC12)	12	15
	ElectiveCourse1(Generic/DisciplineSpecific)EC6	3	5
	ProjectwithVivavoce(CC13)	3	4
PartB	ProfessionalCompetencySkillEnhancement CourseTrainingforCompetitive Examinations • ChemistryforNET/UGC-CSIR/SET/TRBCompetitiveExaminations(2hours) • GeneralStudiesforUPSC/TNPSC/OtherCompetitiveExaminations(2hours) OR ChemistryforAdvancedResearchStudies(4hours)	2	4
	AbilityEnhancementCompulsoryCourse(AECC4)SoftSkill-4	2	2
PartC	Extension Activity(Can be carriedoutfromSemIIto SemIV)	1	
		23	30

Credit Distribution for PG Programme in Chemistry M.Sc.

Chemistry

Illustration-I

	First Year Semester-I	Credit	Hours per week (L/T/P)
Part A	CC1–Organic Reaction Mechanism-I	4	5(4L+ 1T)
	CC2–Structure and Bonding in Inorganic Compounds	4	5(4L+ 1T)
	CC3 –Organic Chemistry Practical	4	5(4L+ 1T)
	Elective I (Generic/Discipline Specific) (One from Group A) Pharmaceutical Chemistry/Nanomaterials and Nanotechnology	3	5(4L+ 1T)
	Elective II (Generic/Discipline Specific) (One from Group B) Electrochemistry/Molecular Spectroscopy	3	5(4L+ 1T)
Part B	Ability Enhancement Compulsory Course (AECC 1) Soft Skill-1	2	2
	Skill Enhancement Course-SEC1 (One from Group G)	2	3
	Total	22	30

	Semester-II	Credit	Hours per week (L/T/P)
Part A	CC4–Organic reaction mechanism-II	4	5(4L+ 1T)
	CC5–Physical Chemistry-I	4	5(4L+ 1T)
	CC6–Inorganic Chemistry Practical	4	5(4L+ 1T)
	Elective III (Generic/Discipline Specific) (One from Group C) Medicinal Chemistry/Green Chemistry	3	5(4L+ 1T)
	Elective-IV (Computer /IT related) (One from Group D) Bio Inorganic Chemistry/Material Science	3	5 (3L+ 2 P)
Part B	Skill Enhancement Course-SEC2 (One from Group G)	2	3
	Ability Enhancement Compulsory Course (AECC 2) Soft Skill-2	2	2
	Total	22	30

	SecondYear - Semester-III	Credit	Hoursper week(L/T/P)
PartA	CC7– Organic synthesis and Photochemistry	4	5(4L+ 1T)
	CC8 –Coordination Chemistry-I	4	5(4L+ 1T)
	CC9 – Physical Chemistry Practical	4	5(4L+ 1T)
	ElectiveV(Generic/DisciplineSpecific) (OnefromGroupE) Pharmacognosy and Phytochemistry	3	5(4L+ 1T)
	CoreIndustryModule	3	5(4L+ 1T)
PartB	Internship/IndustrialActivity (Carriedout inSummerVacationattheend ofIyear– 30hours)	2	
	SkillEnhancementCourse-SEC3: ProfessionalCommunication Skill-Termpaper&Seminarpresentation	2	3
	AbilityEnhancementCompulsoryCourse (AECC3)SoftSkill-3	2	2
	Total	24	30

	Semester-IV	Credit	Hoursper week(L/T/P)
PartA	CC10–Coordination Chemistry-II	4	5(4L+ 1T)
	CC11–Physical Chemistry-II	4	5(4L+ 1T)
	CC12– Analytical Instrumentation technique Practicals	4	5(4L+ 1T)
	ElectiveVI (Generic/DisciplineSpecific) (OnefromGroupF) Chemistry of Natural products/Polymer Chemistry	3	5(4L+ 1T)
	CoreProjectwithvivavoce	3	4
PartB	ProfessionalCompetencySkillEnhancement CourseTrainingforCompetitive Examinations - ChemistryforNET/UGC- CSIR/SET/TRBCompetitiveExaminations(2hours) - GeneralStudiesforUPSC/TNPSC/OtherCompetitiveExaminations(2hours) OR Chemistry for AdvancedResearchStudies(4hours)	2	4
	AbilityEnhancementCompulsoryCourse (AECC 4)SoftSkill-4	2	2
PartC	ExtensionActivity	1	
	Total	23	30

