PERIYAR UNIVERSITY

(NAAC 'A^{++}' Grade-State University-NIRF Rank 59 NIRF-Innovation band 11-50)

SALEM – 636 011

M.Sc. DEGREE

[Choice Based Credit System (CBCS)]

Branch IV (A) CHEMISTRY

Programme Code : CHE

REGULATIONS AND SYLLABUS

FROM THE ACADMIC YEAR
2023-2024

CONTENTS

I - Programme Outcomes:

1. Graduates are prepared to be creators of new knowledge leading to innovation and entrepreneurship employable in various sectors.
2. Graduates are trained to evolve new technologies in chemistry.
3. Graduates are groomed to engage in lifelong learning process by exploring their knowledge independently.
4. Graduates are nurtured to design and conduct experiments /demos/create models to analyze and interpret data independently.
5. Graduates will be able to effectively communicate the findings of Chemical Sciences.

II- Programme Specific Outcomes:

1. M.Sc. Chemistry graduates will earn human and social values and responsibilities in the context of learning Chemistry.
2. The graduates will attain positive approach towards Environment and Ecology from the Chemistry perspective.
3. Graduates will acquire critical thinking and analytical mind, with the in depth knowledge in advanced Chemistry.
4. The graduates will extend their Chemistry knowledge in solving social issues.
5. Entrepreneurial skills shall empower the students to start their own industries/ business in core Chemistry fields.

III - Objectives of the programme

Life has changed more in the past two centuries than in all the previously recorded span of human history. In one-way or another, all the changes involve CHEMISTRY. Chemistry is central to the current revolutions in Science. No educated person today can understand the modern world without a basic knowledge of chemistry. The existence of a large number of chemical factories, mines and related industries in the catchments of University necessitates chemistry education.Hence our goal in introducing the M.Sc. programme in Chemistry has been to educate the undergraduate students in the fascinating fields of chemistry in an effective manner. Rigorous and comprehensive in approach, this syllabus presents essential contents in a detailed, clear and direct way.

M.Sc. Chemistry is a unique kind of course dealing with all aspects of chemistry such as preparation, properties, structure elucidation, kinetics and mechanism of the reaction, techniques of analysis for different kinds of materials, which are very essential for the human society. The major objectives of M.Sc. Chemistry course are:

- To impart knowledge in fundamental aspects of all branches of chemistry
- To acquire deep knowledge in the study of physical, chemical, electrochemical and magnetic properties, structure elucidation using various techniques and applications of various organic and inorganic materials and
- To acquire basic knowledge in the specialized areas like Nanomaterial Chemistry, Polymer chemistry, Environmental Chemistry, Green Chemistry, Pharmaceutical Chemistry etc.

This programme is offered under Choice Based Credit System (CBCS). Outcome based Education(OBE) is followed in the syllabi. The CBCS enables the students to select variety of subjects as per their interest and requirement. Acquiring knowledge in the related fields is advantageous to the students. The programme is structured in such a way to impart more knowledge in science, in particular, in Chemistry.

IV- Eligibility for Admission

A candidate who has passed B.Sc., Degree Examination with Branch IV Chemistry as main subject of study of this university or any of the B.Sc., degree examination with specialization such as Industrial chemistry, Polymer Chemistry, Applied Chemistry, Pharmaceutical Chemistry or any other specialization in Chemistry of some other universities accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed thereto shall be permitted to appear and qualify for the M.Sc. degree in Chemistry of this University after a course of study of two academic years.

V - Duration of the Programme

The programme for the degree of Master of Science in Chemistry shall consist of two academic years divided in

Semester I	**Credit**	**Hours**	**Semester II**	**Credit**	**Hours**	**Semester III**	**Credit**	**Hours**	**Semester IV**	**Credit**	**Hours**
Core-I	5	7	Core-IV	5	6	Core-VII	5	6	Core-XI	5	6
Core-II	5	7	Core-V	5	6	Core-VIII	5	6	Core-XII	5	6
Core – III	4	6	Core – VI	4	6	Core – IX	5	6	Project with viva voce	7	10
Elective -I Discipline Centric	3	5	Elective – III Discipline Centric	3	4	Core – X	4	6	Elective - VI (Industry / Entrepreneurship) 20% Theory 80% Practical	3	4
Elective -II Generic:	3	5	Elective - IV Generic:	3	4	Elective - V Discipline Centric	3	3	Skill Enhancement course / Professional Competency Skill	2	4
			NME I	2	4	3.6 NME II	2	3	Extension Activity	1	
						3.7 Internship / Industrial Activity	2	-			
	20	**30**		**22**	**30**		**26**	**30**		**23**	**30**
Total Credit Points -91											

to four semesters. Each Semester consist of 90 working days.

VI –Credit Distribution and Course of Study

ComponentwiseCreditDistribution

Credits	SemI	Sem II	Sem III	SemI V	Total
PartA -Core	14	14	19	17	64
Part B (i)Elective –Discipline– Centric	3	3	3	-	9
(ii)Elective- Generic	3	3	-		6
(iii) Elective –industry				3	3
(iv)Skill enhancement				2	2
(v)NME		2	2		4
(vi)Summer Internship/Industrial Training			2		2
PartC –Extension activity				1	1
Total	20	22	26	23	91

Part A component and Part B (i) will be taken into account for CGPA calculation for thepostgraduateprogrammeandtheothercomponentsPartB

M.Sc. Chemistry - CBCS

Structure of the Programme

S. No	Paper code	Title of the Paper	Hours	L	T	P	C
First Semester							
1.	23UPCHE1C01	Core Course 1 - Organic reaction mechanism - I	7	6	1	0	5
2.	23UPCHE1C02	Core Course 2 - Structure & bonding in inorganic compounds	7	6	1	0	5
3.	23UPCHE1C03	Core Course 3 - Organic chemistry practical	6	0	0	6	4
4.	23UPCHE1E--	Elective course 1 - Discipline centric	5	4	1	0	3
5.	23UPCHE1E---	Elective course 2 - Generic	5	4	1	0	3
		Total	30	20	4	6	20
Second Semester							
7.	23UPCHE1C04	Core Course 4 - Organic reaction mechanism –II	6	5	1	0	5
8.	23UPCHE1C05	Core Course 5 - Thermodynamics and chemical kinetics	6	5	1	0	5
9.	23UPCHE1C06	Core Course 6 - Inorganic chemistry practical	6	0	0	6	4
10.	23UPCHE1E--	Elective course 3 - Discipline centric	4	3	1	0	3
11.	23UPCHE1E--	Elective course 4 - Generic	4	3	1	0	3
12	23UPPGC1H01	Human Rights	1	-	-	-	1
13.	23UPCHE1N--	Non Major Elective - I	SWAYAM/NPTEL				2
		Total	27	19	5	6	23
	23UPCHE1I01	INTERNSHIP-During Summer Vacation					
Third Semester							
13.	23UPCHE1C07	Core Course 7 - Organic Synthesis and photochemistry	6	5	1	0	5
14.	23UPCHE1C08	Core Course 8 - Coordination chemistry - 1	6	5	1	0	5
15.	23UPCHE1C09	Core Course - 9 Quantum chemistry and group theory	6	5	1	0	5
16.	23UPCHE1C10 --	Core Course 10 - Physical Chemistry practical	6	0	0	6	4
17.	23UPCHE1E--	Elective course - 5 Discipline Centric	3	3	0	0	3
18.	23UPCHE1N--	Non Major Elective -2	3	3	0	0	2
19.	23UPCHE1I01	Internship Viva	-	-	-	-	2
		Total	30	21	3	6	26
Fourth Semester							
20.	23UPCHE1C11	Core Course 11 - Coordination Chemistry -2	6	5	1	0	5
21.	23UPCHE1C12	Core Course 12 - Equilibria and surface chemistry	6	5	1	0	5
22.	23UPCHE1C13	Core Course 13-Project	10	0	0	10	7
23.	23UPCHE1E--	Elective course - 6 (Industry / Entrepreneurship)	4	1	0	3	3
24.	23UPCHE1E--	Skill Enhancement course	4	3	1	0	2
25.	23UPCHE1X01	Extension Activity	-	-	-	-	1
26.	23UPCHE1V01	Value Added Course	-	-	-	-	-
		Total	30	14	03	13	23

Total Credits: 92

Elective Courses – Discipline Centric

1.	23UPCHE1E01	Electrochemistry
2.	23UPCHE1E02	Bioinorganic Chemistry
3.	23UPCHE1E03	Biomolecules and Heterocyclic Compounds
4.	23UPCHE1E04	Medicinal Chemistry
5.	23UPCHE1E05	Green Chemistry
6.	23UPCHE1E06	Chemistry of Natural Products
7.	23UPCHE1E07	Polymer Chemistry

Elective Courses 2 – Generic

1.	23UPCHE1E08	Nanomaterials and Nanotechnology
2.	23UPCHE1E09	Molecular Spectroscopy
3.	23UPCHE1E10	Pharmaceutical Chemistry
4.	23UPCHE1E11	Pharmacognosy and Phytochemistry
5.	23UPCHE1E12	Material Science

Elective - (Industry / Entrepreneurship)

1.	23UPCHE1E13	Cosmetic Chemistry
2.	23UPCHE1E14	Chemical Polishing of metals
3.	23UPCHE1E15	Preparation of Consumer Products

Skill Enhancement Courses

1.	23UPCHE1E16	Research Tools and Techniques
2.	23UPCHE1E17	Chemical Safety and Health
3.	23UPCHE1E18	Computational Chemistry

Non-Major Elective courses

1.	23UPCHE1N01	Chemistry and Health
2.	23UPCHE1N02	Industrial Chemistry
3.	23UPCHE1N03	Chemistry in Agriculture
4.	23UPCHE1N04	Chemistry in Daily Life
5.	23UPCHE1N05	Environmental Chemistry
6.	23UPCHE1N06	Chemistry in Consumer Products
7.	23UPCHE1N07	Chemistry for life sciences
8.	23UPCHE1N08	Fundamentals of Analytical Chemistry

Value Added Courses (Certificate course-Extra credits)

S.No	Course Code	Title of the course	Total Hours	Credit
1.	23UPCHE1V01	Chemical Energy	15	1
2.	23UPCHE1V02	Water Analysis	15	1

SWAYAM Courses (Extra credits)

1.	Fundamentals of Protein Chemistry
2.	Chemical Process Safety
3.	Organic Chemistry in Biology and Drug Development

Note:

C - Core Courses, **CE** -Discipline Centric Elective Courses;**GE**- Generic Elective Courses;
NME – Non Major Elective Courses; **IE**-Industry / Entrepreneurship; **SE** - Skill Enhancement course;
VA -Value Added Courses;**L** - Lecture; **T** - Tutorial; **P** - Practical.

Scheme of Examination

M.Sc. Chemistry - CBCS

S. No	Paper code	Title of the Paper	Exams Hours	Internal Marks	External Marks	Total	Credits
First Semester							
1.	23UPCHE1C01	Core Course 1 - Organic reactionmechanism - I	3	25	75	100	5
2.	23UPCHE1C02	Core Course 2 - Structure & bonding in inorganic compounds	3	25	75	100	5
3.	23UPCHE1C03	Core Course 3 - Organic chemistry practical	6	40	60	100	4
4.	23UPCHE1E--	Elective course 1 - Discipline centric	3	25	75	100	3
5.	23UPCHE1E---	Elective course 2 - Generic	3	25	75	100	3
Second Semester							
7.	23UPCHE1C04	Core Course 4 - Organic reactionmechanism –II	3	25	75	100	5
8.	23UPCHE1C05	Core Course 5 - Thermodynamics and chemical kinetics	3	25	75	100	5
9.	23UPCHE1C06	Core Course 6 - Inorganic chemistrypractical	6	40	60	100	4
10.	23UPCHE1E--	Elective course 3 - Discipline centric	3	25	75	100	3
11.	23UPCHE1E--	Elective course 4 - Generic	3	25	75	100	3
12	23UPPGC1H01	Human Rights	3	25	75	-	1
13.	23UPCHE1N--	Non Major Elective - I	SWAYAM/NPTEL				2
	23UPCHE1I01	INTERNSHIP-During Summer Vacation					
Third Semester							
13.	23UPCHE1C07	Core Course 7 - Organic Synthesis andphotochemistry	3	25	75	100	5
14.	23UPCHE1C08	Core Course 8 - Coordination chemistry - 1	3	25	75	100	5
15.	23UPCHE1C09	Core Course - 9 Quantum chemistry and group theory	3	25	75	100	5
16.	23UPCHE1C10	Core Course 10 - Physical Chemistry practical	6	40	60	100	4
17.	23UPCHE1E--	Elective course - 5 Discipline Centric	3	25	75	100	3
18.	23UPCHE1N--	Non Major Elective -2	3	25	75	100	2
19.	23UPCHE1I01	Internship Viva	-	-	-	-	2
Fourth Semester							
20.	23UPCHE1C11	Core Course 11 - Coordination Chemistry -2	3	25	75	100	5
21.	23UPCHE1C12	Core Course 12 - Equilibria and surface chemistry	3	25	75	100	5
22.	23UPCHE1C13	Core Course 13-Project	6	-	-	200	7
23.	23UPCHE1E--	Elective course - 6 (Industry / Entrepreneurship)	3	25	75	100	3
24.	23UPCHE1E--	Skill Enhancement course	3	25	75	100	2
25.	23UPCHE1X01	Extension Activity	-	-	-	-	1
26.	23UPCHE1V01	Value Added Course	-	-	-	-	-

Total Credits: 92

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

VII - Teaching Methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power Point presentations. The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

VIII - Examinations

The examination shall be three hours duration to each paper at the end of each semester. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination.

Practical examinations for M.Sc. course in Chemistry will be conducted at the end of the each semester except final semester.

At the end of fourth semester viva-voce will be conducted on the basis of the Dissertation / Project report submitted by the student. One internal and one external examiner will conduct the viva-voce jointly.

Question Paper Pattern

Time: 3 Hours Max. Marks - 75

PART-A: 20x1=20
(Answer all questions)
(Four questions from each unit-Objective type)

PART-B: 3 x 5=15
(Answer any three questions)
(One question from each unit)

PART C: 5x8=40
(Answer all questions)
(One question from each unit with internal choice)
(Maximum two Sub-Divisions only)

6. a) or b)
7. a) or b)
8. a) or b)
9. a) or b)
10. a) or b)

XI - Distribution of Marks Theory and Practical Examinations

Theory Marks

PART-A: 16x1=16, PART-B: 2x5=10, PART-C: 3x8=24

Internal

Test	05 Marks (Best one out of two Tests)
Model Test	05 Marks
Seminar	05 Marks
Assignment	05 Marks
Attendance	05 Marks
Total	25 Marks

Practical (Internal marks 40)

Internal - For All Practicals

Test	20marks
Model Practical	20marks
Total	**40 marks**

Practicals - External : 60 marks Duration: 6 hours

Organic Chemistry Practical	
Qualitative analysis	20 marks
Quantitative analysis or Preparation	20 marks
Viva – Voce in practical	10 marks
Record	10 marks
Total	**60 marks**

Inorganic Chemistry Practical	
Qualitative analysis	20 marks
Quantitative analysis or Preparation	20 marks
Viva – Voce in practical	10 marks
Record	10 marks
Total	**60 marks**

Physical Chemistry Practical	
Experiment	40 marks
Viva-voce in practical	10 marks
Record	10 marks
Total	**60 marks**

XII - Dissertation / Project Work

Concise Dissertation	**150 marks**
Viva-Voce	**50 marks**
Total	**200 marks**

(a) Topic:

The topic of the dissertation shall be assigned to the candidate before the end of first semester and a copy of the same should be submitted to the University for Approval.

(b) Advisory Committee:

Each guide shall have a maximum of five students.

There will be an advisory committee consisting of the guide as chairman and one member from the same department or allied departments of the University.

(c)Plan of Work:

The student should prepare plan of work for the dissertation, get the approval of the advisory committee and should be submitted to the university during the second semester of their study. In case the student wants to avail the facility from other University/laboratory, they will undertake the work with the permission of the guide and acknowledge the alien facilities utilized by them.

The duration of the dissertation research shall be a minimum of three months in the fourth semester.

(d) Dissertation Work outside the Department:

In case the student stays away for work from the Department for more than one month, specific approval of the university should be obtained.

(e)No. of copies / distribution of dissertation:

The students should prepare three copies of dissertation and submit the same for the evaluation by Examiners. After evaluation one copy is to be retained in the Department library and one copy is to be submitted to the University (Registrar) and one copy can be held by the student.

(f)Format to be followed:

The format/certificate for dissertation to be submitted by the students is given below:

Format for the preparation of project work:

(a) Title page
(b) Bonafide Certificate
(c) Acknowledgement
(d) Table of contents

CONTENTS

Format of the Title Page:

TITLE OF THE DISSERTATION

Dissertation Submitted in part fulfillment of the requirement for the award of the Degree of Master of Science in Chemistry to the Periyar University, Salem-636 011.

By

Students Name:

Register Number:

Department of Chemistry

Year:

Format of the Certificate:

CERTIFICATE

This is to certify that the dissertation entitled ---------- submitted in partial fulfillment of the requirement for the award of the degree of Master of Science in Chemistry to the Periyar University, Salem is a record of bonafide research work carried out by ----------under my supervision and guidance and that no part of the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal or magazine.

Date:
Place:

Supervisor and Guide Head of the Department

External Examiner:

Internal Examiner:

Guidelines for approval of M.Sc. Chemistry guides for guiding students in their research for submitting dissertation:

1. M.Sc. Chemistry (Part fulfillment) Guide:

(i) The person seeking for recognition, as guide should have:

(a) A Ph.D. Degree in Chemistry or specializations in various branches of Chemistry (or)

(b) M.Phil. / M.Sc. degree in Chemistry with first class/second class

(c) Should have 3 years of active teaching/research experience

(ii) They should have published at least one research paper in a National Journal authored solely or jointly.

2. Procedure for submitting application for approval as guides:

(i) The University will on request give prescribed application form.

(ii) The filled in applications should be submitted before the close of said date by the University.

(iii) All such applications should be routed through the HOD with specific recommendations.

(iv) All relevant proofs should be submitted along with the applications.

3. Approval:

The committee constituted for the purpose will scrutinize the applications and recommend for approval/rejection.

Orders will then be passed by the authority of the University and communicated to each member individually through the HOD.

XIII - Passing Minimum

The candidate shall be declared to have passed the examination if the candidate secures a minimum of 50 % (Both in Internal and External) in the University examination.

For a pass in the Practical paper, a candidate has to secure a minimum of 50% marks in the University examination. There is no passing minimum for the record notebook. However submission of a record notebook is a must.

For the project work and viva-voce, a candidate should secure 50% of the marks for pass. The candidate should compulsorily attend viva-voce examination to secure pass in that paper.

Candidates who do not obtain the required minimum marks for a pass in a paper/Project Report, shall be required to appear and pass the same at a subsequent appearance.

XIV - Classification of Successful Candidates

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First Class.

All other successful candidates shall be declared to have passed in the Second Class.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the course in the first instance and within a period two academic years from the year of admission to the course only are eligible for University Ranking.

A candidate is deemed to have secured first rank provided he/she

(i) should have passed all the papers in first attempt itself

(ii) should have secured the highest overall grade point average (OGPA)

XV - Maximum Duration for the Completion of the Course

The maximum duration for completion of M.Sc. Degree in Chemistry Programme shall not exceed eight semesters.

XVI - Commencement of this Regulation

These regulations shall take effect from the academic year 2022-2023.i.e., for students who are to be admitted to the first year of the course during the academic year 2022-2023 and thereafter.

XVII - Transitory Provision

Candidates who were admitted to the M.Sc. Degree in Chemistry (before 2022-2023 shall be permitted to appear for the examinations under those regulations for a period of three years i.e., up to and inclusive of the examination of April/May 2025. Thereafter, they will be permitted to appear for the examination only under the regulations then in force. LearningandTeachingActivities

XVIII – Learning and Teaching activities

TopicwiseDeliverymethod

HourCount	Topic	Unit	ModeofDelivery

WorkLoad

Theinformationbelowisprovidedasaguidetoassiststudentsinengagingappropriatelywiththecourserequirements.

Activity	Quantity	Workloadperiods
Lectures	60	60
Tutorials	15	15
Assignments	5	5
CycleTestorsimilar	2	4
ModelTestorsimilar	1	3
UniversityExam	1	3
	Total	90periods

TutorialActivities

Tutorial Count	Topic

LaboratoryActivities

Field StudyActivities

XIX - AssessmentActivities

AssessmentPrinciples:

Assessmentforthiscourseis basedonthefollowingprinciples

1. Assessment must encourageandreinforcelearning.
2. Assessment mustmeasureachievementofthestatedlearningobjectives.
3. Assessmentmustenablerobustandfair judgmentsaboutstudent performance.
4. Assessmentpracticemustbefairandequitabletostudentsandgivethem theopportunitytodemonstratewhattheylearned.
5. Assessmentmustmaintainacademicstandards.

