FACULTY OF SCIENCE AND HUMANITIES

ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMME

Bachelor of Science (Honors)
in
Chemistry

Four Years

National Education Policy

Learning Outcome-based Curricula Framework

National Credit Framework

Academic Year

2024 - 2025

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Content

1.	Vision Statement
Stmt - 1	To be a nationally and an internationally acclaimed hub for high-level teaching in chemistry
Stmt - 2	To Implement the global standards and nurturing the students through innovation and quality education.

2.	Mission Statement
Stmt - 1	To motivate the next generation graduates to effectively contribute to the advancement of society with integrity and commitment.
Stmt - 2	To expose the students to a breadth of experimental techniques using modern instrumentation.
Stmt - 3	To contribute to industry and address problems of societal importance.
Stmt - 4	To attain entrepreneurship and self-empowerment in the field of chemical sciences.
Stmt - 5	To provide comprehensive specialist expertise in the domain of chemistry

"Stmt" stands for Statement

3.	Program Education Objectives (PEO)
PEO - 1	To develop critical analysis and problem-solving skills required in the field of Chemistry
PEO - 2	To prepare students with a working knowledge of experimental techniques and instrumentation required to work independently.
PEO - 3	To develop student strength in organizing and presenting acquired knowledge coherently both orally and in written discourse.
PEO - 4	To prepare the students to successfully compete for current employment opportunities
PEO - 5	To develop an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)

4.	Consistency of Program Education Objectives with Mission				
	Mission Stmt. – 1	Mission Stmt. – 2	Mission Stmt. – 3	Mission Stmt. – 4	Mission Stmt. - 5
PEO - 1	Medium	High	High	High	Medium
PEO - 2	High	High	High	Medium	Medium
PEO - 3	High	High	High	Medium	Medium
PEO - 4	Medium	Medium	Medium	High	High
PEO - 5	High	Medium	Medium	High	High

**** H – High Correlation, M – Medium Correlation, L – Low Correlation**
**** H, M, and L have numerical equivalents of 3, 2, 1 correspondingly**

5.	Programme Learning Outcomes (PLO)
	Graduate Learning Attributes
PLO - 1	Problem Solving, Critical Thinking, Creativity
PLO - 2	Communication Skills, Collaborating Skills
PLO - 3	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills
PLO - 4	Leadership Qualities, Professionalism, Autonomy, Accountability
PLO - 5	Digital Technology Skills
PLO – 6	Value Inculcation, Multicultural inclusivity
PLO – 7	Environmental Action, Community Engagement
PLO – 8	Entrepreneurial Risk Taking
PSO – 1	Identifying real world problems and solving through chemistry concepts
PSO - 2	Conducting independent research in academic and industrial sectors

PSO – Programme Specific Outcomes

6.	Mapping of PLOs with PEOs									
	PLO – 1	PLO - 2	PLO - 3	PLO - 4	PLO - 5	PLO – 6	PLO – 7	PLO – 8	PSO -1	PSO – 2
PEO – 1	3	3	3	3	2	3	2	3	3	3
PEO – 2	3	2	3	3	3	1	2	3	3	3
PEO – 3	2	3	3	3	3	2	1	3	3	3
PEO – 4	3	3	3	3	2	2	3	3	2	3
PEO - 5	2	3	2	1	2	3	3	3	3	3

7. Program Structure

Discipline Core Courses (C)						
Course Code	Course Title	Sessions per Week L	T	P	C
UCY24101T	Atomic Structure and Chemical Bonding	3	1	0	4
UCY24102J	Basic Reactions in Organic Chemistry	3	0	2	4
UCY24103J	States of Matter, Chemical and Phase Equilibria	3	0	2	4
UCY24201J	Chemistry of s and p - Block Elements	3	0	2	4
UCY24202J	Functional Groups in Organic Chemistry and Spectroscopy	3	0	2	4
UCY24203T	Chemical Kinetics and Surface Chemistry	3	1	0	4
UCY24301J	Transition Metals and Coordination Chemistry	3	0	2	4
UCY24302T	Physical Organic Chemistry and Stereochemistry	3	1	0	4
UCY24303T	Thermodynamics and Electrochemistry	3	1	0	4
UCY24401L	Physical Chemistry Practical	0	2	4	4
Total Learning Credits					40

Discipline Core /Elective Courses (D)						
Course Code	Course Title	Sessions per Week L	T	P	C
UCY24D01T	Analytical Chemistry	3	1	0	4
UCY24D02T	Nanomaterials and Nanochemistry				
UCY24D03J	Computational Modeling in Chemistry	3	0	2	4
UCY24D04J	Instrumental Methods of Analysis				
UCY24D05J	Polymer and Industrial Chemistry	3	0	2	4
UCY24D06J	Organometallics and Bioinorganic Chemistry				
UCY24D07T	Hydrogen Energy: Production, Storage and Transportation	3	1	0	4
UCY24D08T	Radioactive and Nuclear Chemistry				
UCY24D09T	Heterocyclic Compounds, Natural Products and Biomolecules	3	1	0	4
UCY24D10T	Thin Film Technology				
UCY24D11T	Research Methodology	3	1	0	4
UCY24D12T	Medicinal Chemistry and Drug Design	3	1	0	4
UCY24D13T	Green Chemistry				
UCY24D14T	Solid State Chemistry	3	1	0	4
UCY24D15T	Organic Semi-conductors: Materials and Devices				
UCY24D16T	Energy Conversion and Storage	3	1	0	4
UCY24D17T	Polymer Chemistry and its Uses				
UCY24D18T	Industrial Chemistry	3	1	0	4
UCY24D19T	Pharmaceutical Chemistry				
Total Learning Credits					40

Elective Courses (Minor) (E)					
Course Code	Course Title	Sessions per Week L	T	P	C
UCY24E01T	Fundamentals in Chemistry	3	1	0	4
UCY24E02T	Chemical Technology and Society	3	1	0	4
UCY24E03T	IT Skills for Chemistry	3	1	0	4
UCY24E04T	Industrial Materials and its Applications	3	1	0	4
UCY24E05T	Energy Conversion and Storage	3	1	0	4
UCY24E06T	Organic Semiconductors and Optoelectronics	3	1	0	4
UCY24E07T	Chemistry of Biomolecules	3	1	0	4
UCY24E08T	Functional Materials and Bioelectronics	3	1	0	4
Total Learning Credits					32

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Multidisciplinary Courses (M)					
Course Code	Course Title	Sessions per Week L	T	P	C
UCY24M01T	Chemistry in Everyday Life	3	0	0	3
UCY24M02T	Food Chemistry - Functions and Analysis	3	0	0	3
UCY24M03T	Industrial Skills	2	1	0	3
Total Learning Credits					9