TOTALCREDITS:91

Consolidated Table for Credits Distribution

	Category of Courses	Credits for each Course	Number of Courses	Number of Credits in each Category of Courses	Total Credits	Total Credits for the Programme
PART A	Core	4	12	48	72	
	Project with viva voce	3	1	3		
	Industry aligned Programmes-	3	1	3		
	Elective (Generic and Discipline Centric)	3	6	18		
PART B (i)	Skill Enhancement (Term paper and Seminar & Generic/Discipline - Centric Skill Courses) (Internal Assessment Only)	2	4	8	8	80 (CGPA)
PART B (ii)	Ability Enhancement (Soft skill)	2	4	8	10	11 (Non CGPA)
	Summer Internship	2	1	2		
PART C	Extension Activity	1	1	1	1	
						91

7. Template for Semester

Code	Category	TitleofthePaper	Marks (Max100)		Duration forUE	Credits
			CIA	UE		
Semester-I						
PartA	CoreI		25	75	3Hrs	4
	CoreII		25	75	3Hrs	4
	CoreIII		25	75	3Hrs	4
	ElectiveI	Elective-I(Chooseonefrom Group-A)	25	75	3Hrs	3
	ElectiveII	Elective-II(Choose one fromGroup-B)	25	75	3Hrs	3
PartB	Skill Enhancement Course-SEC1	(Choose One fromgroupG)	InternalAssessment			2
	AbilityEnhan cement Course (AECC1)	SoftSkillI	Performance basedassessment			2
Semester-II						
PartA	CoreIV		25	75	3Hrs	4
	CoreV		25	75	3Hrs	4
	CoreVI		25	75	3Hrs	4
	ElectiveIII	Elective-III (Choose one fromGroup-C)	25	75	3Hrs	3
	ElectiveIV	Elective-IV(Chooseonefro m Group-D)	25	75	3Hrs	3
PartB	SkillEnhance ment Course-SEC2	(Choose one fromGroup-G)	InternalAssessment			2

	AbilityEnhancement Course (AECC2)	SoftSkillII	Performance basedassessment	2
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Semester-III						
PartA	Core VII		25	75	3Hrs	4
	Core VIII		25	75	3Hrs	4
	CoreIX		25	75	3Hrs	4
	Elective/EDV	Elective-VI /ED-V(Chooseonefrom Group-E)	25	75	3Hrs	3
	Core IndustryMod ule	ED-IV (Choosefrom outside theDepartme nt)	25	75	3Hrs	3
PartB						
	Skill based(Termpap erandSeminar)	Assignmentofproblem bythefacultyLecture-I(bythestudent) 25%Lecture-II(bythestudent) 25%Lecture-III(bythestudent) 25% Submissionofawrite-up (10-15pagesusingLaTeX) 25% Marks/Grade Point/ LetterGrade asperthe Regulation)				2
	AbilityEnhan cement Course (AECC3)	SoftSkillIII	Performance basedassessment			2
	Internship/Industrial- VacationActivity					2
Semester-IV						
PartA	CoreX		25	75	3Hrs	4
	CoreXI		25	75	3Hrs	4
	Core XII		25	75	3Hrs	4
	Projectwithviva voce XIII		25	75	3Hrs	3
	ElectiveVI	Elective-VI (Choose one fromGroup-F)	25	75	3Hrs	3
PartB	SkillEnhance ment Course-SEC4	ProfessionalCompete ncy Skill EnhancementCourse	InternalAssessment			2
	AbilityEnhan cement Course(AECC4)	SoftSkillIV	Performance basedassessment			2

PartC	Extension Activity	Performancebasedassessment	1
TotalCredits			91

Elective Courses

Courses are grouped (Group A to Group F) so as to include topics from Pure Chemistry (P C), Applied Chemistry (AC) and Industrial Components (IC) like pharmaceutical industries, Polymer labs courses for flexibility of choice by the stakeholders/institutions.