AssessmentDetails:

AssessmentItem	DistributedDueDate	Weightage	Cumulative Weightage
Assignment1	3rdweek	2%	2%
Assignment2	6thWeek	2%	4%
CycleTest–I	7thWeek	6%	10%
Assignment3	8thWeek	2%	12%
Assignment4	11thWeek	2%	14%
CycleTest–II	12thWeek	6%	20%
Assignment5	14thWeek	2%	22%
ModelExam	15thWeek	13%	35%
Attendance	Allweeks as perthe AcademicCalendar	5%	40%
UniversityExam	17thWeek	60%	100%

InstructionsforCourseTransaction

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

2. Testing Pattern

(25+75)

13.1 InternalAssessment

Theory Course: For theory courses there shall be three tests conducted by the faculty concernedand the average of the best two can be taken as the Continuous Internal Assessment (CIA) for amaximumof25marks.The durationofeachtestshallbe one/oneandahalfhour.

Computer Laboratory Courses: For Computer Laboratory Oriented Courses, there shall be twotests in Theory part and two tests in Laboratory part. Choose one best from Theory part and otherbest from the two Laboratory part. The average of the best two can be treated as the CIA for amaximumof25marks.The durationofeachtestshallbe one/oneanda halfhour.

Thereis noimprovementforCIAofboththeoryandlaboratory, and, alsoforUniversityEndSemesterExamination.

Syllabus for different Courses of M.Sc. Chemistry

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC REACTION MECHANISM - I</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td>1</td><td colspan="3">-</td><td colspan="2">7</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the structure and reactivity of chemically active centers
To understand the concept of aromaticity and the mechanism of aromatic and aliphatic electrophilic substitution reactions
To study the mechanism of aromatic and aliphatic nucleophilic substitution reactions
To understand the concept of stereochemistry involved in organic compounds.
To learn the basics of stereochemistry, conformation and reactivity, ORD and CD curves.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I:Methods of determination of reaction mechanism: Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.</td></tr>
<tr><td colspan="7">UNIT-II:Aromatic and aliphatic electrophilic substitution: Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.</td></tr>
<tr><td colspan="7">UNIT-III:Aliphatic and aromatic nucleophilic substitution: S_N1, S_N2, and SNi mechanism and evidences, Stereochemistry of S_N1 and S_N2 mechanisms, Reactivity - Effect of structure, leaving group, attacking nucleophile and solvent polarity. Neighbouring group participation and non-classical carbocations. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles. Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements.</td></tr>
<tr><td colspan="7">UNIT-IV:Stereochemistry-I: Introduction to molecular symmetry and chirality – axis, plane, center and 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,</td></tr>
</table>

	cation, reversible formation, epimerization, mutarotation. D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, si phase and re phase, Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls 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, 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 rings: bicyclic, poly cyclic systems – decalins and perhydrophenanthrenes. Bridged rings – bicycle[2.2.1]heptane and Bredt'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 Books	1. J. March and M. Smith, Advanced Organic Chemistry, 5th Edition, John-Wiley and Sons.2001. 2. E.S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959. 3. P.S.Kalsi, Stereochemistry of Carbon Compounds, 8th Edition, New Age International Publishers, 2015. 4. P.Y. Bruice, Organic Chemistry, 7th Edition, Prentice Hall, 2013. 5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd Edition, Oxford University Press, 2014.
Reference Books	1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th Edition, Kluwer Academic / Plenum Publishers, 2007. 2. D.G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001. 3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987. 4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000. 5. I.L. Finar, Organic Chemistry, Vol-1 & 2, 6th Edition, Pearson Education Asia, 2004.
Website and e-learning source	1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able

CLO1: To recall the basic principles of organic chemistry and the formation and detection of reaction intermediates of organic reactions.

CLO2: To recall the basic principles of aromaticity of organic and heterocyclic compounds and understand the concepts of electrophilic substitution reactions in aromatic and aliphatic compounds.

CLO3: To understand in detail about the mechanism of both aliphatic and aromatic nucleophilic substitution reactions.

CLO4: To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.

CLO5:To understand the effect of conformation on the stabilities and reactivities of the cyclic and acyclic systems, -to use the Cotton effect curves, Octant rule and α-haloketone rule for the stereochemical prediction of complex molecules like steroids.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong M-Medium L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">STRUCTURE AND BONDING IN INORGANIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C02</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>6</td><td>1</td><td colspan="3">-</td><td colspan="2">7</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Inorganic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To determine the structural properties of main group compounds and clusters.
To gain fundamental knowledge on the structural aspects of ionic crystals.
To study the effect of point defects and line defects in ionic crystals.
To evaluate the structural aspects of solids.
To familiarize various diffraction and microscopic techniques.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Structure of main group compounds and clusters: VB theory – Effect of lone pair and electronegativity of atoms (Bent’s rule) on the geometry of the molecules; Structure of silicates - applications of Pauling’s rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three dimensional silicates. Structure of silicones; Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade’s rule to predict the structure of borane cluster; main group clusters – zintl ions and mno rule.</td></tr>
<tr><td colspan="7">UNIT-II: Solid state chemistry – I: Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.</td></tr>
<tr><td colspan="7">UNIT-III: Solid state chemistry – II: Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.</td></tr>
<tr><td colspan="7">UNIT-IV: Band theory and defects in solids
Band theory – features and its application in 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 properties; Laser and phosphors; Linear defects and their effects due to dislocations.</td></tr>
<tr><td colspan="7">UNIT-V: Techniques in solid state chemistry: X-ray diffraction technique: Bragg’s law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle,</td></tr>
</table>

	instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications; Theory, principle, instrumentation, sampling methods and applications of SEM and TEM.
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 Books	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, ATextbook 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; 4thEdition, Harper and Row: New York, 1983.
Reference Books	1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rdEdition, 1994. 2. R. J. D. Tilley, Understanding Solids - The Science of Materials, 2ndEdition, 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; 3rdEdition, 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: Understand band theory and defects in crystals.
CO5:Understand the principles of diffraction techniques and microscopic techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong M-Medium L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C03</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">6</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of Organic Chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the concept of separation and analysis of organic compounds.
To estimate various organic compounds by suitable methods.
To construct suitable experimental setup for the organic preparations involving two stages.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Separation and analysis:
A. Two component mixtures.
B. Three component mixtures.</td></tr>
<tr><td colspan="7">UNIT-II: Estimations:
a) Estimation of Phenol (bromination)
b) Estimation of Aniline (bromination)
c) Estimation of Ethyl methyl ketone (iodimetry)
d) Estimation of Glucose (redox)
e) Estimation of Ascorbic acid (iodimetry)
f) Estimation of Aromatic nitro groups (reduction)
g) Estimation of Glycine (acidimetry)
h) Estimation of Formalin (iodimetry)
i) Estimation of Acetyl group in ester (alkalimetry)
j) Estimation of Hydroxyl group (acetylation)
k) Estimation of Amino group (acetylation)</td></tr>
<tr><td colspan="7">UNIT-III: Two stage preparations:
a) p-Bromoacetanilide from aniline
b) p-Nitroaniline from acetanilide
c) 1,3,5-Tribromobenzene from aniline
d) Acetyl salicylic acid from methyl salicylate
e) Benzilic acid from benzoin
f) m-Nitroaniline from nitrobenzene
g) m-Nitrobenzoic acid from methyl benzoate</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text Books</td><td colspan="7">1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Vogel’s Practical Organic Chemistry. 5th Edition ELBS, 1989</td></tr>
</table>

	2. Raj K. Bansal, Laboratory Manual of Organic Chemistry, III Edition, New Age International (P) Ltd. 1996. 3. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry Lab Manual, New Edition, SV Publishers, 2006 4. Chemdraw 8.0 to 16.0, Perkin Elmer-User Guide Version 16.0, Cambridge Soft Corporation.
Reference Books	1. B.S. Furniss, A.J. Hannaford, P.W.G. Smith and A.R. Tatchell, Vogel's Practical Organic Chemistry. 5thEdition ELBS, 1989 2. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry Lab Manual, New Edition, SV Publishers 2006 3. P.S. Subramanian, R. Gopalan and K. Rangarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 2003.
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 understand the concept of separation and analysis of organic compounds.

CO2: To estimate various organic compounds by suitable methods.

CO3: To construct suitable experimental setup for the organic preparations involving two stages.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

II-SEMESTER

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC REACTION MECHANISM-II</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td rowspan="2">5</td><td>Course Code</td><td>23UPCHE1C04</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the mechanism of elimination as well as free radical reactions.
To understand the oxidation and reduction reactions.
To understand the mechanism involved in various rearrangements.
To understand the reactions involvingaddition to carbon multiple bonds
To design synthetic routes for synthetically used organic reactions.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Elimination and free radical reactions: Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of free radicals, characteristics of free radical reactions and free radicals, Reactions of free radicals: polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.</td></tr>
<tr><td colspan="7">UNIT-II: Oxidation and reduction reactions: Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide. Oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide-dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with trialkyl and triphenyltin hydrides, McFadyen-Steven’s reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.</td></tr>
<tr><td colspan="7">UNIT-III: Rearrangements: Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann</td></tr>
</table>

	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 rearrangements. Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, Oxy-Cope and 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, Prinsreaction. Stereochemical aspects of addition reactions. Organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates –Stobbe reactions. Hydrolysis of esters and amides, ammonolysis ofesters.
	UNIT-V: Reagents and modern synthetic reactions: Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu_3SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB). Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$), $TiCl_3$, $NaIO_4$, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex**.** Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. J. March and M. Smith, Advanced Organic Chemistry, 5thEdition, 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, 8thEdition, New Age International Publishers,2015. 4. P.Y.Bruice, Organic Chemistry, 7th Edition,Prentice Hall, 2013. 5. R.T. Morrison, R.N. Boyd, S.K. BhattacharjeeOrganic Chemistry, 7thEdition, Pearson Education,2010.
Reference Books	1. S.H. Pine, Organic Chemistry, 5thEdition, McGraw Hill International Edition, 1987. 2. L.F. Fieser and M. Fieser, Organic Chemistry, Asia Publishing House, Bombay,2000. 3. E.S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc.,1959. 4. T.L. Gilchrist, Heterocyclic Chemistry, Longman Press, 1989. 5. J.A. Joule and K. Mills, Heterocyclic Chemistry, 4thEdition, John-Wiley,2010.
Website and e-learning source	1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic 2. https://www.organic-chemistry.org/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:
CO1: To understand the mechanism of elimination as well as free radical reactions
CO2: To understand the oxidation and reduction Reactions.
CO3: To understand the mechanism involved in various rearrangements
CO4: To understand the reactions involving addition to carbon multiple bonds
CO5:To design synthetic routes for synthetically used organic reactions.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S – Strong, M – Medium,

Level of Correlation between PSO's and CO's

CO /PSOs	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">THERMODYNAMICS AND CHEMICAL KINETICS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td rowspan="2">5</td><td>Course Code</td><td>23UPCHE1C05</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
To compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein statistics
To understand the theories and applications of irreversible thermodynamics
To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
To study the mechanism and kinetics of reactions.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Classical thermodynamics: Partial molar properties-Chemical potential, Gibb's- Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation.Applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Statistical thermodynamics: Introduction to statistical thermodynamics; concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function, residual entropy, equilibrium constants and equipartition principle. Heat capacity of mono and diatomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Irreversible thermodynamics: Theories of conservation of mass and energy; entropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification-Onsager reciprocal relationships. Electrokinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Kinetics of reactions: Theories of reaction rates - effect of temperature on reaction rates, collision theory of reaction rates. Unimolecular reactions -Lindeman and Christiansen hypothesis;</td></tr>
</table>

	Molecular beams, collision cross sections and effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determining the reaction rates in solution - primary salt effect and secondary salt effect; Homogeneous catalysis; Acid-base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law.Enzyme catalysis-Michelis-Menton equation.
	UNIT-V: Kinetics of complex and fast reactions: Kinetics of complex reactions, reversible reactions, consecutive reactions and parallel 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 and pulse radiolysis methods. Kinetics of polymerization-free radical, cationic andanionic 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 Books	1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd Edition,S.L.N.Chand and Co., Jalandhar, 1986. 2. I.M. Klotz and R.M. Rosenberg, Chemical Thermodynamics, 6th Edition, W.A. BenjaminPublishers, California, 1972. 3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995. 4. K.J. Laidler, Chemical Kinetics, 3rd Edition, Pearson, Reprint - 2013. 5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of Chemical Transformation,Macmillan India Ltd, Reprint 2011.
Reference Books	1. D.A. Mcqurrie and J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999. 2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990. 3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974 4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996. 5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.
Website and e-learning source	1. https://nptel.ac.in/courses/104/103/104103112/ 2. https://bit.ly/3tL3GdN
Course Learning Outcomes (for Mapping with POs and PSOs)	

Students will be able:
CO1: To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
CO2: To compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein
CO3: To understand the theories and applications of irreversible thermodynamics
CO4: To correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
CO5:To compare the theories of reactions rates and fast reactions and to study the mechanism and kinetics of reactions.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSOs	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">INORGANIC CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VI</td></tr>
<tr><td>Category</td><td>Core</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>4</td><td>Course Code</td><td>23UPCHE1C06</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>-</td><td>-</td><td colspan="3">6</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic principles of gravimetric and qualitative analysis</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the basic principles of quantitative analysis of mixture of cations.
To prepare the inorganic metal complexes.
To estimate the metal ions present in the given solution by complexometric titration.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations.Cations to be tested.
Group-I : W, Tl and Pb.
Group-II : Se, Te, Mo, Cu, Bi and Cd.
Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U.
Group-IV : Zn, Ni, Co and Mn.
Group-V : Ca, Ba and Sr.
Group-VI : Li and Mg.</td></tr>
<tr><td colspan="7">UNIT-II: Preparation of metal complexes: Preparation of inorganic complexes:
a. Preparation of tristhioureacopper(I)sulphate
b. Preparation of potassium trioxalate chromate(III)
c. Preparation of tetramminecopper(II) sulphate
d. Preparation of Reineck’s salt
e. Preparation of hexathioureacopper(I) chloridedihydrate
f. Preparation of cis-Potassium di oxalate diaquachromate(III)
g. Preparation of sodium trioxalatoferrate(III)
h. Preparation of hexathiourealead(II) nitrate</td></tr>
<tr><td colspan="7">UNIT-III: Complexometric titration:
1. Estimation of zinc, nickel, magnesium, and calcium.
2. Estimation of mixture of metal ions-pH control, masking and demasking agents.
3. Determination of calcium and lead in a mixture (pH control).
4. Determination of manganese in the presence of iron.
5. Determination of nickel in the presence of iron.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
</table>

Recommended Text	1. Jeya Rajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United Global Publishers, 2021. 2. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; 3rdEdition, The National Publishing Company, Chennai, 1974. 3. Vogel's Text book of Inorganic Qualitative Analysis, 4th Edition, ELBS, London.
Reference Books	1. G. Pass, and H. Sutcliffe, Practical Inorganic Chemistry, Chapman Hall, 1965. 2. W. G. Palmer, Experimental Inorganic Chemistry, Cambridge University Press, 1954.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1:To determine the amount of ions, present in a binary mixture accurately.

CO2: To prepare the inorganic metal complexes.

CO2: To estimate metal ions, present in the given solution accurately by complexometric titration

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CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**

S– Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

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

3 – Strong, 2 – Medium, 1 – Low

III-SEMESTER

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC SYNTHESIS AND PHOTOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C07</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of organic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To plan an organic synthesis and understand various synthetic routes.
To study various synthetic methodologies and approaches for successful organic synthesis.
To learn the concepts and mechanisms of various pericyclic reactions
To gain the knowledge of various photochemical processes
To understand the photochemistry of variousorganic reactions.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I:Planning an organic synthesis and control elements: Preliminary Planning – knowns and unknowns of the synthetic systems, analysis of the complex and interrelated carbon framework into simple rationalprecursors, alternate synthetic routes, key intermediates that wouldbe formed, available starting materials and resulting yield of alternativemethods. Linear Vs convergent synthesis. Synthesis based on Umpolung. Concepts ofSeeback,Control elements-Regiospecific control elements and stereospecific control elements.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Organic synthetic methodology: Retrosynthetic analysis; Alternate synthetic routes. Synthesis of organic mono and bifunctional compounds via disconnection approach. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis. Use of protective groups, activating groups, and bridging elements. Functional group alterations and transposition.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Pericyclic reactions: Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO methods and correlation diagrams. Cycloaddition and retrocycloaddition reactions; [2+2], [2+4], [4+4], cationic, anionic, and 1,3-dipolar cycloadditions. Cheletropic reactions. Electrocyclization and ring opening reactions of conjugated dienes and trienes. Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations. Degenerate rearrangements. Ionic sigmatropic rearrangements. Group transfer reactions. Regioselectivity, stereoselectivity and periselectivity in pericyclic reactions.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Organic photochemistry-I: Photochemical excitation: Experimental techniques; electronic transitions; Jablonskii diagram; 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;</td></tr>
<tr><td></td><td colspan="7">UNIT-V: Organic photochemistry-II: Photochemistry of α,β-unsaturated ketones; cis-trans isomerisation. Photon energy transfer reactions, Photo cycloadditions, Photochemistry of aromatic compounds; photochemical rearrangements; photo-stationery state; di-π-methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4-diphenyl phenols; Barton’s reactions.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. F.A. Carey and Sundberg, Advanced Organic Chemistry, 5th Edition, Tata McGraw-Hill, New York, 2003. 2. J. March and M. Smith, Advanced Organic Chemistry, 5thEdition, John-Wiley and Sons, 2007. 3. R.E. Ireland, Organic synthesis, Prentice Hall India, Goel Publishing House, 1990. 4. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016. 5. M.B. Smith, Organic Synthesis 3rd Edition, McGraw Hill International Edition, 2011.
Reference Books	1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974. 2. J.A. Joule and G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004. 3. W. Caruthers, Some Modern Methods of Organic Synthesis 4thEdition, 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 plan an organic synthesis and understand various synthetic routes.

.**CO2:**To study various synthetic methodologies and approaches for successful organic synthesis

CO3: To learn the concepts and mechanisms of various pericyclic reactions

CO4: To gain the knowledge of various photochemical processes.

CO5: To understand the photochemistry of various organic reactions

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSOs	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">COORDINATION CHEMISTRY – I</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C08</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To gain insights into the modern theories of bonding in coordination compounds.
To learn the spectral characteristics of complexes.
To understand the stability and magnetic properties of complexes.
To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
To study the kinetics and mechanisms of substitution reactions of octahedral and square planar complexes
To study the kinetics and mechanisms of electron transfer in octahedral complexes</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I:Modern theories of coordination compounds: Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of 10Dq - factors affecting 10Dq. Spectrochemical series - crystal field stabilization energy for high spin and low spin complexes - evidences for crystal field splitting - site selections in spinels and antispinels - Jahn-Teller distortions and their consequences. Molecular orbital theory and energy level diagrams Concept of weak and strong fields, Sigma and pi bonding in octahedral, square planar and tetrahedral complexes.</td></tr>
<tr><td colspan="7">UNIT-II: Spectral characteristics of complexes: Term states for d ions - characteristics of d-d transitions - charge transfer spectra. Selection rules for electronic spectra - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - Nephelauxetic series - Racha parameter and calculation of inter-electronic repulsion parameter.</td></tr>
<tr><td colspan="7">UNIT-III: Stability and magnetic properties of the complexes: Stability of complexes: Factors affecting stability of complexes. Thermodynamic aspects of complex formation, Stepwise and overall formation constants, stability correlations, statistical factors and chelate effect; Determination of stability constant and composition of the complexes - Formation curves and Bjerrum’s half method, potentiometric method, spectrophotometric method, ion exchange method, polarographic method and continuous variation method (Job’s method). Magnetic properties of complexes - Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.</td></tr>
<tr><td colspan="7">UNIT-IV: Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: Inert and labile complexes - Associative, dissociative and SNCB mechanistic pathways for substitution reactions; Acid and base hydrolysis of octahedral complexes; Classification of metal ions based on the rate of water replacement reactions and their correlation to crystal field activation</td></tr>
</table>

	energy; Substitution reactions in square planar complexes: Trans effect - theories and applications of trans effect in synthesis of square planar complexes; 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, E.A. Keiter, R.L. Keiter and O.K. Medhi, Inorganic Chemistry – Principles of Structure and Reactivity, 4th Edition, Pearson Education Inc., 2006 2. G.L. Meissler and D.A. Tarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B.N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976. 5. F.A. Cotton, G.Wilkinson. C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6thEdition, 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. F.A. Cotton, G. Wilkinson and P. L. Guas, Basic Inorganic Chemistry, 3rd Edition, John Wiley, 2002. 4. B. Douglas, D. McDaniel and J. Alexander, Concepts and Models of Inorganic Chemistry, 3rdEdition, John Wiley, 1994. 5. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 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: To understand and comprehend various theories of coordination compounds.