Value Added Courses (V)					
Course Code	Course Title	Hours/ Week L	T	P	C
UCD24V01T	Essentials of Artificial Intelligence	1	0	0	1
UES24V01T	Environmental Studies	2	0	0	2
UCD24V02T	Universal Human Values	2	0	0	2
Total Learning Credits					5

Ability Enhancement Courses (A)					
Course Code	Course Title	Sessions per Week L	T	P	C
ULT24AE1J	Tamil – I	2	0	2	3
ULH24AE1J	Hindi – I				
ULF24AE1J	French – I				
ULE24AE1J	English	2	0	2	3
ULT24AE2J	Tamil – II	2	0	2	3
ULH24AE2J	Hindi – II				
ULF24AE2J	French – II				
Total Learning Credits					9

Skill Enhancement Courses (S)					
Course Code	Course Title	Sessions per Week L	T	P	C
UCD24S01J	Verbal Ability and Skill Development	1	0	2	2
UCD24S02L	Quantitative Aptitude and Logical Reasoning	0	0	2	1
UCD24S03J	Industry Oriented Employability and Leadership Skills	1	0	2	2
UEN24S01L	Communication Skills	0	0	4	2
UCD24S04J	Career Readiness and Professional Skills	1	0	2	2
Total Learning Credits					9

Project Work / Internship (P)					
Course Code	Course Title	Sessions per Week L	T	P	C
UCY24I01L	Internship - I	-	-	-	1
UCY24I02L	Internship – II	-	-	-	1
UCY24P01L	Project Work	0	0	4	2
UCY24P02L	Research Project and Dissertation	0	0	24	12
UCY24P03L	Professional Internship				
Total Learning Credits					16

Mandatory Courses (Y)					
Course Code	Course Title	Sessions per Week L	T	P	C
UNS24Y01L	NSS	0	0	0	0
UNC24Y01L	NCC				
UNO24Y01L	NSO				
UYG24Y01L	YOGA				
UMI24Y01L	My India Project	0	0	0	0
Total Learning Credits					0

Internship – I to be completed during Summer Vacation of the First year
Internship – II to be completed during Summer Vacation of the Second year

Students from other departments can enroll in Elective Courses (Minor) (E)
Students from all departments will be able to enroll in Multidisciplinary Courses (M)

8. Course Allocation across Semesters

Semester – I					
Code	Course Title	Sessions per Week			C
		L	T	P	
ULT24AE1J	Tamil – I	2	0	2	3
ULH24AE1J	Hindi – I				
ULF24AE1J	French – I				
ULE24AE1J	English	2	0	2	3
UCY24101T	Atomic Structure and Chemical Bonding	3	1	0	4
UCY24102J	Basic Reactions in Organic Chemistry	3	0	2	4
UCY24103J	States of Matter, Chemical and Phase Equilibria	3	0	2	4
UCD24S01J	Verbal Ability and Skill Development	1	0	2	2
Learning Credits					20

Semester – II					
Code	Course Title	Sessions per Week			C
		L	T	P	
ULT24AE2J	Tamil – II	2	0	2	3
ULH24AE2J	Hindi – II				
ULF24AE2J	French – II				
UCY24201J	Chemistry of s and p - Block Elements	3	0	2	4
UCY24202J	Functional Groups in Organic Chemistry and Spectroscopy	3	0	2	4
UCY24203T	Chemical Kinetics and Surface Chemistry	3	1	0	4
UCD24V01T	Essentials of Artificial Intelligence	1	0	0	1
	Multidisciplinary – I	3	0	0	3
UCD24S02L	Quantitative Aptitude and Logical Reasoning	0	0	2	1
UNS24Y01L	NSS	0	0	0	0
UNC24Y01L	NCC				
UNO24Y01L	NSO				
UYG24Y01L	YOGA				
Learning Credits					20

Total Learning Credits of Courses of FIRST year = 40

Semester – III					
Code	Course Title	Sessions per Week			C
		L	T	P	
UCY24301J	Transition Metals and Coordination Chemistry	3	0	2	4
UCY24302T	Physical Organic Chemistry and Stereochemistry	3	1	0	4
UCY24303T	Thermodynamics and Electrochemistry	3	1	0	4
	Minor – I				4
UCY24I01L	Internship – I	-	-	-	1
	Multidisciplinary Course – II				3
Learning Credits					20

Semester – IV					
Code	Course Title	Sessions per Week			C
		L	T	P	
UCY24401L	Physical Chemistry Practical	0	2	4	4
UCY24D01T	Analytical Chemistry	3	1	0	4
UCY24D02T	Nanomaterials and Nanochemistry				
	Minor –II				4
	Minor - III				4
UEN24S01L	Communication Skills	0	0	4	2
UCD24S03J	Industry Oriented Employability and Leadership Skills	1	0	2	2
UMI24Y01L	My India Project	0	0	0	0
Learning Credits					20

Total Learning Credits of Courses of SECOND year = 40

Semester - V					
Code	Course Title	Sessions per Week			C
		L	T	P	
UCY24D04J	Instrumental Methods of Analysis	3	0	2	4
UCY24D03J	Computational Modeling in Chemistry				
UCY24D06J	Organometallics and Bioinorganic Chemistry	3	0	2	4
UCY24D05J	Polymer and Industrial Chemistry				
	Minor–IV				4
	Multidisciplinary – III				3
UES24V01T	Environmental Studies	2	0	0	2
UCD24S04J	Career Readiness and Professional Skills	1	0	2	2
UCY24I02L	Internship – II	-	-	-	1
Learning Credits					20

Semester - VI					
Code	Course Title	Sessions per Week			C
		L	T	P	
UCY24D07T	Hydrogen Energy: Production, Storage and Transportation	3	1	0	4
UCY24D08T	Radioactive and Nuclear Chemistry				
UCY24D09T	Heterocyclic Compounds, Natural Products and Biomolecules	3	1	0	4
UCY24D10T	Thin Film Technology				
	Minor –V				4
	Minor - VI				4
UCY24P01L	Project Work	0	0	4	2
UCD24V02T	Universal Human Values	2	0	0	2
	Learning Credits				20

Total Learning Credits of Courses of THIRD year = 40

Semester - VII					
Code	Course Title	Sessions per Week			C
		L	T	P	
UCY24D11T	Research Methodology	3	1	0	4
UCY24D12T	Medicinal Chemistry and Drug Design	3	1	0	4
UCY24D13T	Green Chemistry				
UCY24D14T	Solid State Chemistry	3	1	0	4
UCY24D15T	Organic Semi-conductors: Materials and Devices				
	Minor –VII				4
	Minor –VIII				4
Learning Credits					20