Semester I: Elective I and Elective II

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

Group A: (PC/AC/IC)

1. Pharmaceutical Chemistry
2. Nanomaterials and Nanotechnology

Group B: (PC/AC/IC)

1. Electrochemistry
2. Molecular Spectroscopy

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. Medicinal Chemistry
2. Green Chemistry

Group D: (PC/AC/IC)

1. Bioinorganic Chemistry
2. Material Science

Semester III: Elective V

Elective V to be chosen from Group E.

Group E: (PC/AC/IC)

1. Pharmacognosy and Phytochemistry
2. Biomolecules and Heterocyclic compounds

Semester IV: Elective VI

Elective VI to be chosen from Group F.

Group F: (PC/AC/IC)

1. Chemistry of Natural products
2. Polymer Chemistry

Skill Enhancement Courses

Skill Enhancement Courses are chosen to keep in pace with the latest developments in the 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

- Soft Skill courses

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

8. Instructions for Course Transaction

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

9. 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 25 marks. 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.**

TANSCHÉ 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.
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Title of the Course	ORGANIC REACTION MECHANISM - I						
Paper No.	Core I						
Category	Core	Year	I	Credits	4	Course Code	
		Semester	I				
Instructional hours per week	Lecture	Tutorial	Lab Practice			Total	
	4	1	-			5	
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: Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate.Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism.Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants. UNIT-II:Aromatic and Aliphatic Electrophilic Substitution: Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions.Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences. UNIT-III:Aromatic and Aliphatic Nucleophilic Substitution:Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attackingnucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and						

	Smiles rearrangements. S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. S_N1, S_N2, S_Ni, and S_E1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles. UNIT-IV:Stereochemistry-I: Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining the configuration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation. D, L system, Cram's and Prelog's rules: R, S-notations, 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. Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis. UNIT-V:Stereochemistry-II: Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J. March and M. Smith, Advanced Organic Chemistry, 5th 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, 7 th edn, Prentice Hall, 2013. 5. J. Clayden, N. Greeves, S. Warren, Organic Compounds, 2 nd edition, Oxford University Press, 2014.
Reference Books	1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5 th 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, 6 th edition, Pearson Education Asia, 2004.
Website and e-learning source	1. https://sites.google.com/site/chemistrybookscollection02/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 organic reactions. 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 stereochemistry of 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

	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

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 R West, Solid state Chemistry and its applications, 2nd Edition (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 various chemical 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 suitable procedure for organic preparations.	

CO-PO Mapping (Course Articulation Matrix)

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

	modification of lead compounds. Structure-Activity Relationship (SAR): Factors affecting bioactivity, resonance, inductive effect, isomerism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory, 4.3 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables. UNIT-V: Computers in Pharmaceutical Chemistry: Need of computers for chemistry. Computers for Analytical Chemists- Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C++) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, extrapolation, data smoothing, numerical differentiation and integrations.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE / TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Physical Chemistry- Bahl and Tuli. 2. Text Book of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan-.C.V.S. Subramanyam. 3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house. 4. Instrumental method of Analysis: Hubert H, Willard, 7th edition. 5. Textbook of Pharmaceutical Chemistry by, Jayashree Ghosh, S. Chand & company Ltd. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultanchand & Sons.
Reference Books	1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993. 2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2nd edition, New age international (P) limited, New Delhi. 3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins. 4. Cooper and Gunn's Tutorial Pharmacy, 6th edition by S.J. Carter, CBS Publisher Ltd. 5. Ansel's pharmaceutical Dosage forms and Drug Delivery System by Allen Popovich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