CO2: To learn the spectral characteristics of coordination complexes.

CO3: To understand the stability and magnetic properties of complexes.

CO4: To study the **k**inetics and mechanisms of substitution reactions of octahedral and square planar complexes

CO5: To 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
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S– Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">QUANTUM CHEMISTRY AND GROUP THEORY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td>Credits</td><td rowspan="2">5</td><td>Course Code</td><td>23UPCHE1C09</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the essential characteristics of wave functions and need for the quantum mechanics.
To know the importance of quantum mechanical models of particle in a box, rigid rotor,harmonic oscillator and hydrogen atom.
To apply the quantum mechanics to gas hydrogen atom and polyelectronic systems.
To familiarize the symmetry in molecules and predict the point groups.
To predict the vibrational modes and hybridization using the concepts of group theory.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Introduction to quantum mechanics-black body radiation, wave particle duality, uncertainty principle, photoelectric effect, hydrogen spectrum. Need for quantum mechanics, postulates of quantum mechanics. Particle wave and Schrodinger wave equation-Time independent and time dependent.Wave function, properties of wave function- Normalized, orthogonal, orthonormal, Eigen values and Eigen function: Hermitian properties of operators.</td></tr>
<tr><td colspan="7">UNIT-II: Applications to particles, quantum models and hydrogen atom:Application of Schrodinger wave equation toparticle in a box-(1D, 2D and 3D).Degeneracy,free particles. Harmonic Oscillator-wave equation and solution, anharmonicity, force constant and its significance. Rigid Rotor-wave equation and solution, calculation of rotational constants and bond length of diatomic molecules. Hydrogen atom and hydrogen like ions, Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions.</td></tr>
<tr><td colspan="7">UNIT-III: Applications to polyelectron atoms:
Approximation methods: variation methods- trial wave function, variation integral and application to particle in 1D box. Perturbation method - first order applications. Hartree-Fock self-consistent field method, Helium atom-electron spin, Pauli’s exclusion principle and Slater determinant.Hohenberg-Kohn theorem and Kohn-Sham equation.Molecular orbital theory and Heitler London (VB) treatment, Energy level diagrams. Hydrogen molecule ion; Use of linear variation function and LCAO methods. Electronic conjugated system: Huckel method to Ethylene butadiene, cyclopropenyl, cyclo butadiene and Benzene</td></tr>
<tr><td colspan="7">UNIT-IV: Group theory: Groups, sub groups, symmetry elements and symmetry operations. Point groups-Classification, axial, non-axial anddihedral point groups- C_n,C_{nh}, D_n, D_{nh}, D_{nd}, Td and Oh. Matrix representation and classes of symmetry operations, reducible irreducible and direct product representation.</td></tr>
<tr><td colspan="7">UNIT-V: Applications of group theory: Reducing the reducible representation into irreducible representation. Reduction</td></tr>
</table>

	formula. Properties of irreducible representation, Great orthogonality theorem. Construction of character table for C_{2v}, C_{2h}, C_{3v} and D_{2h} point groups. Hydrogen Molecule- Applications of group theory to molecular vibrations and hybridizations of simple molecules (H_2O, NH_3, BF_3, CH_4, XeF_4,).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, 2nd Edition John Wiley & Sons, 2003. 3. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, 2nd Edition, John and Willy & Sons Ltd., 2013, 4. T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, 4th Edition Pearson, New Delhi, 2018. 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 and 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 understand the essential characteristics of wave functions and need for the quantum mechanics.

CO2: To know the importance of quantum mechanical models of particle in a box, rigid rotor, harmonic oscillator and hydrogen.

CO3: To apply the quantum mechanics to polyelectronic systems.

CO4: To familiarize the symmetry in molecules and predict the point groups.

CO5: To predict the vibrational modes, hybridization using the concepts of group theory.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSICAL CHEMISTRY PRACTICAL</td></tr>
<tr><td>Paper No.</td><td colspan="7">CoreX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C10</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">6</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the principle of conductivity experiments through conductometric titrations.
To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
To construct the phase diagram of two component system and to determine the kinetics of adsorption of oxalic acid on charcoal.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I:Conductivity Experiments
1. Determination of equivalent conductance of a strong electrolyte & the verification of DHO equation.
2. Verification of Ostwald’s Dilution Law & Determination of pKa of a weak acid.
3. Verification of Kohlrausch’s Law for weak electrolytes.
4. Determination of solubility of a sparingly soluble salt.
5. Acid-base titration (strong acid and weak acid vs NaOH).
6. Precipitation titrations (mixture of halides only).</td></tr>
<tr><td colspan="7">UNIT-II: Kinetics
1. Study the kinetics of acid hydrolysis of an ester, determine the temperature coefficient and also the activation energy of the reaction.
2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.</td></tr>
<tr><td colspan="7">UNIT-III: Phase diagram
Construction of phase diagram for a simple binary system
1. Naphthalene-phenanthrene
2. Benzophenone- diphenyl amine
Adsorption
Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only).</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended</td><td colspan="7">1. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry,</td></tr>
</table>

Text Books	Viva Books, New Delhi, 2009. 2. Sundaram, Krishnan and 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 Edition, 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 Edition, Wiley-Blackwell.
Website and e-learning source	https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the principle of conductivity experiments through conductometric titrations.

CO2: To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.

CO3: To construct the phase diagram of two component system and to determine the kinetics of adsorption of oxalic acid on charcoal.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

SEMESTER IV

<table>
<tr><td>Title of the Course</td><td colspan="7">COORDINATION CHEMISTRY – II</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td>Course Code</td><td>23UPCHE1C11</td></tr>
<tr><td>Semester</td><td>IV</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of inorganic chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To recognize the fundamental concepts and structural aspects of organometallic compounds.
To learn reactions of organometallic compounds and their catalytic behaviour.
To identify or predict the structure of coordination compounds using spectroscopic tools.
To understand the structure and bonding in coordination complexes.
To evaluate the characteristics of selected complexes using PES.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Chemistry of organometallic compounds: Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Metal – carbonyl complexes: MO diagram of CO; Structure and bonding − bonding modes, MO approach of M-CO bonding, π-acceptor, nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters – Structures based on polyhedral skeleton electron pair theory or Wade’s rule. Bonding in metal – olefin complexes (example: Ziese’s salt), metal-acetylene and metal-allyl complexes; Metal-cyclopentadienyl complexes – Examples. MO approach to bonding in metallocenes; fluxional isomerism.</td></tr>
<tr><td colspan="7">UNIT-II: Reactions and catalysis of organometallic compounds: Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction and metathesis reaction. Organometallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt and rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerisation, water gas shift reaction, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsonto process.</td></tr>
<tr><td colspan="7">UNIT-III: Inorganic spectroscopy -I: IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea and DMSO complexes; IR spectroscopy of carbonyl compounds. NMR spectroscopy- Introduction, applications of ^{1}H, ^{15}N, ^{19}F, ^{31}P-NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.</td></tr>
<tr><td colspan="7">UNIT-IV: Inorganic spectroscopy-II: Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer’s doublets; ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldimine)copper(II) and $[(NH_3)_5Co\text{-}O_2\text{-}Co(NH_3)_5]^{5+}$.complexes.Mossbauer spectroscopy – Mossbauer effect, Recoil energy, Mossbauer active nuclei, Doppler</td></tr>
</table>

	shift, Isomer shift, quadrupole splitting and magnetic interactions. Applications of Mössbauer spectra to Fe and Sn compounds.
	UNIT-V: Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2, O_2) and heteronuclear diatomic molecules (CO, HCl) and polyatomic molecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations. Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. J.E. Huheey, E.A. Keiter, R.L. Keiter and O.K. Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006 2. G.L. Meissler and D.A. Tarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008 3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993. 4. B.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 and M. Bochmann, Advanced Inorganic Chemistry, 6thEdition, Wiley Inter-science, New York, 1988.
Reference Books	1. Robert H. Crabtree, The Organometallic Chemistry of the Transition Metals. 3rdEdition, John Wiley, New York, 2000. 2. P. Gütlich, E. Bill and A.X. Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st Edition, Springer-Verlag Berlin Heidelberg, 2011. 3. B. Douglas, D. McDaniel, J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edition, John Wiley, 1994. 4. K.F. Purcell, J.C. Kotz, Inorganic Chemistry, Saunders, USA, 1977. 5. R.S. Drago, PhysicaI Methods in Chemistry, Saunders, Philadelphia, 1977.

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

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able to:
CO1: Understand and apply 18 and 16 electron rule for organometallic compounds
CO2: Understand the reactions of organometallic compounds and their catalytic behavior.
CO3: Understand the structure of coordination compounds using spectroscopic tools.
CO4: Understand the structure and bonding in coordination complexes
CO5: Understand the characteristics of selected complexes using PES

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">EQUILIBRIA AND SURFACE CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Core XII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1C12</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic concepts of physical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To recall the fundamentals of thermal and chemical equillibria
To understand the phase equillibria concepts in liquids and solutions.
To understand the properties, stability and applications of various types of colloids.
To understand the theories of isotherms and mechanisms ofsurface reactions.
To understand the principles of various photochemical processes and kinetics of photochemical reactions.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Thermal and chemical equillibria: Thermochemistry-Heats of reaction, relation between heats of reaction at constant volume and pressure.Standard enthalpy changes of reactions-Determination of enthalpies of reaction and variation of enthalpy of reaction with temperature. Kirchhoff equation, Hess’s law of constant heat of summation: Equllibrium constant for reactions involving real gases, Le Chatelier’s principles, Clausius-Clapeyron equation, chemical potential and absolute entropy - Temperature dependence of equilibrium constant, The Van’t Hoff equation and pressure dependence of equilibrium constant.</td></tr>
<tr><td colspan="7">UNIT-II: Phase equillibria: Phase rule - One component (CO_2, H_2O, S) and two-component systems (liquid-vapor, liquid-liquid and solid-liquid), eutectics.
Solutions of non-electrolytes – Solutions of liquid in liquids, Chemical potential of ideal and non-ideal solutions and temperature dependence of vapour pressure of a solution, Fractional distillation of binary solutions,distillation of immiscible liquids- Raoult’s Law;Azeotropic mixtures: Solutions of gases in liquids - Henry’s Law.</td></tr>
<tr><td colspan="7">UNIT-III: Colloids: Colloidal systems: Preparation of lyophobic colloidal solutions- Dispersion and condensation methods, stability and properties of colloids: Determination of size of the colloidal particles. Surfactants-Micelles and reverse micelles andcritical micelle concentration.Emulsification by surfactants-macro emulsions andmicro emulsions.Gels: Preparation and properties.</td></tr>
<tr><td colspan="7">UNIT-IV: Surface chemistry: Adsorption of gases by solids, factors influencing adsorptions. Types of adsorption isotherms - Freundlich, Langmuir and BET adsorption isotherms, Derivation of BET equation and determination of surface area. Adsorption from solution- Gibbs adsorption isotherms. Mechanism of surface reactions- Langmuir-Hinshelwood mechanism and Eley-Rideal mechanism. Modern techniques for investigating surfaces- LEED, PES, STM, EXAFS, SEXAFS.</td></tr>
</table>

	UNIT-V: Photochemistry: Consequences of light absorption, Jablonski diagram. Laws of photochemistry: Quantum yield-Determination of Quantum yield. Kinetics of Photochemical reactions, rates of intermolecular and intramolecular photophysical energy transfer, photosensitization and quenching of fluorescence- Stern Volmer equation; Chemiluminescence: LASER and MASER and their applications in chemistry. Femtosecond transition state spectroscopy.
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 Books	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, 3rdEdition, Pearson, Reprint - 2013. 5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,M 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. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996. 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 recall the fundamentals of thermal and chemical equillibria **CO2**: To understand the phase equillibria concepts in liquids and solutions. **CO3**: To understand the properties, stability and applications of various types of colloids **CO4**: To understand the theories of isotherms and mechanisms of surface reactions. **CO5**:To understand the principles of various photochemical processes and kinetics of photochemical reactions.	

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

ELECTIVE COURSES (DISCIPLINE CENTRIC)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTROCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Centric Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of electrochemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
To familiarize the structure of the electrical double layer of different models.
To compare electrodes between current density and over potential.
To discuss the mechanism of electrochemical reactions.
To highlight the different types of over voltages and its applications in electroanalytical techniques and energy storage devices.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Ionics: Arrhenius theory - limitations, van’t Hoff factor and its relation to colligative properties. Deviation from ideal behaviour. Ionic activity - mean ionic activity and mean ionic activity coefficient-concept of ionic strength; Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient.Ion solvent and ion -ion interactions. Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes- modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolytes-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere,ion association and triple ion formations.</td></tr>
<tr><td colspan="7">UNIT-II: Electrode-electrolyte interface: Interfacial phenomena - Evidences for electrical double layer, polarizable and non-polarizable interfaces. Electrocapillary phenomena - Lippmann equation and electrocapillary curves. Electrokinetic phenomena - electroosmosis, electrophoresis, streaming and sedimentation potentials.Colloidal and poly electrolytes. Structure of electrical double layers- Helmholtz - Perrin, Guoy - Chapman and Stern models. Zeta potential and potential at zero charge- Applications and limitations.</td></tr>
<tr><td colspan="7">UNIT-III: Electrodics of Elementary Electrode Reactions: Behaviour of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and cathodic currents.Condition for the discharge of ions. Nernst equation.Polarizable and non-polarizable electrodes. Model of three electrode system.Over potential. Rates of simple elementary electrochemical reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. Symmetry factor and transfer coefficient; Tafel equations and Tafel plots.</td></tr>
<tr><td colspan="7">UNIT-IV: Electrodics of Multistep Multi Electron System: Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step.Electrode polarization and</td></tr>
</table>

	depolarization. Transfer coefficients-Significance and determination; Stoichiometric number. Electrochemical reaction mechanisms-Rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+} and dissolution of Fe to Fe^{2+}. Overvoltage –chemical, electrochemical, 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 electroactive species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography - Principle and applications. Square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. **Batteries**- 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 and 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 Books	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, Electrochemistry, 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 Electrochemistry, 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, Vol.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 discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes

CO3: To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations

CO4: To understand the mechanism of electrochemical reactions.

CO5:To understand the principles and applications of energy storage devices and electrochemical reaction mechanism.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S – Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">BIOINORGANIC CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Centric Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E02</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the role of trace elements.
To understand the biological significance of transport proteins.
To understand the concepts of nitrogen fixation and photosynthesis.
To study the toxicity of metals in medicines
To understand the properties of various enzymes and enzyme kinetics.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Essential trace elements: Selective transport and storage of metal ions: Ferritin, transferrin and sidorphores, Sodium and potassium transport, Calcium signaling proteins. Metalloenzymes: Zinc enzymes–carboxypeptidase and carbonic anhydrase. Iron enzymes–catalase, peroxidase. Copper enzymes – superoxide dismutase, plastocyanin, ceruloplasmin and tyrosinase. Coenzymes - Vitamin-B12 coenzymes.</td></tr>
<tr><td colspan="7">UNIT-II: Transport Proteins: Oxygen carriers: Haemoglobin and myoglobin - Structure and oxygenation, Bohr Effect, Binding of CO, NO, CN to myoglobin and haemoglobin. Biological redox systems: Cytochromes-Classification, cytochrome a, b and c, Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.</td></tr>
<tr><td colspan="7">UNIT-III: Nitrogen fixation: Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase-redox property. Dinitrogen complexes-Transition metal complexes of dinitrogen. Nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis-Photosystem-I and photosystem-II. Chlorophylls- Structure and function.</td></tr>
<tr><td colspan="7">UNIT-IV: Metals in medicine: Toxicity of metals - Hg, Cd, Zn, Pb, As and Sb. Therapeutic compounds: Vanadium-based diabetes drugs, Platinum-containing anticancer agents. Chelation therapy and cancer treatment. Diagnostic agents: Technetium imaging agents, Gadolinium MRI imaging agents. Temperature and critical magnetic field.</td></tr>
<tr><td colspan="7">UNIT-V:Enzymes: Introduction, nomenclature, classification and properties. Enzyme kinetics- free energy of activation, effect of pH and temperature on enzyme reactions. Factors contributing to the efficiency of enzyme, Michelis - Menton equation,</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the external	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)

examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text Books	1. D.R. Williams, Introduction to Bioinorganic Chemistry. Thomas, 1976. 2. F.M. Fiabre and D.R. Williams, The Principles of Bioinorganic Chemistry, Royol Society of Chemistry, Monograph for Teachers-31, 1977. 3. K.F. Purcell and Kotz, Inorganic chemistry, WB Saunders Co., USA.1977. 4. G.N. Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry, U.N.Dhur, 1993. 5. R. Gopalan, V. Ramalingam, Concise Coordination Chemistry, S. Chand, 2001.
Reference Books	1. M. Satake and Y. Mido, Bioinorganic Chemistry, Discovery Publishing House, New Delhi, 1996. 2. M.N. Hughes, The Inorganic Chemistry of Biological Processes, 2nd Edition, Wiley London, 1982. 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 to: **CO1**: Analyses trace elements. **CO2**: Explain the biological redox systems. CO3: Learn about the nitrogen fixation and photosynthetic mechanism. CO4: Gain skill in analyzing the toxicity in metals. CO5: Learn about enzyme kinetics.	

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S – Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">BIOMOLECULES AND HETEROCYCLIC COMPOUNDS</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Centric Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E03</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of biomolecules and heterocyclic compounds</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To explain various of functions of carbohydrates
To explain various of functions of steroids and hormones
To explain various of functions of protein and nucleic acids,
To elucidate the structure determination of vitamins
To understand the preparation and chemical reactions of fused ring heterocyclic compounds</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Chemistry and metabolism of carbohydrates: Definition, classification and biological role of carbohydrates. Monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose. Polysaccharides: Starch, glycogen and cellulose – structure and properties - glycolysis of carbohydrates.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Steroids and hormones:Steroids-Introduction, occurrence, nomenclature and configuration of substituents. Diels' hydrocarbon, stereochemistry, classification and biological importance. Colour reactions of sterols, cholesterol-occurrence, tests, physiological activity and biosynthesis of cholesterol from squalene. Hormones-Introduction, classification, functions of sex hormones- Androgens and estrogens, adrenocortical hormones-Cortisone and cortisol structure and functions of non-steroidal hormones-Adrenaline and thyroxin.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Proteins and nucleic acids: Separation and purification of proteins – Dialysis, gel filtration and electrophoresis. Catabolism of amino acids - Transamination, oxidative deamination and decarboxylation. Biosynthesis of proteins: Role of nucleic acids. Amino acid metabolism and urea cycle. Structure and methods for the synthesis of nucleosides - Direct combination, formation of heterocyclic base and nucleoside modification, Conversion of nucleoside to nucleotides. Primary and secondary structure of RNA and DNA, Watson-Crick model - Solid phase synthesis ofoligonucleotides.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Vitamins:Introduction, classification, sources and deficiency diseases. Structural determination and synthesis of vitamin A_1, Vitamin B_6, vitamin B_{12}, folic acid, vitamin H, vitamin E and vitamin K_2.</td></tr>
<tr><td></td><td colspan="7">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.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. T.K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America, 2007. 2. I.L. Finar, Organic Chemistry Vol-2, 5th Edition, Pearson Education Asia, 1975. 3. V.K. Ahluwalia and M. Goyal, Textbook of Heterocyclic Compounds, Narosa Publishing, New Delhi,2000. 4. M.K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014. 5. V. K. Ahluwalia, Steroids and Hormones, Ane Books Pub., New Delhi,2009.
Reference Books	1. I.L. Finar, Organic Chemistry Vol-1, 6th Edition, Pearson Education Asia, 2004. 2. Pelletier, Chemistry of Alkaloids, Van Nostrand Reinhold Co,2000. 3. Shoppe, Chemistry of the Steroids, Butterworthes,1994. 4. I.A. Khan, and A. Khanum. Role of Biotechnology in Medicinal &Aromatic Plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004. 5. M.P. Singh and H. Panda, Medicinal Herbs with their Formulations, Daya Publishing House, Delhi, 2005.
Website and e-learning source	2. https://www.organic-chemistry.org/ 3. https://www.studyorgo.com/summary.php 4. https://www.clutchprep.com/organic-chemistry

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the basic concepts and explain various of functions of carbohydrates of biomolecules and natural products.

CO2: To explain various of functions of steroids and hormones

CO3: To illustrate the applications of protein and nucleic acids and their functions in the metabolism of living organisms.

CO4: To analyse and rationalise the structure and synthesis of vitamins.