Semester - VIII					
Code	Course Title	Sessions per Week			C
		L	T	P	
UCY24D16T	Energy Conversion and Storage	3	1	0	4
UCY24D17T	Polymer Chemistry and its Uses				
UCY24D18T	Industrial Chemistry	3	1	0	4
UCY24D19T	Pharmaceutical Chemistry				
UCY24P02L	Research Project and Dissertation	0	0	24	12
UCY24P03L	Professional Internship				
Learning Credits					20

Total Learning Credits of Courses of FOURTH year = 40

8.1 Elective Courses (MINOR) offered by the Department of Chemistry to other Departments (excluding Department of Chemistry)

Elective Courses (Minor) (E)						
Semester	Course Code	CourseTitle	Sessions Per Week			C
			L	T	P	
III	UCY24E01T	Fundamentals in Chemistry	3	1	0	4
IV	UCY24E02T	Chemical Technology and Society	3	1	0	4
IV	UCY24E03T	IT Skills for Chemistry	3	1	0	4
V	UCY24E04T	Industrial Materials and its Applications	3	1	0	4
VI	UCY24E05T	Energy Conversion and Storage	3	1	0	4
VI	UCY24E06T	Organic Semiconductors and optoelectronics	3	1	0	4
VII	UCY24E07T	Chemistry of Biomolecules	3	1	0	4
VII	UCY24E08T	Functional Materials and Bioelectronics	3	1	0	4
	Total Learning Credits					32

8.2 Multidisciplinary Courses offered by the Department of Chemistry to all departments (including Department of Chemistry)

Multidisciplinary Courses (M)						
Semester	Course Code	CourseTitle	Sessions Per Week			C
			L	T	P	
II	UCY24M01T	Chemistry in Everyday Life	3	0	0	3
III	UCY24M02T	Food Chemistry - Functions and Analysis	3	0	0	3
V	UCY24M03T	Industrial Skills	2	1	0	3
Total Learning Credits						9

9. Programme Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes									
		1	2	3	4	5	6	7	8	PSO 1	PSO 2
ULT24AE1J	Tamil – I	3	3	3	3	1	3	3	3	-	-
ULH24AE1J	Hindi – I	3	3	3	3	3	3	3	-	-	-
ULF24AE1J	French – I	3	3	3	3	3	2	3	-	-	-
ULE24AE1J	English	3	3	3	3	3	3	3	3	3	3
UCY24101T	Atomic Structure and Chemical Bonding	3	3	3	3	3	3	3	3	3	3
UCY24102J	Basic Reactions in Organic Chemistry	3	3	3	3	3	3	3	3	3	3
UCY24103J	States of Matter, Chemical and Phase Equilibria	3	3	3	3	3	3	3	3	3	3
UCD24S01J	Verbal Ability and Skill Development	3	3	3	3	3	3	3	3	3	3
ULT24AE2J	Tamil – II	3	3	3	3	1	3	3	3	-	-
ULH24AE2J	Hindi – II	3	3	3	3	3	3	3	-	-	-
ULF24AE2J	French – II	3	3	3	3	3	2	3	-	-	-
UCY24201J	Chemistry of s and p - Block Elements	3	3	3	3	3	3	3	3	3	3
UCY24202J	Functional Groups in Organic Chemistry and Spectroscopy	3	3	3	3	3	3	3	3	3	3
UCY24203T	Chemical Kinetics and Surface Chemistry	3	3	3	3	3	3	3	3	3	3
UCD24V01T	Essentials of Artificial Intelligence	3	3	3	3	3	3	3	3	3	3
	Multidisciplinary – I										
UCD24S02L	Quantitative Aptitude and Logical Reasoning	3	1	3	-	3	3	-	-	-	-
UNS24Y01L	NSS										
UNC24Y01L	NCC										
UNO24Y01L	NSO										
UYG24Y01L	YOGA										
UCY24301J	Transition Metals and Coordination Chemistry	3	3	3	3	1	3	3	3	-	-
UCY24302T	Physical Organic Chemistry and Stereochemistry	3	3	3	3	3	3	3	-	-	-
UCY24303T	Thermodynamics and Electrochemistry	3	3	3	3	3	2	3	-	-	-
	Minor – I										
UCY24I01L	Internship – I										
	Multidisciplinary Course – II	3	3	3	3	3	3	3	3	3	3
UCY24401L	Physical Chemistry Practical	3	3	3	3	3	3	3	3	3	3
UCY24D01T	Analytical Chemistry	3	3	3	3	3	3	3	3	3	3
UCY24D02T	Nanomaterials and Nanochemistry	3	3	3	3	1	3	3	3	-	-
	Minor–II										
	Minor - III										
UEN24S01L	Communication Skills	3	3	3	3	1	3	3	3	-	3
UCD24S03J	Industry Oriented Employability and Leadership Skills	3	3	3	3	3	3	3	-	2	-
UMI24Y01L	My India Project	3	3	3	3	3	2	3	-	-	-
UCY24D04J	Instrumental Methods of Analysis	3	3	3	3	3	3	3	3	3	3
UCY24D03J	Computational Modeling in Chemistry	3	3	3	3	3	3	3	3	3	3
UCY24D06J	Organometallics and Bioinorganic Chemistry	3	3	3	3	3	3	3	3	3	3
UCY24D05J	Polymer and Industrial Chemistry	3	3	3	3	3	3	3	3	3	3
	Minor –IV										
	Multidisciplinary Course–III										
UES24V01T	Environmental Studies	3	3	3	3	1	3	3	3	-	3
UCD24S04J	Career Readiness and Professional Skills	3	3	3	3	3	3	3	-	-	-
UCY24I02L	Internship – II										
UCY24D07T	Hydrogen Energy: Production, Storage and Transportation	3	3	3	3	1	3	3	3	-	2