Website and e-learning source	https://www.ncbi.nlm.nih.gov/books/NBK482447/ https://training.seer.cancer.gov/treatment/chemotherapy/types.html
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: CO1: To identify the suitable drugs for various diseases. CO2: To apply the principles of various drug action and drug design. CO3: To acquire the knowledge on product development based on SAR. CO4: To apply the knowledge on applications of computers in chemistry. CO5: To synthesize new drugs after understanding the concepts SAR.	

CO-PO Mapping (Course Articulation Matrix)

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

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

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

3 – Strong, 2 – Medium, 1 - Low

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

	determination, Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}. Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams. UNIT-V: Concentration Polarization, Batteries and Fuel cells: Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. D. R. Crow, Principles and applications of electrochemistry, 4th edition, 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, electrostatics and activity coefficient of electrolytes CO5: To have knowledge on storage devices and electrochemical reaction mechanism.	

CO-PO Mapping (Course Articulation Matrix)

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

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

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

3 – Strong, 2 – Medium, 1 - Low

	UNIT-IV:NMR and ESR spectroscopy: Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX₂, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. ¹³CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to ³¹P, ¹⁹F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples. UNIT-V:Mass Spectrometry, EPR and Mossbauer Spectroscopy: Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of 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 question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. C. N. Banwell and E. M. McCash, <i>Fundamentals of Molecular Spectroscopy</i>, 4th Ed., Tata McGraw Hill, New Delhi, 2000. 2. R. M. Silverstein and F. X. Webster, <i>Spectroscopic Identification of Organic Compounds</i>, 6th Ed., John Wiley & Sons, New York, 2003. 3. W. Kemp, <i>Applications of Spectroscopy</i>, English Language Book Society, 1987. 4. D. H. Williams and I. Fleming, <i>Spectroscopic Methods in Organic Chemistry</i>, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988. 5. R. S. Drago, <i>Physical Methods in Chemistry</i>; Saunders: Philadelphia, 1992.
Reference Books	1. P.W. Atkins and J. de Paula, <i>Physical Chemistry</i>, 7th Ed., Oxford University Press, Oxford, 2002. 2. I. N. Levine, <i>Molecular Spectroscopy</i>, John Wiley & Sons, New York, 1974. 3. A. Rahman, <i>Nuclear Magnetic Resonance-Basic Principles</i>, Springer-Verlag, New York, 1986. 4. K. Nakamoto, <i>Infrared and Raman Spectra of Inorganic and coordination Compounds</i>, PartB: 5th ed., John Wiley& Sons Inc., New York, 1997. 5. J. A. Weil, J. R. Bolton and J. E. Wertz, <i>Electron Paramagnetic Resonance</i>; 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 F NMR and ESR spectroscopic techniques. CO5: To develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy 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