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

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S – Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">MEDICINAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-4</td></tr>
<tr><td>Category</td><td>Centric Elective</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23UPCHE1E04</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of medicinal chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To study the chemistry behind the development of pharmaceutical materials.
To understand the need of antibiotics and usage of drugs
To gain knowledge on antihypertensive agents and diuretics.
To gain knowledge on antiviral and antibacterial agents.
To study about analgesics, antipyretics and anti-inflammatory drugs.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Introduction to receptors: Introduction, targets, agonist, antagonist, partial agonist. Receptors - Receptor types, Theories of drug – receptor interaction, Drug synergism, Drug resistance and physicochemical factors influencing drug action.</td></tr>
<tr><td colspan="7">UNIT-II: Antibiotics: Introduction - Targets of antibiotics action - classification of antibiotics. Enzyme-based mechanism of action, SAR of penicllins and tetracyclins.Clinical application of penicillins and cephalosporin. Current trends in antibiotic therapy.</td></tr>
<tr><td colspan="7">UNIT-III: Antihypertensive agents and diuretics: Classification of cardiovascular agents -Introduction to hypertension.Etiology – types and classification of antihypertensive agents, mechanism of action of diuretics, furosemide, hydrochlorothiazide, amiloride.</td></tr>
<tr><td colspan="7">UNIT-IV: Antiviral and Antibacterial: Classification of antiviral agents, Mechanism of action - Chloroquine Phosphate, Amodiaquine hydrochloride and Pyrimethamine.Antibacterial: Classification and mechanism of action- Sulphanilamide, Sulphapyridine, Sulphadiazine and Sulphisoxazole.</td></tr>
<tr><td colspan="7">UNIT-V: Analgesics, antipyretics and anti-inflammatory drugs: Introduction, mechanism of inflammation, classification and mechanism of action of paracetamol, ibuprofen, diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal chemistry of antidiabetic agents - introduction, types of diabetics, drugs used for the treatment, chemical classification, mechanism of action, treatment of diabetic mellitus - Chemistry of insulin, sulfonyl urea.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. 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, Oxford University Press, 5th Edition, 2013. 4. JayashreeGhosh,AtextbookofPharmaceuticalChemistry,S.ChandandCo.Ltd,1999,1999 Edition. 5. O.LeRoy,Natural andSyntheticOrganicMedicinal Compounds,Ealemi,1976. 6. S.AshutoshKar,MedicinalChemistry, WileyEasternLimited, New Edition, NewDelhi,1993.
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. WilsonandGisvold'sTextbookofOrganicMedicinalandPharmaceuticalChemistry,John M.BealeJrandJohnM. Block, Wolters Kluwer, 2011,12th Edition. 4. P.Parimoo,ATextbookofMedicalChemistry,NewDelhi:CBSPublishers.1995. 5. S.Ramakrishnan, K.G.PrasannanandR.Rajan,TextbookofMedicalBiochemistry,Hyderabad: OrientLongman.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 drugs 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 study about analgesics, antipyretics and anti-inflammatory drugs.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">GREEN CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Centric Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E05</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of general chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To discuss the principles of green chemistry.
To propose green solutions for chemical energy storage and conversion.
Propose green solutions for industrial production of Petroleum and Petrochemicals.
Propose solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries.
Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations of Green Chemistry. Chemical accidents, terminologies, International green chemistry organizations and Twelve principles of Green Chemistry with examples.</td></tr>
<tr><td colspan="7">UNIT-II: Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water,Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in $ScCO_2$. Green synthesis-adipic acid and catechol.</td></tr>
<tr><td colspan="7">UNIT-III: Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Polymer supported photosensitizers.</td></tr>
<tr><td colspan="7">UNIT-IV: Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.</td></tr>
<tr><td colspan="7">UNIT-V: Microwave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and applications.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005. 2. W.L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7thEdition, McGraw-Hill, 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 , 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 organic synthesis.

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

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S – Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY OF NATURAL PRODUCTS</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-6</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Centric Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E06</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry of natural products</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the basic concepts and biological importance of natural products.
To explain various of functions of terpenoids and carotenoids.
To understand the functions of anthocyaninesandflavones.
To elucidate the structure determination of purinesandsteroids.
To understand the synthesis of natural dyes and structural determination.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">UNIT-I: Alkaloids: Introduction, occurrence, classification, isolation and functions ofalkaloids. Classification, general methods of structurallelucidation. Chemical methods of structure determination of coniine, piperine, nicotine, papaverine. atropine, quinine, belladine, cocaine, heptaphylline, papaverine and morphine.</td></tr>
<tr><td colspan="7">UNIT-II: Terpenoids: Introduction, occurrence, Isoprene rule,classification. General methods of determiningstructure. Structure determination of camphor, abietic acid, cadinene, squalene, zingiberine. Carotenoids: Introduction, geometricalisomerism, structure, functions and synthesis of β-carotene andvitamin-A.</td></tr>
<tr><td colspan="7">UNIT-III: Anthocyaninesandflavones: Anthocyanines: Introduction toanthocyanines. Structure and general methods of synthesis ofanthocyanines. Cyanidine chloride: structure anddetermination. Flavones: Biological importance of flavones. Structure and determination of flavone andflavonoids.Quercetin: Structure determination andimportance.</td></tr>
<tr><td colspan="7">UNIT-IV: Purinesandsteroids:Purines - Introduction, occurrence, isolation,classification, biological importance, and spectral properties of purines. Synthesis, structure and its biological importance ofuric acid and caffeine.Steroids: Introduction, occurrence, nomenclature, configuration of substituents, stereochemistry, classificationand biological importance. Diels' hydrocarbon and colour reactions of sterols. Cholesterol-occurrence, tests, physiological activity and biosynthesis of cholesterol from squalene.</td></tr>
<tr><td></td><td colspan="7">UNIT-V: NaturalDyes: Occurrence, classification, isolation, purification, properties, colour andconstitution of natural dyes. Structural determination and synthesis of indigotin andalizarin.</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text Books</td><td colspan="7">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.</td></tr>
</table>

	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. C.W.Shoppe, Chemistry of the Steroids, Butterworthes,1994. 4. I.A. Khan, and A. Khanum. Role of Biotechnology in Medicinal &Aromatic Plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004.
Website and e-learning source	https://sites.google.com/site/chemistryebookscollection02/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 understandfunctions of terpenoids and carotenoids.
CO3: To elucidate the structure of alkaloids, terpenoids, carotenoids, flavonoids and anthocyanins.
CO4: To determine the structure of purinesandsteroids.
CO5: To understand the synthesis of natural dyes and structural determination.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S – Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">POLYMER CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">CE-7</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Centric Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E07</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of PolymerChemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the basic concepts and bonding in polymers.
To explain various types of polymerization reactions and kinetics.
To understand the importance of industrial polymers and their applications.
To determine the molecular weight of polymers.
To predict the degradation of polymers and conductivity.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Characterization, Molecular Weight and its determination: Primary and secondary bond forces in polymers; cohesiveenergy, molecular structure, chemical tests, thermal methods, Tg, molecular distribution, stability. Determination of Molecular mass of polymers: Number Average molecular mass (M_n)and Weight average molecular mass (M_w) ofpolymers. Molecular weight determination of high polymers by physical and chemical methods.</td></tr>
<tr><td colspan="7">UNIT-II:Mechanism and Kinetics ofpolymerization: Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Nattapolymerization. Reaction kinetics. Step growthpolymerization, Degree of polymerization.</td></tr>
<tr><td colspan="7">UNIT-III: Techniques of polymerization andpolymerdegradation: Bulk, Solution, Emulsion, Suspension, solid, interfacial and gas phasepolymerization. Types of Polymer Degradation, Thermal degradation, mechanicaldegradation, photodegradation, Photostabilizers, Solid and gas phase polymerization.</td></tr>
<tr><td colspan="7">UNIT-IV: Industrialpolymers: Preparation of fibre forming polymers, elastomericmaterial. Thermoplastics: polyethylene, polypropylene,polystyrene, polyacrylonitrile,polyvinyl Chloride, Poly tetrafluoro ethylene, nylon andpolyester. Thermosetting Plastics: Phenolic and epoxy resin. Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers: Elementary ideas; examples: poly sulphur nitriles, polyphenylene, polypyrrole and polyacetylene. Polymethylmethacrylate, polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropyleneglycols.</td></tr>
<tr><td colspan="7">UNIT-V:Polymer processing: Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardantsand colourants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding andreinforcing. Film casting, Thermofoaming, Foaming.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component</td><td colspan="7">Questions related to the above topics, for various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

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, Polymer Science, Wiley Eastern, 1995. 2. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996. 3. M.S. Bhatnagar, A Text Book of Polymers,Vol-I & II, S.Chand & Company, New Delhi, 2004. 4. G.Odian, Principles of Polymerization, Wiley-Interscience publishers, 1981.
Reference Books	1. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1, 1971. 2. Kumar and S. K. Gupta, Fundamentals and Polymer Science andEngineering, Tata McGraw-Hill, 1978. 3. P.J. Flory, Principles of Polymer Chemistry, Springer Publisher 2012.

Course Learning Outcomes (for Mapping with POs and PSOs)

On the successful completion of the course students will be able:

CO1: To understand the bonding in polymers.

CO2: To scientifically plan and perform the various polymerization reactions.

CO3: To conceive different ideas and conceptualize 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
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S – Strong, M– Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

ELECTIVE COURSES (GENERIC)

<table>
<tr><td>Title of the Course</td><td colspan="7">NANOMATERIALS AND NANOTECHNOLOGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">GE-1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E08</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on concepts of nanomaterials chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the concept of nanomaterials and nanotechnology.
To study the various types of nanomaterials and their properties.
To study the applications of synthetically important nanomaterials.
To correlate the characteristics of various nanomaterials synthesized by new technologies.
To understand the synthesis, characterization and applications of various nanocomposites.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Introduction of nanomaterials and nanotechnologies: Role of size and classification - 0D, 1D, 2D, 3D. Synthesis - Bottom – Up and Top – Down.Consolidation of Nano powders. Features of nanostructures. Background of nanostructures and metallic nanoparticles - gold and silver.Metal oxides -Silica, iron oxide andalumina. Nano thin films, core-shellnanoparticles. Nanocomposites –Metal-ceramic andpolymer-matrixcomposites.</td></tr>
<tr><td colspan="7">UNIT-II: Techniques of synthesis of nanomaterials. Synthesis- Physical and chemical methods - Inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal methods. CVD-types–Metal-organic, plasma enhanced and low-pressure CVD. Microwave assisted and electrochemical synthesis of various nanostructures.</td></tr>
<tr><td colspan="7">UNIT-III: Bonding and structure of the nanomaterials, predicting the type of bonding. Surface of materials, nanoparticle size and properties. Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials</td></tr>
<tr><td colspan="7">UNIT-IV: Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Semiconductor materials - classification - Ge, Si, Ga, As. Identification of materials as p and n - type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.</td></tr>
<tr><td colspan="7">UNIT-V: Characterization and application: SEM, TEM and AFM - principle,instrumentationand applications. Application of metallic nanoparticles, metal oxides, silica, iron oxide andalumina. Nano thin films, Nanocomposites-metal,ceramic -andpolymer-matrixcomposites in different fields – medicine, energy, environment, food and agriculture.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

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 Books	1. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday Text Book of Nanoscience Nanotechnology, Springer, 2013. 2. P. Venugopal Reddy and M. Lakshmi Introduction to Nanoscience and Nanotechnology, BS Publications, 2023. 3. K.S. Subramanian, K.Raja and M.Kannan, Text book on fundamental and applications, Daya Publishing House, 2018. 4. Sundar Sing, New Pattern Nanomaterial and Applications, Pragati Prakashan Publishers, 2020. 5. Rishal Sing, Shipra mittal Guptha, Introduction to Nanotechnology, Oxford Publishers, 2018.
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. F. James, Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6thEdition, 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 the identification of nanostructures.

CO4: To learn about the properties and applications of nanomaterials.

CO5:To understand the synthesis, characterization and applications of various nanocomposites..

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

<table>
<tr><td>Title of the Course</td><td colspan="7">MOLECULAR SPECTROSCOPY</td></tr>
<tr><td>Paper No.</td><td colspan="7">GE-2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E09</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Students should know about the fundamental aspects on spectroscopy and their importance in the characterization of chemical compounds. Basic knowledge on UV-Vis, IR, NMR and Mass spectroscopic techniques will be advantageous.</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand role of spectroscopy (UV, IR, NMR & Mass spectroscopy) to determine the structure of the compounds.
To understand the influence of rotation and vibrations on the polyatomic molecules.
To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, NOESY.
To carry out the structural elucidation of molecules using ESR and Mossbauer Spectroscopy techniques.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT-I: Rotational and raman spectroscopy: Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability,as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches. Polarization of Raman scattered photons.</td></tr>
<tr><td colspan="7">UNIT-II: Vibrational spectroscopy: Vibrations of diatomic molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.</td></tr>
<tr><td colspan="7">UNIT-III: Electronic spectroscopy: Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.</td></tr>
</table>

	UNIT-IV: NMR and mass 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. ^{13}CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to ^{31}P, ^{19}F NMR.Mass 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.
	UNIT-V: ESR and Mossbauer Spectroscopy: 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.Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Recommended Text	1. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw Hill, New Delhi, 2000. 2. R.M. Silverstein and F.X. Webster, Spectroscopic Identification of Organic Compounds, 6th Edition, John Wiley & Sons, New York, 2003. 3. W. Kemp, Applications of Spectroscopy, English Language Book Society, 1987. 4. D.H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 1988. 5. R.S. Drago, Physical Methods in Chemistry; Saunders: Philadelphia, 1992.
Reference Books	1. P.W. Atkins and J. de Paula, Physical Chemistry, 7th Edition, Oxford University Press, Oxford, 2002. 2. I.N. Levine, Molecular Spectroscopy, John Wiley & Sons, New York, 1974. 3. A. Rahman, Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York,1986. 4. K. Nakamoto, Infrared and Raman Spectra of Inorganic and coordination Compounds, PartB: 5th Edition, John Wiley& Sons Inc., New York, 1997. 5. J.A. Weil, J.R. Bolton and J.E. Wertz, Electron Paramagnetic Resonance; Wiley Interscience, 1994.
Website and e-learning source	1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview 2. https://www.digimat.in/nptel/courses/video/104106122/L14.html

Course Learning Outcomes (for Mapping with POs and PSOs)

On the successful completion of the course, student will be able to:

CO1: The student can interpret the electromagnetic spectra

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 understand and utilize the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}F NMR and mass spectroscopic techniques.

CO5:To develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using ESR and Mossbauer Spectroscopy techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">PHARMACEUTICAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">GE-3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E10</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on drugs and doses</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the advanced concepts of pharmaceutical chemistry.
To recall the principle and biological functions of various drugs.
To train the students to know the importance as well the consequences of various drugs.
To have knowledge on the various analysis and techniques.
To familiarize on the drug dosage and its structural activities.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT-I: Physical properties in pharmaceuticals: Physical properties of drug molecule: Refractive index- Definition, explanation, formula, importance, determination.Specific & molar refraction. Optical activity rotation- Monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, Measurement of optical activity. Dielectric constant. Induced polarization- Dielectric constant - Explanation & determination. Rheology of pharmaceutical systems - Introduction, definition, applications and concept of viscosity. Newton’s law of flow, Kinematic, Relative, Specific, Reduced &intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow. Dilatent flow. Viscosity measurements- Selection of viscometer for Newtonian and non-Newtonian systems.</td></tr>
<tr><td></td><td colspan="7">UNIT-II: Isotopic dilution analysis:Principles and applications. Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics.for research and sterilization. Physicochemical Properties and drug action. Physicochemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.</td></tr>
<tr><td></td><td colspan="7">UNIT-III: Drug dosage and product development: Introduction to drug dosage forms &drug. Delivery system – Definition of Common terms. Drug Regulation and control, Pharmacopoeias and formularies.Sources of drug - Drug nomenclature, routes of administration of drugs products.Need for a dosage form and classification of dosage forms. Drug dosage and product development.</td></tr>
<tr><td></td><td colspan="7">UNIT-IV: Development of new drugs: Introduction, procedure followed in drug design, the research for lead compounds and molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism and spatial considerations.Biological properties of simple functional groups -Theories of drug activity, occupancy theory, rate theory, induced-fit theory. Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions and the additivity of group contributions, Physicochemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator and</td></tr>
</table>

	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 Books	1. Bahl and Tuli, Physical Chemistry. 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, Jayshree Ghosh, S. Chand & company Ltd. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan Chand& Sons.
Reference Books	1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993. 2. Computers for Chemists, S.K Pundir, Anshu Bansal, A pragate prakashan., 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. Ansels pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

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

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

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

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">PHARMOCOGNOSY AND PHYTOCHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">GE-4</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>II</td><td>Credits</td><td rowspan="2">3</td><td>Course Code</td><td>23UPCHE1E11</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>1</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To develop the knowledge of natural products, biological functions and pharmacological uses.
To develop knowledge on primary and secondary metabolites and their sources.
To understand the concepts of isolation methods and separation of bioactive compounds.
To provide the knowledge on selected glycosides and marine drugs.
To familiarize the guidelines of WHO and different sampling techniques.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I:Pharmacognosy and standardization of herbal drugs: Introduction, definition, development classification and source of drugs: Biological, mineral, marine, and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of crude drugs. Standardization of herbal drugs. WHO guidelines - Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture and ash value. Phytochemical investigations-General chemical tests.</td></tr>
<tr><td colspan="7">UNIT-II: Extraction Techniques: General methods of extraction, types – Maceration, decoction, percolation, immersion and soxhlet extraction. Advanced techniques- Counter current, steam distillation, supercritical gases, sonication, micro waves assisted extraction. Factors affecting the choice of extraction process.</td></tr>
<tr><td colspan="7">UNIT-III: Drugs containing terpenoids and volatile oils: Terpenoids: Classification - Isoprene rule, isolation and separation techniques. General properties of camphor, menthol, eucalyptol. Volatile oils or essential oils: Method of Preparations, Classifications of Volatile oils. Camphor oil, Geranium oil and Citral – Structure and uses. Pentacyclic triterpenoids: Amyrines; taraxasterol: Structure and pharmacological applications.</td></tr>
<tr><td colspan="7">UNIT-IV: Drugs containing alkaloids: Occurrence, function of alkaloids in plants, Pharmaceutical applications. Isolation - Preliminary qualitative tests and general properties. General methods of structural elucidation. Morphine, reserpine and papaverine - Chemical properties, structure and uses.</td></tr>
<tr><td colspan="7">UNIT-V: Plant Glycosides and Marine drugs: Glycosides: Basic ring systems. Classification - isolation, properties, qualitative analysis and pharmacological activity of Senna glycosides, Cardiac glycosides- Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs -Selected drug molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial</td></tr>
</table>

	compounds, antibiotic compounds, anti-inflammatory agents andmarine 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, 5thEdition, 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, 4thEdition, Indian reprint, Springer. 2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2ndEdition, 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
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">MATERIAL SCIENCE</td></tr>
<tr><td>Paper No.</td><td colspan="7">GE-5</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Generic Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E12</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge of solid-state chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the crystal structure, growth methods and X-ray scattering.
To explain the optical, dielectric and diffusion properties of crystals.
To recognize the basis of semiconductors, superconductivity materials and magnets.
To study the synthesis, classification and applications of nanomaterials.
To learn about the importance of materials used for renewable energy conversion.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT-I: Crystallography: Symmetry - Unit cell and Miller indices - crystal systems - Bravais lattices - Point groups and space groups - X-ray diffraction-Laue equations-Bragg's law-Reciprocal lattice and its application to geometrical crystallography. Crystal structure–powder and single crystal applications. Electron charge density maps, Neutron diffraction-method and applications.</td></tr>
<tr><td colspan="7">UNIT-II: Crystal growth methods: Nucleation–Equilibrium stability and metastable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growthmethods-nucleation–equilibrium stabilityandmetastablestate. Melt growth - Bridgeman-Stockbarger and Czochralskimethods.Fluxtechnique,physicalandchemical vapourtransport. Lorentz and polarization factora - Primary and secondary extinctions.</td></tr>
<tr><td colspan="7">UNIT-III: Properties of crystals: Optical studies - Electromagnetic spectrum (qualitative) Refractive index, reflectance, transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, inorganic and polymer LED materials - Applications. Dielectric studies- Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. Dielectric constant and dielectric loss. Types of dielectric breakdown– intrinsic, thermal, discharge, electrochemical and defect breakdown.</td></tr>
<tr><td colspan="7">UNIT-IV: Special materials: Superconductivity: Meissner effect, Critical temperature and critical magnetic field, Type I and II superconductors, BCS theory-Cooper pair - Applications. Soft and hard magnets – Domain theory hysteresis loop-Applications. Magneto andgiant magneto resistance. Ferro, ferri and antiferromagnetic materials-Application:Magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory alloys-characteristics and applications, Non-linear optics-Second harmonic generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.</td></tr>
<tr><td colspan="7">UNIT-V: Materials for renewable energy conversion: Solar Cells: Organic, bilayer, bulk heterojunction, polymer and perovskite based solar energy conversion: Lamellar solids and thin films, dye-sensitized photo voltaic cells.Coordination compounds anchored onto</td></tr>
</table>