UCY24D08T	Radioactive and Nuclear Chemistry	3	3	3	3	3	3	3	-	-	1
UCY24D09T	Heterocyclic Compounds, Natural Products and Biomolecules	3	3	3	3	1	3	3	3	-	-
UCY24D10T	Thin Film Technology	3	3	3	3	3	3	3	-	-	-
	Minor–V										
	Minor - VI										
UCY24P01L	Project Work	3	3	3	3	3	3	3	3	3	3
UCD24V02T	Universal Human Values	3	3	3	3	3	3	3	3	3	3
UCY24D11T	Research Methodology	3	3	3	3	3	3	3	3	3	3
UCY24D12T	Medicinal Chemistry and Drug Design	3	3	3	3	3	3	3	3	3	3
UCY24D13T	Green Chemistry	3	3	3	3	1	3	3	3	-	-
UCY24D14T	Solid State Chemistry	3	3	3	3	3	3	3	-	-	-
UCY24D15T	Organic Semi-conductors: Materials and Devices	3	3	3	3	3	2	3	-	-	-
	Minor –VII										
	Minor –VIII										
UCY24D16T	Energy Conversion and Storage	3	3	3	3	1	3	3	3	-	-
UCY24D17T	Polymer Chemistry and its Uses	3	3	3	3	3	3	3	-	-	-
UCY24D18T	Industrial Chemistry	3	3	3	3	3	2	3	-	-	-
UCY24D19T	Pharmaceutical Chemistry	3	3	3	3	3	3	3	3	3	3
UCY24P02L	Research Project and Dissertation	3	3	3	3	3	3	3	3	3	3
UCY24P03L	Professional Internship	3	3	3	3	3	3	3	3	3	3

Abbreviations

CLR – Course Learning Rationale
CLO – Course Learning Outcomes
PLO – Programme Learning Outcomes
SLO – Session Learning Outcomes
BLoT – Bloom's Level of Thinking
CLA – Continuous Learning Assessment

SEMESTER - I

Course Code	ULT24AE1J	Course Title	Tamil – I	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	Tamil	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	மரபிலிருந்துமாற்றம்பெற்றபுதுக்கவிதைமரபின்சிந்தனைகளைஅறியச்செய்தல்
CLR-2	நவீனகவிதையின்வழிமனிதவாழ்வியல்விழுமியங்களைத்தெரியச்செய்தல்
CLR-3	சிற்றிலக்கியங்கள், காப்பியங்கள்கற்பிக்கும்தமிழ்ச்சமூகத்தின்வாழ்வியலைஅறியச்செய்தல்
CLR-4	நவீனதமிழ்இலக்கியவளர்ச்சிவரலாற்றைப்புரியச்செய்தல்
CLR-5	மொழிப்பயிற்சிவழிமொழியின்பல்வேறுநுட்பங்களைத்தெரியச்செய்தல்

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO - 1	PSO -2
CLO-1	புதுக்கவிதைஉருவாக்கித்தந்தபுதியசிந்தனைக்களங்களைஅறிந்துகொள்ளுதல்	✓	✓	-	-	2	75	60	3	-	3	-	-	-	-	3		
CLO-2	நவீனகவிதைகள்வழிமாற்றம்பெற்றுவரும்மானுடவிழுமியங்களைத்தெரிந்துகொள்ளுதல்	✓	✓	✓	-	2	80	70	-	-	-	2	-	3	3	-	-	-
CLO-3	தமிழ்ச்சமூகத்தின்இடைக்காலவாழ்வியல்முறைகளைஉணர்ந்துகொள்ளுதல்	✓	✓	✓	✓	2	70	65	3	-	3	-		3	-	-	-	-
CLO-4	நவீனஇலக்கியவரலாறுவழிதமிழ்க்கல்விவரலாறு, சமூகவரலாறுபெற்றவளர்ச்சிநிலைகளைத்தெரிந்துகொள்ளுதல்	✓	✓	✓	✓	2	70	70	-	3	-	-	1	3	-	-	-	-
CLO-5	மொழியின்நுட்பங்களைத்தெரிந்துமொழிஆளுமையோடுசெயல்படும்திறன்பெறுதல்	✓	✓	✓	✓	3	80	70	3	3	-	3	-		-	-	-	-

Session	CLO – 1	CLO – 2	CLO – 3	CLO – 4	CLO - 5
	12	12	12	12	12

SLO-1	தமிழ்க்கவிதைமரபு	நவீனகவிதைதோற்றம், வரலாறு	தமிழரின்வீரமரபு - போர்விழுமியங்கள்	சிற்றிலக்கியத்தோற்றம் – வகைமை	தமிழ்உரைநடைமரபு – உ.வே.சா. வின்பங்களிப்பு
SLO-2	புதுக்கவிதைஉருவாக்கம், புதுக்கவிதைவளர்ச்சி நெறிகள்	நவீனகவிதைகளில் செல்நெறிகள்	பரணிஅறிமுகம் பரணிஇலக்கியங்கள்	பிள்ளைத்தமிழ் -உலா - தூது	உ.வே.சா. வின்ராஜவைத்தியம்
SLO-3	பாரதியார்பன்முகஆளுமைத்திறன்	கவிதைமொழி - நவீனகவிஆளுமைகள்	தலைவனின்வீரம்- கலிங்கத்துப்பரணி 477,490	புதுக்கவிதையின்தோற்றமும்மொழியும்	நாட்டுப்புறமரபில்சிறுதெய்வவழிபாடு
SLO-4	பாரததேசம் பாரததேசத்தின்வளம்	கவிதையில்நாட்டுப்புறவடிவம்	தமிழ்இலக்கியமரபில் தூதுஇலக்கியங்கள்	புதுக்கவிதையில்சமூகம் - புதுக்கவிதையும்இதழ்களும்	கழனியூரனின்பொன்காத்தஐயனார்
SLO-5	வெள்ளிப்பனிமலையின்மீதுலவுவோம்…	பெண்களின்கல்விநிலை - இளம்பிறை – அம்மா	தமிழின்பெருமை – தமிழ்விடுதூது (184 – 186)	மணிக்கொடிஇதழ், எழுத்துஇதழ், வானம்பாடிஇதழ்	பிழைநீக்கிஎழுதும்நுட்பங்கள்
SLO-6	20 ஆம்நூற்றாண்டுக்கவிதைமரபில்பாரதிதாசன்	ஆண்பெண்சமத்துவமும் ப. கல்பனா – கீறல்விழுந்தமாலைக்காலங்கள்	செய்யுள்மரபில் கலம்பகஇலக்கியங்கள்	சிறுகதைதோற்றம் - சிறுகதைவளர்ச்சி	எழுத்துப்பிழை – ந - ண -ன ல, ள, ழ, ர, றவேறுபாடுஅறிதல்
SLO-7	பாரதிதாசன் - அழகின்சிரிப்பு ஆல் – ஆயிரம்கிளைகள்கொண்டஅடிமரம்	விளிம்புநிலைவாழ்வியல்: திருநர்களும்சாதனைகளும்	கையறுநிலை – நந்திக்கலம்பகம்- வானுறுமதியை (110)	சிறுகதைவரலாறு - சிறுகதைஆசிரியர்கள்	தொடர்பிழை ஒருமைபன்மைவேறுபாடு
SLO-8	ஆல் – ஆயிரம்கிளைகள்கொண்டஅடிமரம்	திருநங்கைகுணவதி – சமூகப்பார்வை	தமிழ்இலக்கியமரபில் குறவஞ்சிஇலக்கியங்கள்	இதழ்களும்சிறுகதையும்	பிறமொழிச்சொற்களைநீக்கிஎழுதுதல், ஷ,ஜ,ஸ,ஹமாற்றொலிகள்