	and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements. UNIT-IV: Addition to Carbon Multiple Bonds: Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms- Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions. Addition to Carbon-Hetero atom Multiple bonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. UNIT-V: Reagents and Modern Synthetic Reactions: Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride (NaBH_3CN), <i>meta</i>-Chloroperoxybenzoic acid (m-CPBA), Dimethyl aminopyridine (DMAP), <i>n</i>-Bu_3SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), <i>N</i>-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperidin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB). Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($\text{Cu}(\text{acac})_2$), TiCl_3, NaIO_4, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex. Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE / TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. J. March and M. Smith, <i>Advanced Organic Chemistry</i>, 5th ed., John-Wiley and Sons, 2001. 2. E. S. Gould, <i>Mechanism and Structure in Organic Chemistry</i>, Holt, Rinehart and Winston Inc., 1959. 3. P. S. Kalsi, <i>Stereochemistry of carbon compounds</i>, 8th edn, New Age International Publishers, 2015. 4. P. Y. Bruice, <i>Organic Chemistry</i>, 7th edn., Prentice Hall, 2013. 5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, <i>Organic Chemistry</i>, 7th edn., Pearson Education, 2010.
Reference Books	1. S. H. Pine, <i>Organic Chemistry</i>, 5th edn, McGraw Hill International Edition, 1987. 2. L. F. Fieser and M. Fieser, <i>Organic Chemistry</i>, Asia Publishing House, Bombay, 2000. 3. E. S. Gould, <i>Mechanism and Structure in Organic Chemistry</i>, Holt, Rinehart and Winston Inc., 1959. 4. T. L. Gilchrist, <i>Heterocyclic Chemistry</i>, Longman Press, 1989. 5. J. A. Joule and K. Mills, <i>Heterocyclic Chemistry</i>, 4th ed., John-Wiley, 2010.
Website and e-learning source	1. https://sites.google.com/site/chemistrybookscollection02/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: To design 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

	molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of Arrhenius equation to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. 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-Michaelis-Menten catalysis. UNIT-V: Kinetics of complex and fast reactions: Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of $H_2 - Cl_2$ & $H_2 - Br_2$ reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods-temperature and pressure jump methods 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. Benjamin Publishers, 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. Kuriacose, Kinetics and Mechanisms of chemical transformation, Macmillan India Ltd, Reprint - 2011.
Reference Books	1. D.A. McQuarrie 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. Yatsimirski, "Kinetic Methods of Analysis", Pergamon 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 and mixtures.

CO5: To compare the theories of reaction 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

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, <i>Inorganic Semimicro Qualitative Analysis</i> ; 3rded., The National Publishing Company, Chennai, 1974. 3. <i>Vogel's Text book of Inorganic Qualitative Analysis</i> , 4thed., ELBS, London.
Reference Books	1. G. Pass, and H. Sutcliffe, <i>Practical Inorganic Chemistry</i> ; Chapman Hall, 1965. 2. W. G. Palmer, <i>Experimental Inorganic Chemistry</i> ; 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 and spot 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

examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry, 2. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011. 3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. - Jayashree Ghosh, A textbook of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn. 4. O. Le Roy, Natural and synthetic organic medicinal compounds, Elsevier, 1976. 5. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.
Reference Books	1. Foye's Principles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012 2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010. 3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn. 4. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers. 1995. 5. S. Ramakrishnan, K. G. Prasanna and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition, 2001.
Website and e-learning source	1. https://www.ncbi.nlm.nih.gov/books/NBK482447/ 2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html 3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: CO1: Predict a drug's properties based on its structure. CO2: Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design. CO3: Explain the relationship between drug's chemical structure and its therapeutic properties. CO4: Designed to give the knowledge of different theories of drug actions at molecular level. CO5: To identify different targets for the development of new drugs for the treatment of infectious and GIT.	

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

examination question paper)	
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, 7th edition, McGraw-Hill, New Delhi, 2005. 3. J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall, 1974. 4. V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001. 5. A. K. De, Environmental Chemistry, New Age Publications, 2017.
Reference Books	1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998 2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001 3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000 4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002. 5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.
Website and e-learning source	2. https://www.organic-chemistry.org/ 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

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. –Introduction to Bioinorganic chemistry. 2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry,RoyalSoceity 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, <i>Concise Coordination Chemistry</i>, 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

	UNIT-V:Materials for Renewable Energy Conversion: Solar Cells: Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO ₂ and N ₂ . Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. S. Mohan 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.Suggested Readings 1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001. 2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001. 3.. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966. 4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998. 5. A.R. West, Solid State Chemistry and Applications, John-Wiley and sons, 1987.
Website and e-learning source	1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf. 3. https://bit.ly/3QyVg2R
Course Learning Outcomes (for Mapping with POs and PSOs)	
Students will be able: CO1: To understand and recall the synthesis and characteristics of crystal structures,semiconductors, magnets, nanomaterials and renewable energy materials. CO2: To integrate and assess the structure of different materials and their properties. CO3: To analyse and identify new materials for energy applications. CO4: To explain the importance of crystal structures, piezoelectric and pyroelectricmaterials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LEDuses, structures and synthesis.	