	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. 6thEdition, PEARSON Press, 2007.
Reference Books	1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001. 2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001. 3. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966. 4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998. 5. A.R. West, Solid State Chemistry and Applications, John-Wiley and sons, 1987.
Website and e-learning source	1. http://xrayweb.chem.ou.edu/notes/symmetry.html. 2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf. 3. https://bit.ly/3QyVg2R

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

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 pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, 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
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Elective – (Industry/Entrepreneurship)

<table>
<tr><td>Title of the Course</td><td colspan="7">COSMETIC CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">IE-1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective - Industry/ Entrepreneurship</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E13</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on cosmetics</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To familiarize with the basic concepts of cosmetics.
To know the theoretical aspect of basic formulations
To know the commonly used additives in cosmetic formulations.
To learn about the properties of cosmetic products
To understand the influence of cosmetic problems.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT - I Cosmeceutical and hair care products
Definition of cosmetics as per Indian and EU regulations, Classification of cosmetic and cosmeceutical products. Cosmetic excipients- Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application. Hair- Basic structure of hair and hair growth cycle. Conditioning shampoo, hair conditioners, antidandruff shampoo and hair oils. Chemistry and formulation of para-phylene diamine based hair dye. Role of herbs in cosmetics. Hair care: Henna and amla. Analytical cosmetics: BIS specification and analytical methods for shampoo.</td></tr>
<tr><td></td><td colspan="7">UNIT - II Skin care products
Skin care- Basic structure and function of skin - Principles of formulation and building blocks of skin care products. Face wash, moisturizing cream, cold cream and vanishing cream. Their relative skin sensory, advantages and disadvantages. Application of these products in formulation of cosmeceuticals. Sun protection, Classification of Sunscreens and SPF. Aloe and turmeric. Analytical cosmetics: BIS specification and analytical methods for skin-creamand toothpaste.</td></tr>
<tr><td></td><td colspan="7">UNIT - III Oral Care Products
Oral care: Neem and clove. Principles of formulation and building blocks of oral care products. Oral cavity- Common problems associated with teeth and gums. Toothpaste for bleeding gums, sensitive teeth. Teeth whitening and mouthwash. BIS specification and analytical methods for toothpaste.</td></tr>
<tr><td></td><td colspan="7">UNIT - IV Properties of cosmetic products
Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs. Principles of cosmetic evaluation. Principles of sebumeter and corneometer. Measurement of TEWL, skin color, hair tensile strength, Hair combing properties. Soaps, and syndet bars. Evolution and skin benefits.</td></tr>
<tr><td></td><td colspan="7">UNIT - V Cosmetic problems
Oily and dry skin causes leading to dry skin-skin moisturisation. Basic understanding of the terms comedogenic, dermatitis. Cosmetic problems associated with hair and scalp - Dandruff, Hair fall causes cosmetic problems associated with skin - blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and deodorants- Actives and mechanism of action.</td></tr>
<tr><td>Extended</td><td colspan="7">Questions related to the above topics, from various competitive examinations</td></tr>
</table>

Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	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. Takeo Mitsu, New Cosmetic Science, Elsevier Science Ltd, 1997. 2. Meyer R. Rosen, Harry's Cosmetology, IFSCC, Nineth Edition, 2019. 3. C.B. Sagrin, Cosmetic Science and Technology, Wiley India Pvt Ltd, Second Edition, 2008. 4. Marc Paye, Andre. O. Barel, Handbook of Cosmetic Science and Technology, CRC Press, 2014.
Reference Books	1. K.R. Kirtikar, B.D.Basu, Archeological Survey, Medicinal Plants, Herbs, Plant, Analysis, 1963. 2. A.P. Purohit, C.K. Kokate, S.B. Gokhale, A Text Book Of Pharmacognosy, Nlrali Prakashan. 3. Marc Avram, Sandy Tsao, Zeina Tannous, Matthew Avram, Color Atlas of Cosmetic Dermatology: A Medical and Surgical, McGraw-Hill Medical, First Edition, 2007.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the basic concepts of cosmeceutical and Hair Care products.

CO2: To understand the skin care products.

CO3: To understand the impact of oral care products.

CO4: To learn about the properties of cosmetic products

CO5: To understand the influence of cosmetic problems.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMICAL POLISHING OF METALS</td></tr>
<tr><td>Paper No.</td><td colspan="7">IE-2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective - Industry/ Entrepreneurship</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E14</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Knowledge about chemical polishing of metals</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the basic principles of electrochemistry
To study about Corrosion Inhibitors
To study about Electrodes used in different electrochemical industries
To understand the principles of chemical polishing.
To study the importance and uses of chemical polishing.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT - I Electrochemistry
Principles of Electrochemistry, electrode potential, reference electrode, half-cell reaction, Nernst’s equation, Application of Thermodynamics to Feasibility of corrosion of metals & alloys in various environments, Pourbaix diagram of common metals, electrolytes, potentiometric and conductometric titration</td></tr>
<tr><td colspan="7">UNIT – II Corrosion inhibitors
Principle of prevention and protection of corrosion, Anodic protection, cathodic protection, application of inhibitors, organic coating & paints, metallic coating, anodizing , phosphating, chromate coating,</td></tr>
<tr><td colspan="7">UNIT - IIIElectrodes used in different electrochemical industries
Metals, graphite, lead dioxide, titanium substrate insoluble electrodes, iron oxide, semi conducting type etc., metal finishing: Electro deposition, electro refining, electro forming, electro polishing, anodizing, selective solar coatings, cell design</td></tr>
<tr><td colspan="7">UNIT - IV Chemical polishing of Al and steel
Chemical polishing - Definition, need for polishing. Chemical polishing of Al - Requirements of polishing bath. Types of baths - Alkaline bath, acidic bath. Rate of metal removal. Factors affecting polishing - selection of polishing bath, temperature, time, surface preparation, nature and type of alloy, shape and size of articles. Cleaning materials and polishes for steel - Content of chemical substances in polishes for steel.</td></tr>
<tr><td colspan="7">UNIT - V Chemical polishing of dilver, gold, and copper/ brass
`Cleaning materials and polishes for silver - All sizes of silver objects - Small objects-Cutlery, Content of chemical substances in polishes for silver objects-Liquid products, creamy products, Textile products. Cleaning materials and polishes for gold-Content of chemical substances in polishes for gold and jewels. Liquid products. Cleaning materials and polishes for copper/brass, content of chemical substances in polishes for copper/brass, Creamy products for copper/brass.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text Books	1. Eckart Uhlmann, Ioan D. Marinescu, Toshiro Doi, Handbook Of Lapping And Polishing, CRC Press, 2006. 2. R.K. Singh, R. Bajaj, M.Monpour, M. Meuris, Chemical-Mechanical Polishing 2000 - Fundamentals and Materials, Issues: Vol. 613, Cambridge University Press, 2000. 3. D. Marinescu, Toshiro Doi, Eckart Uhlmann, Handbook of Ceramics Grinding and Polishing, William Andrew, 2015. 4. Pawan Tyagi, Tobias Goulet, Nitt Chuenprateep, Robert Stephenson, Rudolph Knott, Antione Reddick, Devdas Shetty, Justin Schlitzer, Cordell Benton, Francisco Garcia-Moreno, Chemical Polishing Based Surface Finishing of 3D Printed Steel Components, ASME, 2019. 5. Hawkins Herbert James, The Polishing and Plating of Metals; A Manual for The Electroplater, Giving Modern Methods Of Polishing, Plating, Buffing, Oxydizing and Lacquering Metals, For The Progressive Workman, Read Books, 2012. 6. NIIR Board of Consultants & Engineers, The Complete Technology Book on Electroplating, Phosphating, Powder Coating and Metal Finishing, Asia Pacific Business Press Inc., Second Revision, 2021.
Reference Books	1. H.J. Herbert, The Polishing and Plating of Metals, Forgotten Books, 1987. 2. Sheasby & Pinner, The Surface Treatment and Finishing of Aluminum and its Alloys, Finishing Publications / ASM, Sixth Edition, 2001. 3. R.H. Probert, How to Aluminium anodizing, hard coating, and chromating of aluminum, R. H. Probert, 2005. 4. Jack W. Dini, Electrodeposition, the Materials Science of Coatings and Substrates, 1993. 5. Lawrence J. Durney, Electroplating Engineering Handbook, 1984. 6. Metal Finishing Guidebook and Directory, Elsevier. 7. Metals Handbook of Surface Engineering, American Society for Metals, Vol. 5, Tenth Edition, 1994.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the basic principles of electrochemistry

CO2: To study about Corrosion Inhibitors

CO3: To study about Electrodes used in different electrochemical industries

CO4: To understand the principles of chemical polishing.

CO5: To study the importance and uses of chemical polishing.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">PREPARATION OF CONSUMER PRODUCTS</td></tr>
<tr><td>Paper No.</td><td colspan="7">IE-3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective - Industry/ Entrepreneurship</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E15</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="2">-</td><td colspan="3">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Students should have an idea about consumer products</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To train the student to prepare various consumer products
To analyze various chemicals present in the consumer products</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: Determination of active content (SLS, SLES, LABS) in a detergent; Determination of nitrogen by Kjeldhal method; Estimation of iodine value and saponification value of an oil; Estimation of hardness of water; Estimation of iron (III) by colorimetric method in water; Estimation of ascorbic acid by iodimetric method; Estimation of glucose by Benedict’s method. Estimation of sugar by refractometric method; Estimation of purity of soda ash; Estimation of phenol by Winkler’s method; Estimation of available chlorine in bleaching powder or bleach liquor.</td></tr>
<tr><td colspan="7">UNIT-II: Detection of food adulteration including milk; Microbiological examination of food products. RWC of phenol; Detection of adulteration in petrol / diesel; Analysis of essential oils by gas chromatographic method; Isolation of lactose from milk. Caffeine from tea leaves, Ginger oleoresin from Ginger; Detection of alkaloids, terpenes, flavanoids, anthocyanins, proteins, amino acids; Hydrocarbons in the natural product extracts.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, and online seminars – webinars for strengthening the subject matters.</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. S.Gobala Rao , Outlines of chemical technology, Affiliated East West press,1998</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. Kafaro, Wasteless, Chemical Processing, Mir Publishers, 1995.
2. W. Sawyer, Experimental Cosmetics, Dover Publishers, New York, 2000.</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7"></td></tr>
</table>

Course Learning Outcomes (for Mapping with POs and PSOs)

On the successful completion of the course, student will be able to:
CO1: Prepare various consumer products
CO2: Analyze the chemicals present in variousconsumer products

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**L**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
Weightage	6	6	6	6	6
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Skill Enhancement Courses

<table>
<tr><td>Title of the Course</td><td colspan="7">RESEARCH TOOLS AND TECHNIQUES</td></tr>
<tr><td>Paper No.</td><td colspan="7">SE-1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill enhancement course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E16</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="2">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Students should have an idea about advanced characterization techniques</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the principle, instrumentation, characterization and applications of analysis techniques
To study the principle, instrumentation, characterization and applications of chromatographic and thermal analysis techniques.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: Principle, instrumentation, characterization and applications of X-Ray Photoelectron spectroscopy, Powder X-ray diffraction - Single crystal X-ray diffraction techniques, Scanning electron microscopy (SEM), Energy-dispersive X-ray analysis (EDAX), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).</td></tr>
<tr><td colspan="7">UNIT-II: Principle, instrumentation, characterization and applications of Gas liquid chromatography (GLC), High performance liquid chromatography (HPLC), Gas Chromatograph- Mass Spectrometer (GC-MS), Thermogravimetry (TGA), Differential thermal analysis (DTA) and Differential Scanning Calorimetry (DSC)</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, and online seminars – webinars for strengthening the subject matters.</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. R.A. Day, A.L. Underwood, Quantitative Analysis, Prentice-Hall of India Pvt. Ltd., 1985.
2. D.A. Skoog, D.M. West, Fundamentals of Analytical Chemistry, Fourth Edition, Philadelphia: Saunders College Pub 1982.
3. Jr. L.L. Merritt, J.A. Dean, Jr. F.A. Settle, An Instrumental Methods of Analysis, C.B.S Publishers and Distributors, Seventh Edition, 1992.</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. C. F. Banwell, Fundamentals of Molecular Spectroscopy, Fourth Edition, McGraw Hill, New York, 2017.
2. D.A. Skoog, D.M. West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, Fourth Edition, 1982.</td></tr>
</table>

	3. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, Thomson Asia Pvt, Ltd., Singapore, Eighth Edition, 2004. 4. D.A. Skoog, Principles of Instrumental Analysis, Saunders College Pub. Co., Third Edition, 1985.
Website and e-learning source	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.] 1. https://youtu.be/qrUjaILrOI - Material safety Data Sheet 2. https://youtu.be/FD2hXZjgcEM- Problems related to safety and loss statistics 3. https://youtu.be/8queMM7VVfw- Chemical Hazards / Lab Safety 4. https://youtu.be/GjAD83B4JaY-PPE and Lab Safety 5. https://youtu.be/ICz1GUQoiAQ-Fire Extinguishers

Course Learning Outcomes (for Mapping with POs and PSOs)

On the successful completion of the course, student will be able to:

CO1:To learn the principle, instrumentation, characterization and applications of analysis techniques

CO2: To study the principle, instrumentation, characterization and applications of chromatographic and thermal analysis techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**L**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
Weightage	6	6	6	6	6
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMICAL SAFETY AND HEALTH</td></tr>
<tr><td>Paper No.</td><td colspan="7">SE-2</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill enhancement course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E17</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="2">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Students should have an idea about science laboratories</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To train the student how to work safely in the lab and protect others
To state the role of MSDS and universal precautions for disposal and handling of hazardous chemicals</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: Chemistry lab layout and safety procedures practiced in the Chemical laboratory that pertain to general laboratory safety and awareness including eye shower to fume hoods. Safety kits, devices, uses and storage. SOP for personal safety.</td></tr>
<tr><td colspan="7">UNIT-II: Material Safety Data Sheet (MSDS), chemical, radiation, fire, electrical and gas safety; Clean room facility Universal Precautions and its importance in the handling of hazardous chemicals in the lab; handling of radioactive materials and biohazardous materials</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, and online seminars – webinars for strengthening the subject matters.</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Anthony Fuscaldo, Laboratory Safety Theory and Practice, 1st Edition, December 1980.
2. Stephen R. Rayburn, The Foundations of Laboratory Safety, 1990 Springer-Verlag, New York.</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. Prudent practices in the laboratory: handling and management of chemical hazards, updated version. National Academies Press, 25-Mar-2011 - Science - 360 pages.
2. Guidelines for Chemical Laboratory Safety in Academic Institutions American Chemical Society Washington, DC 2016.
3. Guidelines for Laboratory Design: Health, Safety, and Environmental Considerations, Fourth Edition Louis 15 March 2013 John Wiley & Sons, Inc.</td></tr>
</table>

Website and e-learning source	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.] 6. https://youtu.be/qrUjaILrOI - Material safety Data Sheet 7. https://youtu.be/FD2hXZjgcEM- Problems related to safety and loss statistics 8. https://youtu.be/8queMM7VVfw- Chemical Hazards / Lab Safety 9. https://youtu.be/GjAD83B4JaY-PPE and Lab Safety 10. https://youtu.be/ICz1GUQoiAQ-Fire Extinguishers
Course Learning Outcomes (for Mapping with POs and PSOs)	
On the successful completion of the course, student will be able to: CO1:To work in a lab safely and prevent human accidents CO2: To get best lab practices and handling of harmful chemicals	

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**L**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
Weightage	6	6	6	6	6
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">COMPUTATIONAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">SE-3</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill enhancement course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1E18</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="2">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Students should have an idea about science laboratories</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To study the various computational methods.
To study the various applications of computational methods to chemical structures</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT-I: Computational Analysis
Geometry optimization, calculation of thermodynamic parameters, vibrational frequencies and intensities, NMR and ESR parameters using elementary examples and a few representative molecules using Gaussian 16. Writing a Z - matrix - basis sets and types - vibrational analysis - Finding TS, NMR analysis software’s used in computation, Natural Bond Orbital analysis - current trends in computational chemistry, Output analysis.</td></tr>
<tr><td colspan="7">UNIT-II:Applications
Combined QM/MM methods: Implications of the choice of QM and MM methods; Application of QM/MM methods in organic, inorganic and organometallic systems. Quantitative structure activity relation (QSAR): Early approaches, topological indices, fragmental models; quantum mechanical descriptors. Application to Benzenoid and Non-Benzenoid Aromatic compounds.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, and online seminars – webinars for strengthening the subject matters.</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. D. Frenkel and B. Smit, Understanding Molecular Simulations, Second Edition, Elsevier, 2001.
2. M. P. Allen and D. J. Tildesley, Computer Simulation of Liquids, Second edition, Oxford University Press, 2017.
3. J. B. Foresman and Aeleen Frisch, Exploring Chemistry with Electronic Structure Methods, Gaussian Inc., 2015</td></tr>
</table>

	4. W. Koch & M. C. Holthausen,A Chemists' Guide to Density Functional Theory, Wiley-VCH, 2001.
Reference Books	1. F. Jensen (1999). Introduction to Computational Chemistry. England: John Wiley and Sons Ltd. 2. D.Young ,Computational Chemistry , Wiley-Interscience, 2001 3. J. March, Advanced Organic Chemistry 4. F.Jensen, Introduction to Computational Chemistry, Third edition, Wiley, 2017. 5. , A. Szabo & N. S. Ostlund,Modern Quantum Chemistry McGraw-Hill, 1961 edition reprinted by Dover Publications, 1989.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

On the successful completion of the course, student will be able to:
CO1:To work in a lab safely and prevent human accidents
CO2: To get best lab practices and handling of harmful chemicals

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**L**	**M**	**S**
CO 2	**S**	**S**	**S**	**S**	**S**

S – Strong, M – Medium, L - Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
Weightage	6	6	6	6	6
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Non-Major Elective Courses

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY AND HEALTH</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME-I</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>I
I1</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCHE1N01</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on chemistry and health</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To know the essentials of health and drugs.
To learn the functions of enzymes, hormones and body fluids.
To know the common diseases and their treatment.
To know about the measurement of chemicals in human bodies
To understand the influence of chemicals on health.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT - I Introduction
Fundamental chemical concepts including atomic composition, chemical bonding and chemical forces, and organic chemistry.</td></tr>
<tr><td colspan="7">UNIT - II Biomolecules
Concepts related to biological molecules such as nucleic acids, proteins, lipids, and carbohydrates. Discussion on chemicals and chemical processes involved in living systems. Types of enzymes and enzyme action, Characters of hormones action, examples of essential hormones.</td></tr>
<tr><td colspan="7">UNIT - III Health and Toxicology
Definition, Food, Food pyramid, Health-hygiene-mal, under and over nutrition, their causes and remedies, sanitation. Role of chemicals in our bodies-sense of chemicals exposed to bodies, impact of chemicals on our health. Toxicology-study of poisons, review, evaluation and grading.</td></tr>
<tr><td colspan="7">UNIT - IV Biomonitoring
Measurement of chemicals in our bodies, need for measurements of chemicals. National Biomonitoring Program - translation of national program to the local level -relationship of communities to the government.</td></tr>
<tr><td colspan="7">UNIT - VHealth effects of chemicals
Effects of chemicals on human health - assessing the impact of chemicals on our health - environmental, occupational medicine and epidemiology - assessment of risk and drive policy on chemicals and health.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Alex V Ramani, Food Chemistry, MJP Publishers, Chennai, 2009
2. Jayashree Ghosh, A Text book of Pharmaceutical Chemistry, S. Chand and Co.Ltd, 1999.
3. Ashutosh Kar, Medicinal Chemistry, Wiley Easterns Limited, New</td></tr>
</table>