SLO-9	வானம்பாடிக்கவிஞர்கள்மு. மேத்தாவும்	புலம்பெயர்வாழ்வியல் - வலியும்நம்பிக்கையும்	குற்றாலக்குறவஞ்சி – ஆடுமரவீனுமணி (3)	புதினம்தோற்றம் - புதினம்வளர்ச்சிவரலாறு	தமிழில்சொல்வகைகள் சொல்லும்பயன்பாடும்
SLO-10	மனிதநேயம் - மு. மேத்தாவின் மனிதனைத்தேடி	ஸர்மிளாஸெய்யித் – புராதனஊர்	காப்பியஇலக்கணம் - காப்பியவகைமைகள்	புதினத்தின்வகைமை புதினஆசிரியர்கள்	பெயர்ச்சொற்கள் பெயர்ச்சொற்களும்வகைகளும்
SLO -11	தமிழ்க்கவிதையில்சுற்றுச்சூழலியல்	காலந்தோறும்கவிதைவடிவில்மாற்றங்கள்· ஹைக்கூ – மு. முருகேஷ்	சிலப்பதிகாரம் – அறிமுகம் கட்டுரைக்காதை	தமிழ்இலக்கியத்தில்உரைநடைக்கூறுகள் - உரைநடையின்தோற்றம்	வினைச்சொற்கள்அறிதல்
SLO -12	இயற்கையும்சமத்துவமும் பழனிபாரதியின்காடு	லிமரைக்கூ – ஈரோடுதமிழன்பன் சென்ரியூ – மாமதயானை	ஊழ்வினை - கோவலனின்முற்பிறப்புவரலாறு	தமிழில்உரைநடை வளர்த்தஅறிஞர்கள்	தமிழில்பெயரடை, வினையடை அறிதல்

Resources			
1	முல்லைக்காடு, தொகுப்பும்பதிப்பும் – தமிழ்த்துறைஆசிரியர்கள், எஸ். ஆர்.எம். அறிவியல்மற்றும்தொழில்நுட்பக்கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2023	4	வல்லிக்கண்ணன், புதுக்கவிதைதோற்றமும்வளர்ச்சியும், ஆழிபதிப்பகம், சென்னை, 2018
2	கா. சிவத்தம்பி, தமிழில்சிறுகதைதோற்றமும்வளர்ச்சியும், என்.சி.பி.எச்., சென்னை, 2013	5	மு. வரதராசன், தமிழ்இலக்கியவரலாறு, சாகித்தியஅக்காதெமி, 1972.
3	மதுரைதமிழ்இலக்கியமின்தொகுப்புத்திட்டம் - https://www.projectmadurai.org/	6	தமிழ்இணையக்கல்விக்கழகம் - http://www.tamilvu.org/

Assessment										
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
		(10 %)		(10 %)		(20 %)		(10%)		
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1	Remember	15	15	15	15	10	10	10	10	15
2	Understand	15	15	15	15	10	10	10	10	15
3	Apply	20	25	25	20	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10
6	Create	15	10	10	15	15	15	15	15	10
	Total (%)	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. P.R. Subramanian, Director, Mozhi Trust, Thiruvanmiyur, Chennai – 600 041	1	Dr. V. Dhanalakshmi, Associate Professor, Subramania Bharathi School of Tamil Language &Literaturel, Pondicherry University, Pondicherry	1	Dr. B. Jaiganesh, Associate Professor and Head, Departmenttof Tamil, FSH, SRMIST, Kattankulathur
				2	Dr. R. Ravi, Assistant Professor and Head, Dept.artment of Tamil, FSH, SRMIST, Vadapalani
				3	Mr. G. Ganesh, Assistant Professor, Department of Tamil, FSH, SRMIST, Ramapuram
				4	Dr. T.R. Hebzibahbeulah Suganthi, Assistant Professor, Department of Tamil, FSH, SRMIST, Kattankulathur
				5	Dr. S. Saraswathy, Assistant Professor, Department of Tamil, FSH, SRMIST, Kattankulathur

Course Code	ULH24AE1J	Course Title	Hindi – I	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	Hindi	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	To Communicate in Hindi without any inhibition
CLR-2	To appreciate the Hindi language in its various forms
CLR-3	To analyze the different writing styles
CLR-4	To display moral and social values in the field of social Responsibility and Integrity
CLR-5	To be willing listeners and Translators-where need be

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity Solving	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO - 1	PSO -2
CLO-1	To Understand the Philosophy of life and living through Stories	✓	✓	-	-	2	85	75	3	2	3	-		2	-	-	-	-
CLO-2	To Examine Travelogue writing and Sketch	✓	✓	✓	-	2	85	75	3	-	2	-	3		3	-	-	-
CLO-3	To Identify Irony and essay - based writing	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-
CLO-4	Evaluate the various social issues depicted in the prose	✓	✓	✓	✓	3	85	75	2	-	2	3	-	-	2	-	-	-
CLO-5	To Understand the fundamental principal of Translation	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-

Sessions	CLO – 1	CLO - 2	CLO – 3	CLO - 4	CLO – 5
	12	12	12	12	12
SLO-1	KAHANI KI AVDHARNA	REKHACHITRA & YATRAVITRANT	NIBANDH	NATAK	ANUVAD& PARIBHASHIK SHABDAVALI
SLO-2	SWARUP AUR PARIBHASHA	AVDHARNA EVM SWAROOP	NIBANDH KI AVDHARNA EVM SAWROOP	AVDHARNA EVM SAWROOP	ARTH EVM PARIBHASHA
SLO-3	KAHANI KE TATVA EVM MAHATWA	MAHATVA AUR UDDESHYA	MAHATVA EVM UDDESHYA	TATWA EVM PRAKAR	SWARUP EVM PRAKAR
SLO-4	PARIKSHA- PREMCHAND	GESHA REKHACHITRA	KUTAJ- NIBANDH HAJARI PRASHAD DIVEDI	UDDESHYA	MAHATVA