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

CO-PO Mapping (Course Articulation Matrix)

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

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

	UNIT-IV:Organic Photochemistry-I: Photochemical excitation: Experimental techniques; electronic transitions; Jablonskii diagrams; intersystem crossings; energy transfer processes; Stern Volmer equation. Reactions of electronically excited ketones; $\pi \rightarrow \pi^*$ triplets; Norrish type-I and type-II cleavage reactions; photo reductions; Paterno-Buchi reactions; UNIT-V:Organic Photochemistry-I: Photochemistry of α,β-unsaturated ketones; cis-trans isomerisation. Photon energy transfer reactions, Photo cycloadditions, Photochemistry of aromatic compounds; photochemical rearrangements; photo-stationary state; di-π-methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton's reactions.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5th ed, Tata McGraw-Hill, New York, 2003. 2. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007. 3. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990. 4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, 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 4th edn, 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

	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

Component (is a part of internal component only, Not to be included in the external examination question paper)	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/~nkrur/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

	hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House. 2. S.V.Bhat, B.A. Nagasampagi, M.Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers.
Reference Books	1. Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer. 2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2nd edition, New age international (P) limited, New Delhi.
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: CO1: To recall the sources of natural medicines and analysis of crude drugs. CO2: To understand the methods of evaluation based on various parameters. CO3: To analyze the isolated drugs CO4: To apply various techniques to discover new alternative medicines. CO5: To evaluate the isolated drugs for various pharmacological activities	

CO-PO Mapping (Course Articulation Matrix)

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

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

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

3 – Strong, 2 – Medium, 1 - Low

	nucleoside modification, conversion of nucleoside to nucleotides. Primary and secondary structure of RNA and DNA, Watson-Crick model, solid phase synthesis of oligonucleotides.
	UNIT-V:Fused Ring Heterocyclic Compounds: Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America, 2007. I. L. Finar, Organic Chemistry Vol-2, 5 th edition, Pearson Education Asia, 1975. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi, 2009.
Reference Books	I. L. Finar, Organic Chemistry Vol-1, 6 th edition, Pearson Education Asia, 2004. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000. Shoppe, Chemistry of the steroids, Butterworths, 1994. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad, 2004. M. P. Singh. and H. Panda, Medicinal Herbs with their formulations, Daya Publishing House, Delhi, 2005.
Website and e-learning source	ps://www.organic-chemistry.org/ ps://www.studyorgo.com/summary.php ps://www.clutchprep.com/organic-chemistry
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: CO1: To understand the basic concepts of biomolecules and natural products.	

CO2: To integrate and assess the different methods of preparation of structurally different biomolecules and natural products.

CO3: To illustrate the applications of biomolecules and their functions in the metabolism of living organisms.

CO4: To analyse and rationalise the structure and synthesis of heterocyclic compounds.

CO5: To develop the structure of biologically important heterocyclic compounds by different 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

	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 (N₂, O₂) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules (H₂O, CO₂, CH₄, NH₃) – 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 Gütllich, 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, Physical 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

	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, cyclopropenyl, cyclo 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