	Delhi, 1993.
Reference Books	1. A.C. Deb, Fundamentals of Biochemistry, New Central Book Agency, Calcutta, 1994. 2. M. Satake, Y. Mido, Chemistry for Health Science, Discovery Publishing House, New Delhi, 2003.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the basic concepts of organic chemistry.
CO2: To understand the biomolecules and their importance.
CO3: To understand the impact of chemicals on health.
CO4: To learn about the measurement of chemicals in human bodies
CO5: To understand the influence of chemicals on health.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3– Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">INDUSTRIAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME-II</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>I
I1</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCHE1N02</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on industrial chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To learn the chemical technology and unit operation processes.
To learn the synthesis of industrial products.
To learn industrial application of chemical compounds.
To expertise the various techniques of preparation and increase the yield of the compounds
To understand the raw materials involved in synthesizing industrially important products</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT –I Unit Operations
Evaporation - Introduction, principle, Types of evaporation - vacuum, steam heated, open vessel, closed vessel, under reduced pressure.
Distillation - Role of pressure on distillation, vapour - liquid equilibrium, flash distillation, batch distillation, types of equipments and accessories for distillation.
Crystallization - Role of stability. Types of crystallization - atmospheric cooling with stirring, agitated batch crystallization, sensors-Walker crystallization.</td></tr>
<tr><td></td><td colspan="7">UNIT - IIWater, Fuels and Industrial Gases
Water - water treatment for domestic and industrial purpose
Fuels - Calorific value, requirement of a fuel, type of fuels. Refining crude petroleum, octane number, anti- knocking compound-tetra ethyl lead.
Industrial gases - Coal gas, producer gas, water gas, semi water gas and LPG. Manufacture and industrial application. Biogas, gobar gas, production, composition, calorific value, renewable nature.</td></tr>
<tr><td></td><td colspan="7">UNIT - III Industrial application-1 Glass and Cement
Glass - Commercial glass, composition of glass, properties of glass, raw materials and methods of manufacturing of some special glasses.
Cement - Types, raw materials, manufacture and process of portland cement, setting and hardening of cement, other cements and gypsum, calcium and magnesium compounds.</td></tr>
<tr><td></td><td colspan="7">UNIT - IV Industrial application-2 Oils, Soap & Detergents
Essential oils - Isolation of essential oils from plants, production of natural perfumes - Flower, fruit flavors and artificial flavors. Waxes – Classification, some common waxes - Manufacture of candles. Soaps and detergents - Manufacture of soap and detergents-Action of soap and detergent</td></tr>
<tr><td></td><td colspan="7">UNIT - V Fermentation Technology and sugar
Types of fermentation processes - Industrial preparation of alcohol from molasses, preparation of vinegar from alcohol. Composition of alcoholic beverages - Spirits, wines and beers.
Sugar and Sugar based chemicals - Manufacture of sugar from sugar</td></tr>
</table>

	cane. Sugar industry byproducts – Acetic acid, ethyl acetate, oxalic acid, acetic anhydride, furfural from bagasse, citric acid by fermentation (manufacturing process & their industrial 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. W.L. Mc. Cab, J.C. Smith, Unit Operations of Chemical Engineering, Seventh Edition, 2017. 2. B.K. Sharma, Industrial Chemistry, Goel Publishing House Pvt Ltd, 1999. 3. M.G. Arora, M. Singh, Industrial Chemistry, Anmol Publications, First Edition, 1994. 4. G.N. Pandey, A Textbook of Chemical Technology, Vol. I & II, Vikas Publishing House Pvt Ltd, 1997. 5. John A Monick, Alcohols, their chemistry, properties and manufacture.New York, Reinhold Book Corp, 1968. 6. C.C. Furnas (Edition), Roger's Manual of Industrial Chemistry, Sixth Edition, Vol.I, D. Van Nostrand Company, Inc, 1948. 7. J.C. Kuriacose, J. Rajaram, Chemistry in Engineering and Technology, Vol.-II, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi, 1984.
Reference Books	1. B.N. Chakrabarty, Industrial Chemistry, Oxford & IBH Publishing Co. Pvt Ltd, 1991. 2. V. Subrahmaniyan, S. Renganathan, K. Ganesan, S. Ganesh, Applied Chemistry,Scitech Publications, 1998. 3. J.E. Kuria Cose, J. Rajaram, Chemistry in Engineering & Technology, Vol. I & II,Tata Mc Graw Hill, 1984.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the unit operation processes – Evaporation, Distillation and Crystallization

CO2: To learn the water treatment for domestic and industrial purpose

CO3: To learn the industrial application of chemical compounds

CO4: To expertise the various techniques of preparation and increase the yield of the Synthesized compounds

CO5: To understand the raw materials involved in synthesizing industrially important products

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY IN AGRICULTURE</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME-III</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>3</td><td>Course Code</td><td>23UPCHE1N03</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>3</td><td>1</td><td colspan="3">-</td><td>4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on chemistry in agriculture</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the basic concepts of soil nature and properties.
To learn the soil fertility and water management.
To learn about the fertilizers and its role in plants.
To acquire awareness about the preparation and uses of pests.
To get knowledge about the advantages of biofertilizers</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT I - Soil nature and properties
Soil – Types of soil, composition. Properties - Physical properties - Soil texture, structure, particle density, bulk density, pore space, soil aeration, soil water holding capacity, soil temperature, soil moisture. Chemical properties - Soil clay minerals, soil colloids, cation exchange capacity, soil acidity, soil alkalinity, soil salinity, soil organic matter, soil nutrients.</td></tr>
<tr><td colspan="7">UNIT II - Soil fertility and Water Management
Soil fertility problems.Role of organic matter, important manures and fertilizers including biofertilizers and their application. Different soils behavior and fertilizer recommendation. Role of water in plant development and crop production. Different system of irrigation and drainage and irrigation requirement of different field crops.</td></tr>
<tr><td colspan="7">UNIT III - Fertilizers and their Role in Plants
Classification of nutrients - primary, secondary and micro nutrients. Essential requirement of plant nutrients, effect of nitrogen, phosphorus and potassium on plant growth and development, nutrients deficiency symptoms, commercial method of preparation of urea, ammonium nitrate, triple superphosphate and potassium nitrate. Organic fertilizer - farmyard manure, composite, green manure, liming and vermicomposite, complex and mixed fertilizers-their manufacture and composition.</td></tr>
<tr><td colspan="7">UNIT IV - Insecticides, Fungicides and Herbicides
Insecticides - Classification, types of insecticides and disadvantages of insecticides. Synthesis of insecticides – DDT, BHC, Boric acid and organophosphate. Fungicides - Types, sulphur compounds, copper compounds, bordeaux mixture and benefits of fungicides. Herbicides – Classification, based on mode of action, advantages and limitation of herbicide. Seed – Function of seed, characteristic of good seed and preservation of seeds.</td></tr>
<tr><td colspan="7">UNIT V- Biofertilizers
Biofertilizers-definition, classification, specification, methods of production and role in crop production, few examples are rhizobium, azotobacter, azospirillum, phosphate solubilizing bacteria and mycorrhiza.</td></tr>
<tr><td>Extended Professional Component (is a</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved</td></tr>
</table>

part of internal component only, Not to be included in the external examination question paper)	(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. N.C. Brady, The Nature and Properties of Soils, Eurasia Publishing House, New Delhi, 1977. 2. V.S. Jones, Fertilizers and Soil Fertility, Prentice Hall of India, New Delhi, 1993. 3. D.E.H. Freer, Chemistry of Pesticides, D.Van Nostrand Co, Reinhold, 1969. 4. Krishnendu Acharya, Surjiit Sen, Manjula Rai, Biofertilizers and Biopesticides, Techno World, First Edition, 2019. 5. J.L. Havlin, S.L. Tisdale, W.L. Nelson, J.D. Beaton, Soil Fertility & Fertilizers, Pearson Education India, Eighth Edition, 2016. 6. Dr. Himadri Panda, The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides, Niir Project Consultancy Services, Second Revised Edition, 2022.
Reference Books	1. U.D. Chavan, Agriculture Chemistry and Soil Science, Daya Publishing House, 2015. 2. Margarita Stoytcheva, Roumen Zlatev, Agricultural Chemistry, InTech, 2013. 3. Shalini Suri, Biofertilizers and Biopesticides, Aph Publishing Corporation, 2011. 4. Chamberlain Joseph Scudder, biblio life, Organic Agricultural Chemistry, Wentworth Press, 2016. 5. Hart Edwin Bret, General Agricultural Chemistry, Wentworth Press, 2016. 6. A. Mariakulandai, T.S. Manickam, Chemistry of Fertilizers and Manures, Asia Publishing House1975.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand know thorough knowledge about the basics of soil nature.

CO2: To understand the various types of soils and their properties.

CO3: To learn how to solve the problems in nutrients deficiency in soil.

CO4: To get clear idea about the Soil fertility and water management.

CO5: To produce the various fertilizers used in different types of soil.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY IN DAILY LIFE</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME-IV</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>II
III</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCHE1N04</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on chemistry in daily life</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the food products, vitamins, fats and detergents.
To understand various pollution and pollutants.
To learn water purification and polymers
To understand the importance of vitamins, fat and detergents
To learn the concept of corrosion and importance of polymers.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT - I Food Products and Additives
Dairy Products - Composition of milk and milk products, analysis of fat content and estimation of added water in milk. Beverages - Analysis of caffeine in coffee and tea. Estimation of methyl alcohol in alcoholic beverages. Food additives, adulterants and contaminants. Flavoring agents - Vanillin, alkyl esters (fruit flavours) and monosodium glutamate. Artificial food colorants - Coal tar dyes and non-permitted colours and metallic salts.</td></tr>
<tr><td colspan="7">UNIT - II Pollutants
Air Pollution - Definition, classification, effects and control measure of air pollution. Greenhouse effect, greenhouse gases and acid rain, Ozone hole and CFC’s, photochemical smog and PAN. Soil Pollution - Definition, classification, effects and control measure of soil pollution. Water pollution - Definition, classification, effects and control measure of water pollution and sewage water treatment.</td></tr>
<tr><td colspan="7">UNIT - III Water Purification
Water - Hydrologic cycle, water quality standards, public health, significance of water purification.Measurement of water quality parameters - Colour, turbidity, total solids, acidity, alkalinity, hardness, sulphate, fluoride, phosphate, nitrite, nitrate, BOD and COD. Water purification treatment for drinking purposes.</td></tr>
<tr><td colspan="7">UNIT - IV Vitamins, Fat and Detergents
Vitamins – Definition, composition, classification, Sources and health effects. Structures of Vitamin A_1, Vitamin B_1, Vitamin C, Vitamin D, Vitamin E & Vitamin K_1. Oils and fats - Composition of edible oils, detection of purity, rancidity of fats and oil. Soaps & Detergents: Definition, classification, preparation and uses.</td></tr>
<tr><td colspan="7">UNIT - V Corrosion, Batteries and polymers
Corrosion – Definition, effect of corrosion, causes of corrosion, classification- Dry and wet corrosion, corrosion control and its significances.
Batteries – Definition, characteristic and limitation, Types -primary & secondary batteries. Fuel cell. Future energy storage - Solar energy and wind energy.
Polymers – Definition, classification, and general characteristics of polymers. Typical examples of polymers used as plastics, in textiles, in electronic and automobile components, in the medical and aerospace</td></tr>
</table>

	materials.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. B. K. Sharma, Introduction to Industrial Chemistry, Goel Publishing, Meerut, 1998. 2. Ashutosh Kar, Medicinal Chemistry, New Age International Publisher, Seventh Edition, 2018. 3. Titus A. M. Msagati, Chemistry of food Additives and Preservatives, Wiley-Blackwell, 2012. 4. Deanna M. Minich, An A-Z Guide to Food Additives, ReadHowYouWant, 2010. 5. N. Saradha, V. Dhulasi Birundha, Industrial Pollution: A Reference to small Scale Industries, Serials Publication, 2008. 6. Baboian, Robert, NACE Corrosion Engineer's, NACE International, Fourth Edition, 2016. 7. Pierre R. Roberge, Handbook of Corrosion Engineering, Second Edition, 2016. 8. Manas Chanda, Introduction to Polymer Science and Chemistry, CRC Press, Second Edition, 2013. 9. Charles E. Carraher Jr. Introduction to polymer Chemistry, CRC Press, 2017.
Reference Books	1. Marcel Dekker, Drugs and Pharmaceutical Sciences Series, Vol. II, INC, New York 2. H.E. Cox, David Pearson, Analysis of Foods, Chemical Analysis of Foods, Chemical Publishing Co Inc., U.S. 1962. 3. N. Shakuntala Many, S. Swamy, Foods: Facts and Principles, Fourth Edition, New Age International, 1998. 4. P. Atkins and J. de Paula- Physical Chemistry, Seventh Edition, 2002, Oxford University Press, 2002. 5. S. Swaminathan, Manish Goswamy, K.P. Sundaram, Handbook on Feritilizer Technology, Fertilizer Association of India, Sixth Edition, 2001, 6. I.L. Finar, Organic Chemistry, Vol. 1 & 2. Pearson Education India; Sixth Edition, 2002. 7. J. Fired, Polymer Science and Technology, Pearson Prentice Hall, Third Edition, 2014.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the food products and their additives.

CO2: To understand pollutants and their case study

CO3: To learn the water purification techniques.

CO4: To understand the importance of vitamins, fat

CO5: To learn the concept of corrosion and importance of polymers.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3– Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">ENVIRONMENTAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME-V</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>II
III</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCHE1N05</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on environmental chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the fundamentals of environmental chemistry.
To study water, soil and hazardous wastes.
To study the impact of chemical composition in atmosphere.
To understand the impact of chemical components & pollutants in soil.
To know the detailed issues of hazardous chemicals in environmental.</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT - I Fundamentals
Concept and scope of environmental chemistry, Origin and development of elements.
Natural Cycles - Hydrological cycle, Carbon cycle, Oxygen cycle, Nitrogen cycle, Phosphorus cycle and sulphur cycle. Natural and Man-made Disasters - Recent natural disasters and their case studies.</td></tr>
<tr><td></td><td colspan="7">UNIT - II Water Chemistry
Properties of water,sampling techniques for water, nature of metal ions in water, solubility of gases in water. Occurrence of chelating agents in water and microorganisms. The catalyst of aquatic chemical reactions. Water pollution and its effects, Eutrophication concept of DO, BOD and COD, International standards of drinking water.
Water resources - Properties of water, nature of metal ions in water, solubility of gases in water, occurrence of chelating agents in water and microorganisms. The catalyst of aquatic chemical reactions, source of water pollutants and its effects, eutrophication concept of DO, BOD and COD. Waste water treatment, international standards of drinking water and sampling techniques for water.</td></tr>
<tr><td></td><td colspan="7">UNIT - III Atmospheric Chemistry
Structure and composition of atmosphere. Gaseous organic and inorganic pollutions in the atmosphere. Environmental ethics - Function, problem and solution to environmental problems. Climate - causes and effect of climate change. Chemical and photochemical reactions in the atmosphere. Greenhouse effect, Global warming, Acid rain, Ozone layer depletion, Photochemical smog and control methods for removing particulates from exhaust gases.</td></tr>
<tr><td></td><td colspan="7">UNIT - IV Soil Chemistry
Inorganic and organic components of soil. Sampling techniques for soil.Nitrogen pathways. NPK in soils, Toxic chemicals in the environment - pesticides and their toxicity. Industrial wastes. Strategies to control soil pollution. Biochemical aspects of arsenic, cadmium, lead and mercury.</td></tr>
<tr><td></td><td colspan="7">UNIT - V Hazardous Wastes
Environmental chemistry of hazardous wastes - hazardous wastes in hydrosphere, geosphere and atmosphere. Industrial production of hazardous wastes and health effects of hazardous wastes. Nuclear radioactive wastes - anthropogenic sources and effects of radioactive</td></tr>
</table>

	pollution. Strategies to control environmental pollution. Solid waste management - causes, effects and control measures of wastes. Green chemistry in day-to-day life. Energy from wastes – Water based biomass and biogas.
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. Sharma and Kaur, Environmental Chemistry, Krishna Publishers, New Delhi, 2000. 2. A.K. De, Environmental Chemistry, Wiley Eastern Ltd, New Delhi, 2014. 3. S.E. Manahan, Environmental Chemistry, Lewis Publishers, London, 2001. 4. S.K. Banerji, Environmental Chemistry, Prentice Hall of India, New Delhi, 2005. 5. S.C. Bhatia, Environmental Chemistry, CBS Publishers, 2003.
Reference Books	1. J. Rose, Environmental Toxicology, Gordon and Breach Science Publication, New York, 1998. 2. S. Ladsberger, Creatchman (Ed.), Elemental Analysis of Airborne Particles, Gordon and Breach Science Publication New York, 1998. 3. S.M. Khopkar, Environmental Pollution analysis, Wiley Eastern, New Delhi, 1994.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the fundamentals of environmental chemistry.

CO2: To understand the water pollutants and purification techniques.

CO3: To study the impact of chemical composition in atmosphere.

CO4: To understand the impact of chemical components & pollutants in soil.

CO5: To know the detailed issues of hazardous chemicals in environmental.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY OF CONSUMER PRODUCTS</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME - VI</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCHE1N06</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on consumer products</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">1) To understand the preparation of soaps.
2) To understand the formulations of detergents
3) To understand the preparation of shampoos
4) To understand the chemistry of skin care products</td></tr>
<tr><td>Course Outline</td><td colspan="7">UNIT 1: Soaps
Saponification of oils and fats. Manufacture of soaps. Formulation of toilet soaps.Different ingredients used. Their functions. Medicated soaps. Herbal soaps. Mechanismof action of soap. Soft soaps. Shaving soaps and creams. ISI specifications.</td></tr>
<tr><td></td><td colspan="7">UNIT 2: Detergents
a. Anionic detergents: Manufacture of LAB (linear alkyl benzene). Sulphonation ofLAB – preparation of acid slurry. Different ingredients in the formulation of detergentpowders and soaps. Liquid detergents. Foam boosters. AOS (alpha olefin sulphonates.
b. cationic detergents: examples. Manufacture and applications.
c. Non-ionic detergents: examples. Manufacture of ethylene oxide condensater.
d. Mechanism of action of detergents. Comparison of soaps and detergents.
Biodegradation – environmental effects. ISI specifications / limits.</td></tr>
<tr><td></td><td colspan="7">UNIT 3: Shampoos
Manufacture of SLS and SLES. Ingredients. Functions. Different kinds of shampoos – anti-dandruff, anti-lice, herbal and baby shampoos. Hair dye. Manufacture of conditioners. Coco betaines or coco diethanolamides – ISI specifications. Testing procedures and limits.</td></tr>
<tr><td></td><td colspan="7">UNIT 4: Skin care products
Face and skin powders. Ingredients, functions. Different types. Snows and face creams. Chemical ingredients used. Anti perspirants. Sun screen preparations. UV absorbers. Skin bleaching agents. Depilatories. Turmeric and Neem preparations. Vitamin oil. Nail polishes: nail polish preparation, nail polish removers. Article removers. Lipsticks, roughes, eyebrow pencils. Ingredients and functions – hazards. ISI specifications</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. S. Gobala Rao , Outlines of chemical technology, Affiliated East West press,1998
Reference Books	1. Kafaro, Wasteless Chemical Processing, Mir publishers, 1995. 2. W. Sawyer, Experimental Cosmetics, Dover publishers, New york, 2000.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the preparation of soaps.

CO2: To understand the formulations of detergents

CO3: To understand the preparation of shampoos.