SLO-5	VISLESHAN	PATH KA VISHLESHAN	LEKHIAK PARICHAY	NATAK KA MAHATVA	UDDESHYA
SLO-6	UDDESHYA	GURU SHISHYA KA SAMBANDH	SHANGHARSHIL JEEVAN	RANGMANCH KA PARICHAY	ANUVAD KA PRAYOJAN EVM PRAYOG
SLO-7	MALBE KA MALIK-MOHAN RAKESH	THELE PAR HIMALAY (YATRAVITRANT)	PATH KA MAHATVA	LEKHAK PARICHAY	SHROT EVM LAKSHYA BHASHA KA GYAN
SLO-8	LEKHAK PARICHAY	YATRAVITRANT KA MAHATVA	BHOLARAM KA JEEV-(VYANGYA) HARISHANKAR PARSHAI	NATAK KA VISLESHAN	ANUVAD KA DAYITVA
SLO-9	BATWARE KA YATHARTH VARNAN	YATRA KA YATHARTH CHITRAN	VYANGYA KI AVADHARNA	LALCH KA DUSHPARINAM	PARIBHASHIK SHABDAVALI
SLO-10	TATKALIN PARISHTHITI KA VARNAN	PATH KA VISLESHAN	PATH KA VIHLESHAN	GURU SHISHYA SAMBANDH	TAKANIKI SHABDAVALI KA MHATVA
SLO-11	KAHANI KA VISHLESHAN	HIMALAY KA LOK JEEVAN	SARKARI TANTRA KA KHOKHLA RUP	MAHATTAKANKSHI KA DUSHPARINAM	VIVIDH PRAYOG
SLO-12	KAHANI KA UDDESHYA	HIMALAY KA VARNANA	SANVEDANSHIL BHAVANA	TATKALIN SAMAJIK VYAVASTHA KI CHARCHA	SHABDAVALI KI AVSHYAKTA

Resources			
1	Samanya Hindi, Srijonlok Publication, 2023, New Delhi	4	Bhakti Andolan Aur Surdas Ka Kavya – Manager Pandey
2	Kabir – Hazari Prasad Dwedi	5	Bihari – Vishvnath Prasad Mishr
3	Surdas – Ram Chandra Shukl	6	Aadhunik Vigyapan Aur Jansampark – Taresh Bhatia

Assessment									
	Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
	CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
	(10 %)		(10 %)		(20 %)		(10%)		
Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1 Remember	15	15	15	15	10	10	10	10	15
2 Understand	15	15	15	15	10	10	10	10	15
3 Apply	20	25	25	20	25	25	25	25	25
4 Analyze	20	25	25	20	25	25	25	25	25
5 Evaluate	15	10	10	15	15	15	15	15	10
6 Create	15	10	10	15	15	15	15	15	10
Total (%)	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

***The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments**

Designers

Professional Experts		Higher Institution Experts		Internal Experts	
1	Ms. Reetha Govindan, Senior Manager (Rajbhasha)	1	Dr. S. Padmapriya, Professor and Head, Pondichery University, Kalapet, Puducherry - 605014	1	Dr. S Preeti. Associate Professor, SRMIST
2	Mr. Vipin Kumar Jha, Senior Translation Officer (ALUMNI)			2	Dr. Md. Shwahidul Islam, Assistant Professor, SRMIST
				3	Dr. S. Razia Begum, Assistant Professor, SRMIST
				4	Dr. Nisha Murlidharan Assistant Professor, SRMIST

Course Code	ULF24AE1J	Course Title	French – I	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	French	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Extend and expand their savoir-faire through the acquisition of current scenario
CLR-2	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French
CLR-3	Make them learn the basic rules of French Grammar.
CLR-4	Develop strategies of comprehension of texts of different origin
CLR-5	Strengthen the language of the students both in oral and written

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Bloom's Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Problem Solving, Critical Thinking, Creativity Solving	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	4 Leadership Qualities, Professionalism, Autonomy, Accountability	5 Digital Technology Skills	6 Value Inculcation, Multicultural inclusivity	7 Environmental Action, Community Engagement	8 Entrepreneurial Risk Taking	9 PSO - 1	10 PSO -2
CLO-1	To acquire knowledge about French language	✓	✓	-	-	2	85	75	3	2	3	-	-	2	-	-	-	-
CLO-2	To strengthen the knowledge on concept, culture, civilization, and translation of French	✓	✓	✓	-	2	85	75	3	-	2	-	3	-	3	-	-	-
CLO-3	To develop content using the features in French language	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-
CLO-4	To interpret the French language into other language	✓	✓	✓	✓	3	85	75	2	-	2	3	-	-	2	-	-	-
CLO-5	To improve the communication, intercultural elements in French language	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-

Sessions	CLO – 1	CLO - 2	CLO – 3	CLO - 4	-CLO – 5
	12	12	12	12	12
SLO-1	Contacts, Emma la championne	Les verbes du premier groupe	Qu'est-cequ'ils font?	Portraits	Les verbes du deuxième groupe –
SLO-2	Les nombres à partir de 31	La liaison	Oùestmon sac	Un casting	Les pronoms personnels toniques

SLO-3	Les pays, les nationalités	Entreren contact	Quelquesobjets	Le Petit Spirou	Les verbes faire et lire
SLO-4	Les jours de la semaine, Les jours	Présenter et se présenter	Les professions	L'aspect physique	Les Sons
SLO-5	Les mois de l'année, Les animaux domestiques	Demander et dire la date	La formation du féminin (2)	Le caractère	Décrirel'aspect physique
SLO-6	La famille (1)	Une rencontre.	Qu'est-ce que c'est?	les états d'âme	Demander et dire l'heure
SLO-7	La formation du féminin (1)	Contacts	C'est / Il est (1)	Les prépositions de lieu (1)	Elle est comment?
SLO-8	Les adjectifspossessifs	Emma la Championne	La phrase négative (1)	La famille (2)	Portraits
SLO-9	La phrase interrogative	Mots et expressions	Les verbes aller et venir	La formation du féminin	Mots et Expressions
SLO-10	Les nombres	Grammaire	Les formules de politesse	La formation du pluriel (2)	Grammaire.
SLO-11	Intonation et est-ce que	Communication	C'est qui?	Il y a	Communication
SLO-12	Les exemples	Les verbes du ER –groupe	Mots et Expressions	Les articles contractés	Les concepts

Resources			
1	"La Nouvelle Génération-AI" Méthode de français, Marie-Noëlle COCTON, P. DAUDA, L. GIACHINO, C. BARACCO, Les éditions Didier, Paris, 2018.	4	https://www.elearningfrench.com/learn-french-grammar-online-free.html
2	Cahier d'activités avec deux discs compacts.	5	https://www.lawlessfrench.com/grammar
3	https://www.fluentu.com/blog/french/french-grammar	6	https://blog.gymglish.com/2022/12/15/basic-french-grammar