	8. Estimation of the amount of nitrate present in the given solution using spectrophotometric method. 9. Heavy metal analysis in textiles and textile dyes by AAS 10. Determination of caffeine in soft drinks by HPLC 11. Analysis of water quality through COD, DO, BOD measurements. 12. Assay of Riboflavin and Iron in tablet formulations by spectrophotometry 13. Estimation of chromium in steel sample by spectrophotometry 14. Determination of Stern-Volmer constant of Iodine quenching by fluorimetry 15. Determination of ascorbic acid in real samples using Differential Pulse Voltammetry and comparing with specifications 16. Separation of (a) mixture of Azo dyes by TLC (b) mixture of metal ions by Paper chromatography 17. Estimation of chlorophyll in leaves and phosphate in waste water by colorimetry. 18. Estimation of Fe(II) by 1,10 phenanthroline using spectrophotometry 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	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, <i>Vogel's Textbook of Quantitative Chemical Analysis</i>; 6th ed., ELBS, 1989. 3. J. D. Woollins, <i>Inorganic Experiments</i>; 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

	UNIT-V:NaturalDyes: Occurrence, classification, isolation, purification, properties, colour and constitution. Structural determination and synthesis of indigoitin and alizarin.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 1, Himalaya Publishing House, Mumbai, 2009. 2. G. K. Chatwal, Organic Chemistry on Natural Products, Vol. 2, Himalaya Publishing House, Mumbai, 2009. 3. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 1, Goel Publishing House, Meerut, 1997. 4. O. P. Agarwal, Chemistry of Organic Natural Products, Vol. 2, Goel Publishing House, Meerut, 1997. 5. I. L. Finar, Organic Chemistry Vol-2, 5th edition, Pearson Education Asia, 1975.
Reference Books	1. I. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia, 2004. 2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co, 2000. 3. Shoppe, Chemistry of the steroids, Butterworths, 1994. 4. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad, 2004.
Website and e-learning source	https://sites.google.com/site/chemistrybookscollection02/home/organic-chemistry/organic
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: CO1: To understand the biological importance of chemistry of natural products. CO2: To scientifically plan and perform the isolation and characterization of synthesized natural products. CO3: To elucidate the structure of alkaloids, terpenoids, carotenoids, flavanoids and anthocyanins. CO4: To determine the structure of phytochemical constituents by chemical and physical methods. CO5: To interpret the experimental data scientifically to improve biological activity of active components.	

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

(is a part of internal 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. V.R. Gowariker, <i>Polymer Science</i>, Wiley Eastern, 1995. 2. G.S. Misra, <i>Introductory Polymer Chemistry</i>, New Age International (Pvt) Limited, 1996. 3. M.S. Bhatnagar, <i>A Text Book of Polymers</i>, vol-I & II, S.Chand & Company, New Delhi, 2004.
Reference Books	1. F. N. Billmeyer, <i>Textbook of Polymer Science</i>, Wiley Interscience, 1971. 2. A. Kumar and S. K. Gupta, <i>Fundamentals and Polymer Science and Engineering</i>, Tata McGraw-Hill, 1978.
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: CO1: To understand the bonding in polymers. CO2: To scientifically plan and perform the various polymerization reactions. CO3: To observe and record the processing of polymers. CO4: To calculate the molecular weight by physical and chemical methods. CO5: To interpret the experimental data scientifically to improve the quality of synthetic polymers.	

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

Title of the Course: CORE INDUSTRIAL MODULES**PaperNumber: COREX****SuggestivetopicsforCoreIndustryModules:****1. IndustrialProcessesRecommended****Text:**

1. H.A.Strobel,ChemicalInstrumentation:ASystematicapproach,2ndEdition(1973)AdditionWesley,Reading,Mass
2. R.L.Pecsok,L.D.Shields,T.CavinsandL.C.Mcwilliam,2ndEdition(1976),JohnWiley&Sons,NewYork
3. E.W.Berg,ChemicalMethodsofSeparations,1stEdition(1963),McGrawHill,NewYork

2.Chemometricsandqualitycontrol**inindustryRecommendedText:**

4. G.D.Christian,Analyticalchemistry,5thedition(1994),JohnWiley&Sons,NewYork
5. M.A.SharatandD.L.Illuran,Chemometrics,JohnWiley,NewYork
6. Canlcutt
andR.Roddy,StatisticsforAnalyticalChemists,ChapmanandHall,NewYork.