CO4: To understand the chemistry of skin care products.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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
Weightage	12	12	12	12	12
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMISTRY FOR LIFE SCIENCES</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME - VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Non-Major Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1N07</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">1)To understand the basic concepts of inorganic chemistry.
2) To understand the basic concepts of physical chemistry
3) To understand the basic concepts of organic chemistry.</td></tr>
<tr><td rowspan="3">Course Outline</td><td colspan="7">UNIT 1: Inorganic Chemistry
Introduction to Atomic and Molecular Concepts: Matter, atoms and elements;Molecules and compounds;Equations and stoichiometry</td></tr>
<tr><td colspan="7">UNIT 2: Physical Chemistry
Foundation Physical Concepts in Chemistry: Atomic structure, electronic configurations of elements;Bonding and structure; Orbitals and hybridization;Gases</td></tr>
<tr><td colspan="7">UNIT 3: Organic Chemistry
Introduction to Organic Chemistry:Organic nomenclature, saturated compounds - Alkanes and cycloalkanes;Unsaturated compounds - Alkenes and alkynes;Aromatic compounds –Benzene;Organic functional groups;Introduction to IR spectroscopy</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. J. G. Dawber , A. T. Moore, Chemistry for the Life Sciences, Red Globe Press London,1980</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. P. Atkins, J.D. Paula,Physical Chemistry for the Life Sciences, W H Freeman & Co; 2nd edition, 2011.</td></tr>
<tr><td>Website and e-learning source</td><td colspan="7"></td></tr>
<tr><td colspan="8">Course Learning Outcomes (for Mapping with POs and PSOs)
Students will be able:
CO1: To understand the basic concepts of inorganic chemistry.
CO2: To understand the basic concepts of physical chemistry
CO3: To understand the basic concepts of organic chemistry.</td></tr>
</table>

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
Weightage	9	9	9	9	9
Weighted percentage of Course Contribution to PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">FUNDAMENTALS OF ANALYTICAL CHEMISTRY</td></tr>
<tr><td>Paper No.</td><td colspan="7">NME-VIII</td></tr>
<tr><td>Category</td><td>Non-Major Elective</td><td>Year
Semester</td><td>II
III</td><td>Credits</td><td>2</td><td>Course Code</td><td>23UPCHE1N08</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="3">-</td><td colspan="2">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on fundamentals of analytical chemistry</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To study the definition and basic concepts of analytical data treatment and itsevaluation.
To understand the theory and principles of titrimetric analysis and determination of methods.
To learn the concepts of sample preparation for solids, liquids andgases.
To acquire knowledge on the analysis of industrialsamples.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="7">UNIT- I Analytical Data Treatment and Evaluation
Definition of Terms - Mean, median, precision, accuracy. Errors in chemical analysis - systematic errors and random errors. Treatment of data - Basic statistical concept, Frequency distribution, average and measure of dispersion. Significance of Gaussian distribution curves, confidence interval of mean and Criteria for rejection of data.</td></tr>
<tr><td colspan="7">UNIT- II Titrimetric Analysis
Neutralization reactions - theory of acid-base titrations, titration curves and feasibility of reactions, Indicators-theory and choice, calculation of pH during titrations. Redox titrations - Redox potentials, theory and feasibility of redox titrations, redox indicators, their choice and applications.</td></tr>
<tr><td colspan="7">UNIT- III Sampling Techniques I
Preparing the sample for analysis - Effect of sampling uncertainties, gross sample, determination of the size of the sample, analytical sample. Sampling of solids: Preparation of laboratory sample from gross sample, moisture in the sample. Sampling of gases and liquids.</td></tr>
<tr><td colspan="7">UNIT- IV Sampling Techniques II
Definition, types of sample, sampling plan, quality of sample, subsampling, Sampling of raw materials, intermediates and finished products. Sample preparations - dissolution technology and decomposition and storage of samples.</td></tr>
<tr><td colspan="7">UNIT - V Analysis of Industrial samples
Gaseous fuels - sampling procedure, ultimate and proximate analysis, specific volatile index, ash content, calorific value by bomb colorimeter and Junker’scalorimeter.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. D.A. Skoog, D.M. West, Fundamentals of Analytical Chemistry, Holt Rinehart and Winston Publications, Fourth Edition, 1982. 2. A.I. Vogel, Text Book of Quantitative Inorganic Analysis, ELBS, Third Edition,1987. 3. A.I. Vogel, Text Book of Quantitative Inorganic Analysis, Pearson, Fifth Edition,2001. 4. E. Prichard, Quality in the Analytical Chemistry Laboratory, John Wiley and sons, 1997. 5. W. Funk, V. Dammann, G. Donnevert, Quality Assurance in Analytical Chemistry, VCH Weinheim, 1995. 6. J.G. Dick, Analytical Chemistry, McGraw Hill Publishers,1974. 7. T.S. Ma, V. Horak, Microscale-Manipulations, John Wiley and Sons,1976.
Reference Books	1. D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry, Eighth Edition, Thomson Brooks/Cole Publishers,2004. 2. H.A. Stobel Addison, Chemical Instrumentation, Wesley Publishers Co.,1976.
Website and e-learning source	

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To get in depth knowledge in analytical data treatment.

CO2: To develop an ability to understand the neutralization reactions based on the theory of acid-base titrations.

CO3: To understand the sample preparation techniques to elucidate the effect of sampling uncertainties for analysis.

CO4: To obtain skill on the sample types and their dissolution behaviors.

CO5: To determine the Gaseous fuel properties through sampling procedure for industrial samples.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Value Added Courses (Certificate course-Extra credits)

<table>
<tr><td>Title of the Course</td><td colspan="7">CHEMICAL ENERGY</td></tr>
<tr><td>Paper No.</td><td colspan="7">Value Added Courses</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Certificate course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1V01</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="2">-</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on fundamentals of chemical energy</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand classification and types of cells.
To understand the fossil fuels and solar energy conversion.</td></tr>
<tr><td rowspan="2">Course Outline</td><td colspan="7">UNIT - I Batteries and Fuel Cells
Electrochemical power sources - Primary cells - various types. Secondary cells - classification. Chemistry of the main secondary batteries. Batteries for electric vehicles.
Fuel cells - classification - Chemistry of fuel cells, detailed description of hydrogen/oxygen fuel cells, methanol - molten carbonate, solid polymer electrolyte and biochemical fuel cells. Hydrogen as a fuel.</td></tr>
<tr><td colspan="7">UNIT - II Fossil Fuels and Solar Cells
Fossil fuels - petroleum, natural gas and coal, Origin, processing and production of value added products, available current conversion technologies.
Solar energy conversion devices - photovoltaic cells, photo electrochemical cells- semiconductor electrolyte junctions, photocatalytic modes for fuel conversion process-photo biochemical options.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
<tr><td>Skills acquired from this course</td><td colspan="7">Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. C. A. Vincent, Modern Batteries, Edward Arnold, 1984.
2. R. Narayanan, B. Viswanathan, Chemical and Electrochemical Energy Systems, Orient Longmans, 1997.
3. K. Sriram, Basic Nuclear Engineering, Wiley Eastern, 1990.</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. S. J. Appleby, F. K. Foulkes, Fuel Cell Hand Book, Von Nostrand Reinhold, 1989.
2. D. Linden, Hand Book of Batteries and Fuel cells, McGraw Hill Book Company, 1984.
3. T. Ohta, Solar Hydrogen Energy Systems, Peragamon Press, 1979.
4. M. Gratzel, Energy Resources through Photochemistry and Catalysis, Academic Press, 1983.
5. T. Ohta, Energy Technology, Sources, Systems and Frontiers Conversions, Pergamon, 1994.
6. J. G. Speight, the Chemistry and Technology of Petroleum, Marcel Dekker</td></tr>
</table>

	Inc. 1980.
Website and e-learning source	
Course Learning Outcomes (for Mapping with POs and PSOs) Students will be able: **CO1**: To get knowledge in classification and types of cells. **CO2**: To understand the fossil fuels and solar energy conversion devices.	

CO-PO Mapping (Course Articulation Matrix)

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	M
CO2	M	S	S	S	M

S- Strong; **M**-Medium; **L**-Low

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
Weightage	15	15
Weighted percentage of Course Contribution to PSOs	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

<table>
<tr><td>Title of the Course</td><td colspan="7">WATER ANALYSIS</td></tr>
<tr><td>Paper No.</td><td colspan="7">Value Added Courses</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Certificate course</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23UPCHE1V02</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">-</td><td colspan="3">4</td></tr>
<tr><td>Prerequisites</td><td colspan="7">Basic knowledge on water parameters</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">To understand the various types of water pollution.
To understand the water quality parameter.
To understand the concept of wastewater treatment technique.
To get knowledge on industrial wastewater treatment and removal of particular organic matters.
To understand about sludge disposal treatment.</td></tr>
<tr><td rowspan="4">Course Outline</td><td colspan="7">Unit I: Water analysis I:
Sources of water, meaning of pure water and impurities in water. Meaning of the terms: Portability, sewage, sampling, contamination, eutrophication, pollutants, and pollution. Sources of water pollution. Types of water pollution: Ground water pollution, surface water pollution (river pollution, pond and lake pollution) and marine pollution (Oil spills).</td></tr>
<tr><td colspan="7">Unit II: Water analysis II:
Water quality parameters Physical and chemical properties of water, methods of determination of various water quality parameters. Laboratory tests for water quality parameters: Determination of pH, alkalinity, hardness, chloride, iron and phosphate. Quality assessment of water samples collected from different regions of Salem.</td></tr>
<tr><td colspan="7">Unit III: Water analysis III:
Dissolved oxygen, biological oxygen demand, chemical oxygen demand, total solids and determination of chlorides by argentometric method. Determination of fluorides by SPADNS method. Determination of nitrate by phenol disulphonic method. Determination of sulphate by gravimetric method. Determination of dissolved oxygen by Winkler’s method.</td></tr>
<tr><td colspan="7">Unit IV: Municipal water and wastewater treatment techniques:
Municipal Water: Specification of drinking water. Treatment of water for domestic purpose: Pre-treatment, removal of suspended impurities, methods of disinfection of water. Wastewater: Introduction, characteristics of waste water, need for wastewater treatment. Preliminary treatment: Grit chamber, floatation, skimming tank, and screening. Primary treatment: Coagulation. Secondary treatment: Aerobic (Trickling filter, activated septic tank, sludge digestion and disposal). Tertiary treatment: Aim, need for chlorination, dose of chlorine and Ozonisation.</td></tr>
<tr><td colspan="7">UNIT - V Industrial Wastewater treatment:
Nature of industrial wastewater, preliminary unit processes. Removal of suspended solids, oil, grease, inhibitory substances, pH adjustment, nutrients supplementation, and equalization. Microbes and biological treatment. Reactor configurations. Removal of solids, metals, dissolved organic and inorganic compounds: Electrodialysis, reverse osmosis, phosphorous and nitrogen removal.</td></tr>
<tr><td>Extended Professional Component (is a part of internal component only, Not to be included in the</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

external examination question paper)	
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Anu Gopinath, Soil and water chemistry 2. Anil Kumar De, Environmental Chemistry 3. S.K. Banerji, Environmental Chemisty, Prentice Hall of India, New Delhi, 2003. 4. A.G.S. Reddy, A Text Book on Water Chemistry: Sampling, Data Analysis and Interpretation, 2020. 5. C.S. Rao, Environmental Pollution Control Engineering, New Age International Pvt Ltd, Fourth Edition, 2021.
Reference Books	1. M.V. Sperling, Wastewater Characteristics, Treatment and Disposal, IWA Publishing, London, 2007. 2. N.G. Wun Jern, Industrial Wastewater Treatment, Imperial College Press, London, 2006. 3. L. Winther, Wastewater Engineering, Polyteknisk Forlag, Lyngby, 1978. 4. M. Henze, P. Harremoes, J.C. Jansen, E. Arvin, (Ed.), Waste Water Treatment, Springer Verlag, New York, 1995. 5. P. Harremoes, Water Chemistry, Polyteknisk Forlag, 1989.
Website and e-learning source	

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

CO1: To understand the various types of pollution.
CO2: To understand the water quality parameters.
CO3: To understand the concept of waste water treatment technique.
CO4: To get knowledge on wastewater treatment and removal of particular organic matters.
CO5: To understand about sludge, municipal and disposal treatment.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5
CO 1	S	S	S	S	M
CO 2	M	S	S	S	S
CO 3	S	S	M	S	S
CO 4	M	S	S	S	S
CO 5	M	S	M	S	S

S-Strong, M-Medium, L-Low

Level of Correlation between PSO's and CO's

CO /PSO	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 PSOs	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

MODEL QUESTION PAPERS

(For the Candidates admitted from 2023)

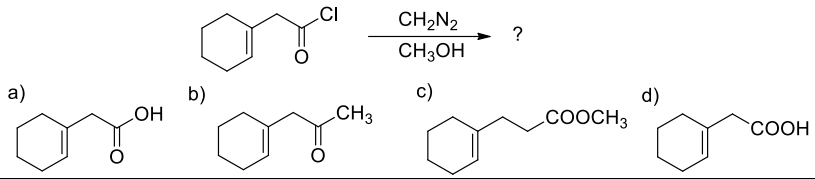
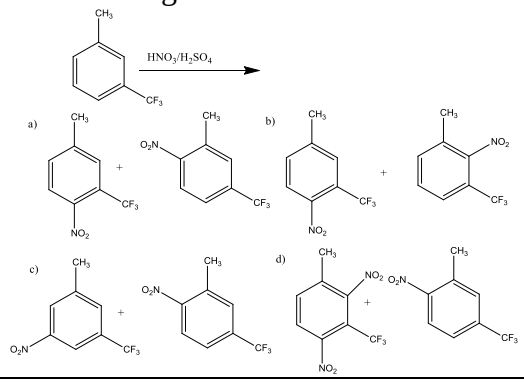
M.Sc. DEGREE EXAMINATION, November 2023

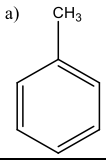
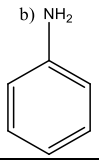
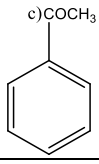
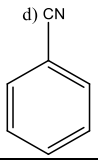
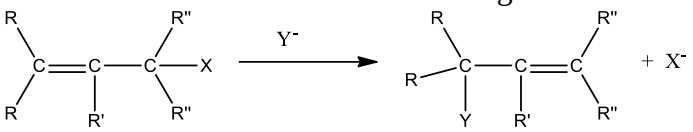
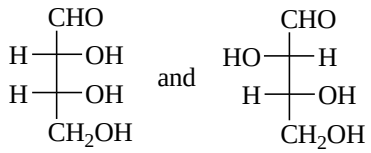
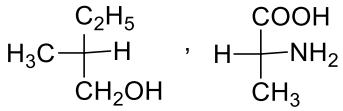
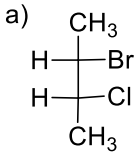
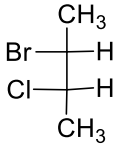
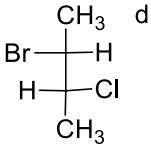
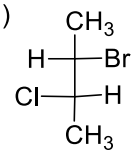
CHEMISTRY

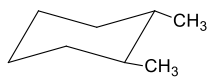
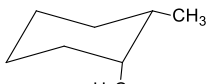
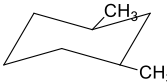
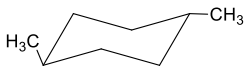
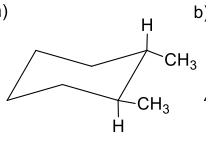
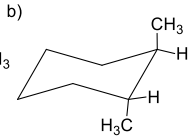
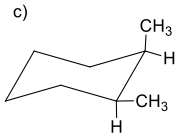
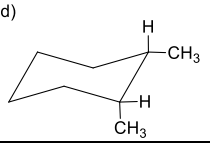
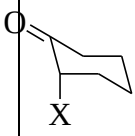
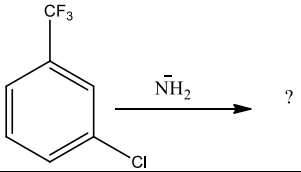
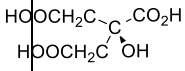
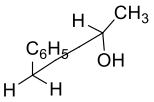
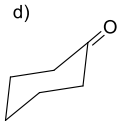
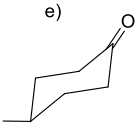
First Semester

23CHEC01 ORGANIC REACTION MECHANISM I

Time: 3 hours Max: 75 Marks

Q. No.	Questions	Cognitive Level	Course Outcome
	PART A (Answer ALL the questions)	**(20 X 1 = 20)**	
1	Free carbene can be generated by heating a) Diazirenesb) α-elimination of H^+c) Photolysis of ketene d) All of these	K1	CO1
2	Predict the product  	K2	CO1
3	What type of graph will be obtained for Hammett equation for the equation $\log K/K_O = \rho\sigma$ a) Straight line b) Bell shaped curve c) ZigZag line d) Circle	K3	CO1
4	The correct trend for the equilibrium constant of *p*- substituted benzoic acid, for the substituent X= OMe, Me, CF_3, NO_2, and Br is a) OMe<Me<Br<CF_3<NO_2 b)NO_2<CF_3<Br<Me<OMe c) OMe<Br<Me<CF_3<NO_2d)NO_2<CF_3<Me<Br<OMe	K3	CO1
5	For Cyclooctatetraene, the ^{1}H-NMR spectrum shows signals for H_a and H_b protons respectively a). -0.3 δ and 5.1 δ b). 5.1 δ and -0.3 δ c). 5.5 δ and -0.5 δ d). 6.4 δ and 8.5 δ	K2	CO2
6	Which pair of compounds are the most probable main products of the following reaction?  	K4	CO2
7	Which is most reactive in electrophilic substitution?	K1	CO2

	a)  b)  c)  d) 		
8	Friedel Craft's arylation reaction is also been called as a) Scholl reaction b) benzylation reaction c)Williamson reaction c) dimerization reaction	K1	CO2
9	When the nucleophile: OR attacks the RX, which of the following will be the resultant product? a) ROX b) ROR c)ROH d) HOH	K2	CO3
10	A low concentration of nucleophile favors which of the following? a) S_N1 reaction b) S_N2 reaction c) Both S_N1 and S_N2 reaction d) None of these	K3	CO3
11	What is the mechanism of the following reaction?  a) S_N1CA b) S_N2CA c) S_N1 d) S_N2'	K1	CO3
12	Meisenheimer salts are the intermediates in a) S_N1 mechanism b) S_N2 mechanism c) S_NAr Mechanism d)$S_{RN}1$ mechanism	K3	CO3
13	Using symmetry considerations show if or not the two H's of CH_2Cl_2, CH_2ClF are homotopic or enantiotopic. a) Homotopic and Enantiotopic b) Homotopic and Homotopic c) Enantiotopic and Enantiotopic d) Enantiotopic and Homotopic	K3	CO4
14	The two compounds given below are examples of  a) Enantiomers b) Diastereomers c) Identical d) Epimer	K3	CO4
15	Assign R and S configuration to the following compounds  a) R,S b) S, R c) R, R d) S, S	K4	CO4
16	Identify the compound with 2S, 3S configuration of 2-Bromo-3-chlorobutane a)  b)  c)  d) 	K4	CO4
17	The order of stability of different conformations of cyclohexane is a) Chair form > boat form > twist boat form b) Chair form > twist boat form > boat form c) twist boat form > boat form > Chair form d) boat form > Chair form > twist boat form	K3	CO5

18	Which one of the following is a cis compound a)  b)  c)  d) 	K2	CO5
19	Which is more stable geometric isomer form of 1,2-dimethyl cyclohexane a)  b)  c)  d) 	K3	CO5
20	The following compound α-halocyclohexanone exhibit  a) Positive b) Negative c) Both positive and negative d) Zero	K4	CO5
	PART B **(3X 5 = 15)** **(Answer ANY THREE of thefollowing questions)**		
21	What are reaction intermediates?Discuss their structure and stability character.	K2	CO1
22	How can you prepare conveniently, the isopropyl benzene?	K4	CO2
23	What will be the major product in the following reaction? Give reason. 	K4	CO3
24	Label the groups/faces homotopic, enantiotopic or diastereotopic in the following compounds. a)  b)  c)  d)  e) 	K4	CO4
25	trans 9-Methyl decalin is more stable than its cis isomer.Why?	K4	CO5
	PARTC **(5 X 8 = 40)** **(Answer ALL the questions)**		
26	a) Derive Hammett equation and mention its significance. (OR) b) What do you understand by kinetic isotope effect? What are primary and secondary isotope effects? Illustrate these techniques of elucidation of reaction mechanism with suitable examples.	K4	CO3
27	a) Explain with suitable examples, the orientation and reactivity in the cases of mono as well as disubstitued benzenes. (OR) b) Write elaborately on the SE2 and SEi, SE1- mechanismsof aliphatic electrophilic substitution.	K2	CO4
28	a) (i) Explain the $S_N1$mechanism of aliphatic nucleophilic substitution with its stereochemistry. (5)	K3	CO3

	ii) Write note on the mechanism of nucleophilic substitution on aliphatic trigonal carbon. (3) (OR) b)Explain the mechanisms of Bucherer, Rosenmundand von Richterreactions.		
29	a) (i) What is the use of chiral shift reagent? Give example. (3) (ii) Explain asymmetric synthesis using chiral reagents, chiral auxiliary and chiral catalyst. (5) (OR) b) Answer the following: (i) asymmetric synthesis (ii) Stereoselective and stereospecific synthesis (8)	K3	CO4
30	a) Explain the reactivity of cyclohexanes on the basis of their conformations taking account of reactions taking place on the ring carbon as well as side chain carbon. (OR) b) (i) Draw and compare the stabilities of mono, di and polysubstituted cyclohexanes.(4) (ii) Explain the conformational analysis of cis-decalin.(4)	K4	CO5

M.Sc., CHEMISTRY

Third Semester – Model Examination

23CHE3C09 QUANTUM CHEMISTRY AND GROUP THEORY

Time: Three hours **Maximum marks: 75**

Q.No.	Question	K level	CO
	PART A (20×1=20 Marks) **Answer ALL questions**		
1	1. Which of the following best describes the energy Eigen states for hydrogenic atoms? a) The radical wave function b) The theta wave function equation c) The phi wave function d) The radical distribution function.	**K2**	**CO1**
2	Which of the following phenomena can be explained by quantum mechanical tunneling through the barrier? (I) α – decay (II) Field emission of electrons from a metal surface (III)β – decay. a) (I),(II) and (III) b) (I) only c) (I) and (II) only d) (II) and (III) only.	**K3**	**CO1**
3	The probability of finding the particle in a volume dV can be written as, a) $P(r,t)\,dV = \lvert \Psi(r,t) \rvert dV$ b) $P(r,t) = \Psi(r,t)\,dV$ c) $P(r,t)\,dV = \lvert \Psi(r,t) \rvert^2 dV$ d) $P(r,t) = \lvert \Psi(r,t) \rvert^3 dV$	**K3**	**CO1**
4	The wave function of a particle moving in a one-dimensional time independent potential V (x) is given by $\Psi(x) = e^{-iax+b}$, Where a and b are constants. This means that the potential V (x) is of the form a) $V(x) \alpha x$ b) $V(x) \alpha x^2$ c) $V(x) = 0$ d) $V(x) \alpha e^{-aX}$	**K4**	**CO1**
5	If E_o is the zero-point energy of a harmonic oscillator of frequency γ and h isplanck's constant then its energy in the n = 2 state will be a) $(E_o + h\gamma)$ b) $2E_o$ c) $4E_o$ d) $(E_o + 2h\gamma$	**K4**	**CO2**