Assessment										
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
		(10 %)		(10 %)		(20 %)		(10%)		
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1	Remember	15	15	15	15	10	10	10	10	15
2	Understand	15	15	15	15	10	10	10	10	15
3	Apply	20	25	25	20	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10
6	Create	15	10	10	15	15	15	15	15	10
	Total (%)	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

***The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments**

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Mr. KavaskarDanasegarane, Language Specialist, Process Expert Maersk Global Service Center Pvt. Ltd	1	Dr. C Thirumurugan, Professor, Department of French, Pondicherry University	1	Mr. Kumaravel K. Assistant Professor and Head, SRMIST
2	Mr. Shrivathsan S, Journalist, Senior Sports Reporter/Sub-Editor, Times of India, Chennai			2	Ms. Abigail A, Assistant Professor, SRMIST
				3	Mrs. 2. Mahalakshmi, Assistant Professor, SRMIST

Course Code	ULE24AE1J	Course Title	English	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	English	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Develop an understanding and sensibility of human consciousness through gender inclusive curriculum
CLR-2	Enhance the abilities of deeper understanding to stay with integrity with the fellow human beings
CLR-3	Develop the overall language competency of the learner
CLR-4	Develop proficient language skills
CLR-5	Learn to express the thoughts clearly, develop logical arguments and enhance the overall communication skills.

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Bloom's Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Problem Solving, Critical Thinking, Creativity Solving	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning, Learning to Learn, Research skills	4 Leadership Qualities, Professionalism, Autonomy, Accountability	5 Digital Technology Skills	6 Value Inculcation, Multicultural inclusivity	7 Environmental Action, Community Engagement	8 Entrepreneurial Risk Taking	9 PSO- 1	10 PSO-2
CLO-1	Analyze different literary texts to identify the representation of issues related to gender, and class	✓	✓	-	-	2	85	75	3	3	3	3	-	3	3	2	3	3
CLO-2	Apply critical thinking skills to analyze and respond to academic texts.	✓	✓	✓	-	2	85	75	3	2	3	2	-	3	1	-	3	2
CLO-3	Critically evaluate and discuss contemporary issues through online articles.	✓	✓	✓	✓	3	85	75	3	3	3	3	3	3	2	1	3	3
CLO-4	Refine their general writing skills	✓	✓	✓	✓	3	85	75	1	2	2	1	3	3	2	2	3	1
CLO-5	Improve their language application skills	✓	✓	✓	✓	3	85	75	3	3	2	3	1	1	1	3	3	1

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	POETRY	SHORT STORIES	LEARNING ABOUT WRITING	LEARNING ABOUT SPEAKING	REFLECTION OF THE LANGUAGE LEARNING

	12	12	12	12	12
SLO-1	Introduction to the poet- Sukirtharani- Reading and recitation of the poem –Debt Analysis and Critical interpretation of the poem.	Introduction to the short story writer Katherine Mansfield. Reading the story- The Doll's House Explaining the story through depiction of characters and representation of injustices.	Introduction to Creative Writing. Explaining the elements of creative writing. Grouping the Students belonging to States other than Tamilnadu	Building the discourse- The significance of conversation and the key elements of discourse- Art of conversation in digital and verbal discourse- Lee Mockobe'sA Powerful Poem of what it means to be a Transgender. TEDX TALK-POEM RECITATION	Reflecting the learning. - Review writing Explaining the process of reviewing and the method of reviewing. Choosing the subject for reviewing.
SLO-2	Introduction to the poet Kalki Subramaniyam. Reading and recitation of the poem Phallus I cut. Analysis and Critical interpretation of the poem. Part-1	Analysis and critical interpretation of the short story Doll's House.	Stand-up comedy show -translate the audio content in English. (any regional language) Practice the writing activity -creative ways of engaging in translation.	Reflecting on the style and the tone of the poem. Practicing conversation	Choosing and planning the topic for students- group 1 and group 2
SLO-3	Analysis and Critical interpretation of the poem. Phallus I cut- Part-2	Class room activity- reviewing characters Group Discussion- social consciousness	Correction of errors- attempting to translate. Identifying equivalent terms to certain regional words - learn the art of translation.	Classroom- Speaking activity- reflection about the issues regarding gender expression and gender identity. Reviewing activity- group discussion- communicating effectively- importance	Choosing and planning the topic for students- group 3 and group 4
SLO-4	Introduction to the poet -Imtiaz Dharker. Reading and reciting the poem Purdah 1. Analysis and Critical	Speaking activity- society and its portrayal in the short story- Magnifying and analyzing the characters from contemporary perspective	Introducing famous art works and the contexts of creation. Salvador Dali- The Face of War Pablo Picasso- Guernica Edward Munch- The	Introducing Content writing in social media- the importance of content writing.	Introducing the students to the review of the various works. Understand the review process how effectively a review of any work can be done.

	interpretation of the poem- Purdah 1- part 1		Scream Pieter Bruegel- The Tower of Babel. Understanding the art works- Part 1		
SLO-5	Analysis and Critical interpretation of the poem- Purdah 1- part 2	Introduction to the writer Haruki Murakami. Reading the Confessions of a Shinawaga monkey. Discussion and analysis of the Confessions of a Shinawaga monkey.	Understanding the art works- Part 2 creative and/ or thoughtful writing - contemporary themes of modern day	BLOG WRITING - Subtleties of Workplace Inclusion: Mental Health and Queer Community- Salik Ansari. Reading the text- content in the blog by the students- Reading Activity	Reviewing -record -post in the social media pages of SRMIST
SLO-6	Reading and reciting the poem Purdah 2 Analysis and Critical interpretation of the poem- Purdah 2- part 1	Group discussion activity reflecting the understanding of the character Shinagwa monkey Speaking activity- review on life and existentialism and identity crisis	Course instructor guidance-Classroom activity for creative writing- discussion on generation of ideas discussion on working and reflection of ideas	Analysing the text- content in the blog by the students- Discussion Activity writer's conversation with the readers - the blog in other blog articles. Practice blog writing	Thoughtful conversation with your team member posts the same in the official social media page of SRMIST. Choosing the team based on the abilities that are comfortable to match the peer members
SLO-7	Analysis and Critical interpretation of the poem- Purdah 2- part 2	Introduction to Crystal Wilkinson Reading Endangered Species: Case 47401.	Elements of writing Incorporate the elements of story in story writing	Apprehending Life by reading the texts of influence- Chimamanda Ngozi Adiche's Notes on Grief- A BRIEF NOTE, we should all be Feminists- An Essay.	Choosing the topics for a thoughtful conversation Planning and preparation for the script of conversation with a team member
SLO-8	Introduction to the poet Arundathi Subramanian. Reading and reciting the poem- Home Student activity- recitation Analysis and Critical interpretation of the poem- Home	Discussion and analysis of Endangered Species: Case 47401.	Students -writing abilities- building stories- a visual treat of variety of pictures.	Class discussion- essay by the author -subjective depiction of life. Understand -subjective opinions -perspectives- Practising the task multiple times with all the students in	Drafting, editing and revising the script of conversation and enacting the conversation with the team members Enactment -proper rehearsal -final