6	**Choose the wrong statement about the spin of an electron,** a) It is related to intrinsic angular momentum. b) Spin is the rotation of an electron about its own axis. c) Value of the spin quantum number must not be 1. d) +1/2 value of spin quantum number represents up spin.	**K2**	**CO2**
7	Antibonding molecular orbital lies at? a) lower energy level than overlapping atomic orbital b) higher energy level than overlapping atomic orbital c) Equal to overlapping atomic orbital d) lower energy level than bonding molecular orbital	**K1**	**CO2**
8	R-S coupling is ---------- a) spin-spin coupling b) spin -orbit coupling c) L-S coupling d) Both (b) and (c)	**K1**	**CO2**
9	In variation method the approximation is a) e-e repulsion b) n-n repulsion c) e-n attraction d) nuclear charge	**K1**	**CO3**
10.	In perturbation method the approximation is neglection of a) e-e repulsion b) n-n repulsion c) e-n attraction d) nuclear charge	**K1**	**CO3**
11.	D.R. Hartree suggested that the wave function of an n-electron atom can be written as the product of …….wave function a) n- single electron b) n- multi electron c) n- double electron d) n-triplet	**K1**	**CO3**
12.	HMO theory is applicable to a) sigma electrons b) pi electrons c) both sigma and pi d) none of the above	**K1**	**CO3**
13.	The point group of H_2O molecule is? a) D_2h b) D_2d c) C_3v d) C_2v	**K3**	**CO4**
14.	Which of the following species possesses both C3 and C2 axes? a) SO_3 b) NH_3c) PCl_3 d) $[H3O]^+$	**K3**	**CO4**
15.	CO_2 has a) 3 vibrational modes b) 4 vibrational modes, 2 of which are degenerate c) Stretching modes only d) one IR active symmetric stretch	**K3**	**CO4**
16.	The number of degrees of vibrational freedom possessed by CH_4 is a) 10 b) 6 c) 4 d) 9	**K2**	**CO4**
17.	Number of symmetry elements in cubic crystals a) 23 b) 14 c) 10 d) 6	**K1**	**CO5**
18.	Total number of point groups in crystals is a) 7 b) 14 c) 32 d) 230	**K1**	**CO5**
19.	Miller indices of crystal plane which cut the crystal axes 2a, 3b, c a) (2 3 1) b) (1/2 1/3 1) c) (3 2 6) d) (2/3 1 1/3)	**K3**	**CO5**

20.	Powder XRD method was proposed by a) W.H. Bragg b) M. von Laue c) W.L. Bragg d) Debye-Scherrer	**K1**	**CO5**
	PART B (3×5=15 Marks) **Answer ANY THREE questions**		
21.	Derive time independent Schrodinger wave equation	**K3**	**CO1**
22.	Distinguish between quantum mechanical MO and VB theory	**K2**	**CO2**
23.	An electron is confined in a one-dimensional box length of 1AO. Calculate its ground state energy in electron volts. Is the energy quantized?	**K3**	**CO3**
24.	State and explain the great orthogonality theorem.	**K2**	**CO4**
25.	Derive the Bragg equation	**K3**	**CO5**
	PART C (5×8=40 Marks) **Answer ALL questions**		
26. a)	Determine the energy and wave function of particle in two-dimensional box. (or)	**K4**	**CO1**
26. b)	Determine the energy of rigid rotator.	**K4**	**CO1**
27. a)	Determine the energy of hydrogen atom by variation method. (or)	**K4**	**CO2**
27. b)	Determine the energy of hydrogen molecule by LCAO-MO method.	**K4**	**CO2**
28. a)	Derive the Huckel determinant for benzene (or)	**K3**	**CO3**
28.b)	Determine the energy of 1, 3-butadiene	**K4**	**CO3**
29. a)	Find out the IR and Raman active vibrations ofethylene molecule? (or)	**K4**	**CO4**
29. b)	Determine the hybrid orbitals in ammonia	**K4**	**CO4**
30. a)	Discuss the symmetry elements and operations of crystals (or)	**K2**	**CO5**
30. b)	Describe X-Ray Diffraction method and write its applications	**K2**	**CO5**

(For the candidates admitted from 2023-2024 onwards)

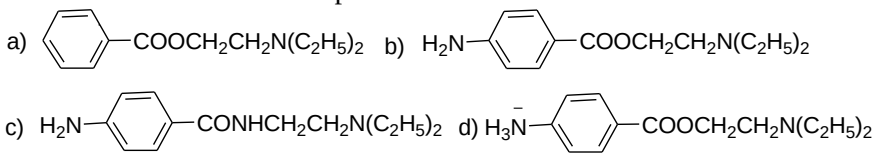
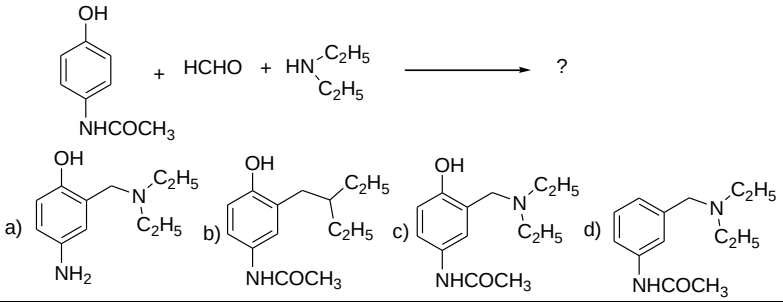
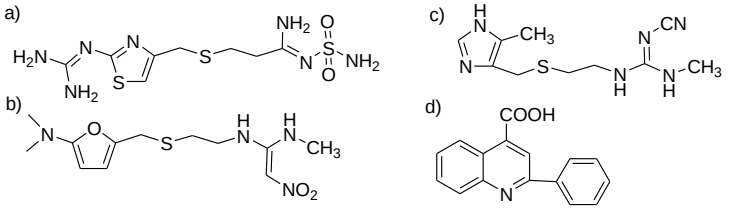
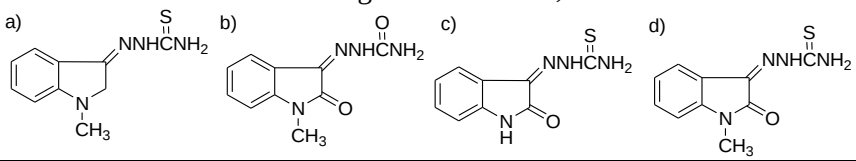
M. Sc. DEGREE EXAMINATION

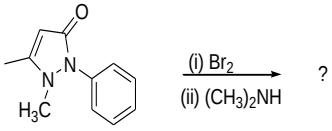
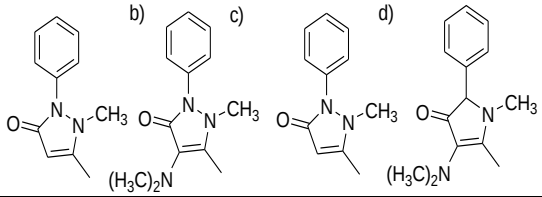
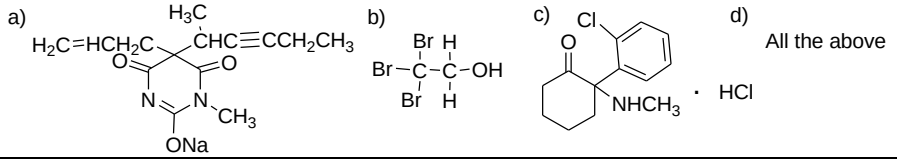
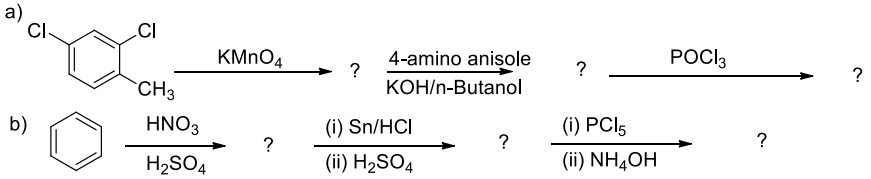
23CHECE4 MEDICINAL CHEMISTRY

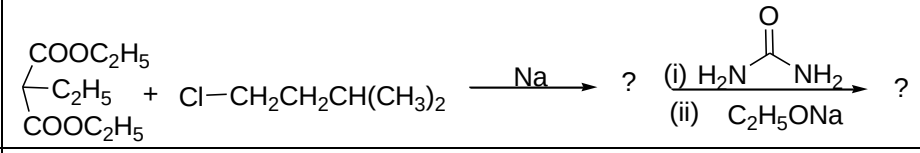
Time : Three Hours **Total marks = 75**

Part A (1X20) =20

Answer all the questions

Q. No.	Questions	Cognitive Level	Course Outcome
	PART A (20X1=20Marks) (Answer ALL the questions)		
1	Which of the following has a poor oral absorption? a) Progesterone b) Pentobarbitone c)Medroxyprogesterone d) Thiobarbital	K3	CO1
2	In which of the following hypothesis states that, "the higher the partition ratio P, the higher the pharmacological a) Henderson-Hasselbach equation b) Overton-Meyer hypothesis c) Ferguson hypothesis d) Hammett's equation	K2	CO1
3	Among the following, which is not a prodrug a) Omeprazole b) Valacyclovir c) Alprazolam d) Propranonol	K3	CO1
4	Find the correct structure of procaine 	K3	CO1
5	What will be product in the following reaction? 	K4	CO2
6	Pyrimethamine is a a) Antipyretic b) Antimalarial c) anaesthetic d) sulpha drug	K3	CO2
7	Which one the following is not act as a anti-ulcer drug, 	K4	CO2
8	The correct structure of the drug Methisazone is, 	K4	CO2
9	Which of the following gives Cinchophen on excess aq. ammonia	K4	CO3

	a) Isatin and acetophenone b) Aldehyde and acetophenone Salicyclic acid and acetophenone d) None of these		
10	Find out the suitable product in the following reaction,  a) b) c) d) 	K4	CO3
11	Which of the following is used as an antiallergic agents a) amobarbital b) pyrilamine maleate c) Halothan d) phenazone c) Sulphapyridine & Ranitidine d) None of the above	K3	CO3
12	Which one the following is not act as a anaesthetic,  All the above	K4	CO3
13	Arsenites are easily soluble in ..... a) Water b) Toluene c) Dichloromethane d) All the above	K2	CO4
14	Which inorganic compound is used as treatment of cardiovascular disease? a) Magnesium disodium EDTA b) Histidine c) Calcium disodium EDTA d) Lanthanum carbonate	K2	CO4
15	ZnO is used for ..... a) Skin ointment b) Anti-allergic agent c) Antidiabetic d) Antiseptic	K3	CO4
16	. ..... is known as Paris green. a) Arsenious oxide b) Monosodium arsenite c) Copper acetoarsenite d) dimethyl arsenic acid	K3	CO4
17	..... is one of the leading metal –based drugs widely used in the treatment of testicular cancer. a)Carboplatin b) Oxaliplatin c) Cis-platin d) Silver sulphadiazine	K2	CO5
18	Cis-amminedichloro (2-methylpyridine) platinum (II) is called ..... a)ZD 0001 b) ZD 0473 c) ZD 3465 d) ZD 3400	K2	CO5
19	Chronic osteoarthrosis affecting fingers, toes and long bones is found in children aged between .....years. a) 5 and 12 b) 6 and 10 c) 2 and 5 d) 5 and 8	K3	CO5
20	..... compound (2% aqueous solution) is used as a topical antiseptic. a) Mercurochrome b) Hemochromec) Both a and b d) none of the all	K3	CO5
	PART B (3X5=15 Marks) **(Answer Any THREE questions**		
21	Write a note on accidental drug discovery.	K3	CO1
22	What will be the drug product formed in the following reactions, 	K4	CO2
23	What will be the drug product formed in the following reaction,	K4	CO3

			
24	Write a short note on chemical forms of arsenic metal and the environmental fate.	K3	CO4
25	Write a short note on neurological agents and give few examples.	K3	CO5
	PARTC (5X8=40Marks) **(Answer ALL the questions)**		
26	(a) (i) Write a note on Ferguson principle. (ii) What is pKa? Why is it an important property for a drug? Explain with example. (OR) (b) Define drug metabolism. Explain phase I and II reactions.	K2	CO1
27	(a) Discuss the synthesis of chloroquine phosphate. (OR) (b) Explain the synthesis of Ranitidine, Nizatidine and its uses	K4	CO2
28	(a) Describe the synthesis of pyrilamine maleate and antazoline hydrochloride and its uses. (OR) (b) What are intravenous and basal anaesthetics? Describe the synthesis of following: Methohexital sodium and Tribromoethanol.	K4	CO3
29	(a) Write about metal activation of organic drugs and magnetic resonance imaging contrast agents. (OR) (b) Explain about radiodiagnostic agents and photochemotherapeutic metallodrugs.	K3	CO4
30	(a) What are anticancer agents? Why many ruthenium compounds are used as very promising anticancer activity in recent years? (OR) (b) Explain about the uses of the following compounds a) Silver sulphadiazine b) N-methylglucamine antimonate and draw their structures.	K3	CO5

Cognitive Level	Total Marks	Percentage (%)
Remember(K1)	-	-
Understand (K2)	13	15
Apply (K3)	40	47
Analyze (K4)	32	38
Evaluate (K5)	-	-
Create (K6)	-	-

MODEL QUESTION PAPER

(For the candidates admitted from 2023-2024 onwards)

M. Sc. DEGREE EXAMINATION

23CHEGE1NANOMATERIALS AND NANOTECHNOLOGY

Time : Three Hours **Total marks = 75**

Part A (1X20) =20

Answer all the questions

Q. No.	Questions	Cognitive Level	Course Outcome

PART A (20X1=20Marks) **(Answer ALL the questions)**			
1	Who got noble price in 2023 for the invention of CdSe nano crystals? A)Alexei Ekimov b) Louis Brus c) Moungi Bawendi d) all the above scientist	K2	CO1
2	The creating of nanoscale materials by chemically or physically breaking down the larger materials is known as _____approach in nanotechnology? a) Top-down b) Bottom-up c) Bottom-down d) None of the above	K3	CO1
3	Which one of the following is an example of a one-dimensional nanostructure? a) Nanoparticles b) Nanorods c) Nano layers d) All of the above.	K2	CO1
4	The Core/Shell nanoparticles are categorized into _____ types? a) One b) Two c) Three d) Four	K3	CO1
5	Due to _____ tensile strength some of the nano materials like carbon nanotubes are used in air crafts. a) High b) Low c) Moderate d) Poor	K3	CO2
6	Coating the nano crystals with the ceramics is carried that leads to _____ a) Corrosion b) Corrosion resistant c) Wear and tear d) Soft	K3	CO2
7	_____ is the field in which the nano particles are used with silica coated iron oxide iron oxide. a) Magnetic applications b) Electronics c) Medical diagnosis d) Structural and mechanical materials.	K3	CO2
8	Usually thin films are _____ a) 0D b) 1D c) 2D d) 3D	K2	CO2
9	The nano particles from iron and palladium are used to produce ___ a) Magnets b) Magnetic lens c) Magneto meters d) Magnetic storage devices	K2	CO3
10	Synthesis of Al_2O_3/SiO_2 CMNC nano composites resulting in the improvement of _____ properties a)Electrical b) Corrosion protection c) Magnetic d) All the properties	K3	CO3
11	Nanomatryushka material is _____ a)spherical core/shell nanoparticles b) hexagonal core/shell nanoparticles c) multiple small core materials coated by single shell material d) Multiple shell layer coated on core material	K3	CO3
12	The range of van der Waals is around _____ meters? a)10 mm b) 100 cm c) 10 nm d) None of the above	K3	CO3
13	Due to _____ tensile strength some of the nano materials like carbon nanotubes are used in air crafts. a) High b) Low c) Moderate d) Poor	K4	CO4
14	Which composite is used for bone repair based on the combination the following matrix? a)MMNC b) PMNC c) CMNC d) Both a and b	K4	CO4
15	In an AFM, the scanning tip is attached to _____	K4	CO4

	a) Spring b) Cantilever c) Spring or Cantilever d) Quartz		
16	The Scanning Tunneling Microscope tip is made up of what ? a) Silicon nitride b) Germanium nitride c) gold c) Platinum.	K3	CO4
17	Which nanomaterial is used in the light emitting electro luminescence devices? a) CdS, b) SiC, c) ZnS d) PbS	K4	CO5
18	To move the STM tip at a small scale by a) Electric motor b) Piezoelectric material c) Human hand d) all the above	K3	CO5
19	The properties of Core shells nanoparticles are depends on a)Size of the Core/Shell b) Shape of the core/Shell c) Core/shell thickness d) All of the above.	K2	CO5
20	In STM tunnelling occurs between a) Electrons of a single atom on the tip of an STM probe b) One atom at a time on the Sample surface c) Between a and b d) Entire surface of the sample	K4	CO5

	PART B (3X5=15 Marks) **(Answer Any THREE Questions)**		
21	Write a short note on top-down approach.	K3	CO1
22	Discuss the synthesis of nanoparticle by CVD	K4	CO2
23	Briefly discuss types of core/shell nanoparticles.	K4	CO3
24	Discuss the synthesis and its applications of Core/Shell nanoparticles.	K3	CO5
25	Explain the significance of shell on the core/shell nanoparticles.	K3	CO4

	PARTC (5X8=40Marks) **(Answer ALL the questions)**		
26	Explain about the Inert gas condensation and arc discharge method of synthesis of nanoparticles (OR) (b) Write note on: (i) Laser ablation synthesis (ii) Solvothermal synthesis.	K3	CO1
27	(a) Describe the technique you used to investigate the surface of the non-conducting nano coating (OR) (b) Describe the technique you used to investigate the surface of the conducting nanocoating	K2	CO2
28	(a) Discuss the synthesis and its properties of silver and gold nanoparticles (OR) (b) What are the important forces are acting on surface of the nanoparticles	K4	CO3

29	(a) Define Core/Shell nanoparticle. Explain the types of core/shell nanomaterials with suitable examples. (OR) (b) Discuss the classification of nano composites based on the combinations of matrix	K3	CO4
30	(a).Discuss the methods of preparation, properties and uses of the core/shell nanoparticles. (OR) (b) Describe about the physical vapor thin film deposition technique	K3	CO5

Cognitive Level	**Total Marks**	**Percentage (%)**
Remember(K1)	-	-
Understand (K2)	13	17
Apply (K3)	49	65
Analyze (K4)	23	31
Evaluate (K5)	-	-
Create (K6)	-	-

From Periyar University & Affiliated Colleges		Outside Periyar University	
S. No.	**Name and Address**	**S. No.**	**Name and Address**
1.	Dr. V. Raj Professor and Head Department of Chemistry Periyar University, Salem – 636 011	1.	Dr. M.Sundrarajan Professor and Head , Department of Industrial Chemistry Alagappa University Karaikudi-630 003
2.	Dr. P. Viswanathamurthi Professor Department of Chemistry Periyar University, Salem – 636 011	2.	Dr. K.Dinakaran Professor and head Department of Chemistry Tiruvalluvar University, Vellore – 632 115
3.	Dr. D. Gopi Professor Department of Chemistry Periyar University, Salem – 636 011	3.	Dr. K.P.Elango. Professor and Head Department of Chemistry Gandhigram Rural University Gandhigram - 624 302, Dindigul District
4.	Dr. A. Lalitha Professor Department of Chemistry Periyar University, Salem – 636 011	4.	Dr. K.Swarnalatha Professor and Head Department of Chemistry Manonmaniam Sundaranar University, Madurai 625 021
5.	Dr. R. Rajavel Professor Department of Chemistry Periyar University, Salem – 636 011	5.	Dr. R. Karvembu Professor Department of Chemistry National Institute of Technology Tiruchirapalli
6.	Dr. V. Sujatha Assistant Professor Department of Chemistry Periyar University, Salem – 636 011	6	Dr. R.Ramesh Professor of Chemistry School of Chemistry Bharathidasan University, Tituchirapalli – 24
7.	Dr. K. Shanmuga Bharathi Assistant Professor Department of Chemistry Periyar University, Salem – 636 011	7.	Dr. T. M. Sridhar Head, Department ofAnalytical Chemistry University of Madras, Guindy Campus, Chennai-600 025
8.	Dr. Umarani Associate Professor and Head Department of Chemistry Govt. Arts College, Salem – 636 007.	8.	Dr. K. Krishnasamy Professor Department of Chemistry Annamalai University, Annamalai Nagar, Chidambaram
9.	Mrs. S.Geetha Associate professor and Head Department of Chemistry Sarada college for women Salem – 636 016	9.	Dr. M.Ilanchelian Professor and Head School of Chemistry Bharathiar University, Coimbatore-46