				the classroom.	performance - conversation- whole performance should be recorded. The recording should be posted in the official media page and social handles of SRMIST.
SLO-9	Recollection of study of the writing styles and intentions of the poets prescribed in the syllabus.	Introduction to C.S Lakshmi also known as Ambai. Reading the short story- In a Forest, A Deer.	Practice -write stories - pictures given or shown. Classroom activity- evaluation of writings ansd reflections for suggesting, correction and improvement	Interposing opinions in famous interviews- FII Interviews: Tasveer Co-Founder and Filmmaker Rita Meher on The Seattle Legislation, Minority Rights and The Fight Against Oppression- INTERVIEW- Analayisng the text and discussing the aspects of an interview	work for this social post - reflect on their experience of learning communicative English course and the testimonial has to be recorded and posted in the social media pages of SRMIST.
S-10	Group Discussion activity for students to reflect up on gender consciousness	Discussion and Analysis of In a Forest, A Deer.	A writing task to write a script is introduced in the classroom.	Students -enact as interviewer and interviewee and practice building the discourse.	Involving the students for the project work. Introducing what is project work and inculcating the interest - Giving instructions to do the project works -
SLO-11	Revision of the poems Debt and Phallus I cut, Purdah 1 and Purdah 2	Classroom activity- speaking about identity, power of women and contemporary issues and perspectives up on women like Thangam Atthai	creative scripts inspiring from the dialogues of their favourite films by changing the scenario to their own wish according to their own whims and fancies. Creative writing - writing news reports. recreated with new	Certain role plays like celebrity personalities, political personalities - conduct the interview and be the interviewer and interviewee. The art of conversation and the ability to build a	Discussion of ideas and generation of creative ideas- Preparation for next semester. Assignment on any piece of creative writing (OR) Presentation- Mastering the art of Public Speaking. (OR) Project on compiling the real-life influential

			characters, places, scenes, incidents.	discourse Reflecting on the points- Student reviewing activity- art of conversation in the text	events on gender inclusive issues and a presentation of the same. Interview Scripting /Blog writing. - Guidance
SLO-12	Revision of the poem Home. Creative activity for the students to reflect up on gender consciousness, influence of religion on women freedom.	Retrospecting the writing styles of the authors- Katherine Mansfield, Haruki Murakami, Crystal Wilkinson and Ambai. Overall Revision- The Doll's House, Confessions of a Shinawaga Monkey, Endangered Species: Case 47401 Classroom activity- speaking about racism in contemporary society- an attempt to understand the issues prevailing in the society from the perspectives of students	Watch debate shows - summarising the arguments Enhance - descriptive writing skill. Repetitive practice and continuous assessment -writing skiills-master the writing skill.	Reflecting on the points- Student reviewing activity- art of conversation in the text The evaluation and assesment of the conversation -constructive feedbacks to the students.	Reflection, Evaluation and Assessment of ideas- Students can opt any of the project from the given choice. Ready for the next semester- reflection of the learning through assignments practiced

Resources

1	Horizon- English Text Book – Compiled and Edited by the Faculty of English Departement, FSH, SRMIST, 2023	5	The Art of Public Speaking by Stephen E. Lucas- 2019
2	The Creative Writing Coursebook: Forty Authors Share Advice and Exercises for Fiction and Poetry by Julia Bell and Paul Magrs- 2001	6	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds by Carmine Gallo – 2014
3	On Writing: A Memoir of the Craft by Stephen King 2000	7	The Anatomy of a Book Review: A Guide for College Students by Ronald J. Weber 1994
4	The Writing Life: Writers on How They Think and Work edited by Marie Arana - 2003	8	How to Write a Simple Book Review: It's easier than you think! by Allyson R. Abbott 2013

Assessment										
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
		(10 %)		(10 %)		(20 %)		(10%)		
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1	Remember	15	15	15	15	10	10	10	10	15
2	Understand	15	15	15	15	10	10	10	10	15
3	Apply	20	25	25	20	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10
6	Create	15	10	10	15	15	15	15	15	10
	Total (%)	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

***The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments**

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Krishna Raj, Sutherland Technologies	1	Dr. J Mangayarkarasi Associate Professor and Head, Department of English, Ethiraj College for Women, Chennai	1	Dr. Pushpanjali Sampathkumar, Assistant Professor, Department of English, FSH, SRMIST
		2	Dr. K S Antonysamy Associate Professor and Head, Department of English, Loyola College, Chennai	2	Dr. Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH, SRMIST
				3	Dr Anchal Sharma, Professor and Head, Department of EFL SRMIST
				4	Dr T Sridevi, Assistant Professor, FSH, SRMIST
				5	Dr Shanmuga Priya, Assistant Professor SRMIST

Course Code	UCY24101T	Course Title	Atomic Structure and Chemical Bonding	Category	C	Core	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Employ the quantum mechanical concepts of atomic structure for energy calculation
CLR-2	Exploit the periodic properties of elements for bulk property manipulation towards scientific advancement
CLR-3	Address the fundamental concepts in different types of chemical bonds
CLR-4	Apply various theories towards the identification of structures and geometries of molecules
CLR-5	Utilize the knowledge of the bonding to design various alloys and semiconductors

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Bloom's Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Problem Solving, Critical Thinking, Creativity Solving	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	4 Leadership Qualities, Professionalism, Autonomy, Accountability	5 Digital Technology Skills	6 Value Inculcation, Multicultural Inclusivity	7 Environmental Action, Community Engagement	8 Entrepreneurial Risk Taking	9 PSO - 1	10 PSO -2
CLO-1	Utilize the knowledge of quantum mechanics to understand the atomic structure	✓	✓	-	-	2	75	75	3	-	-	-	2	-	-	-	-	✓
CLO-2	Correlate the periodic properties of elements with their chemical properties	✓	✓	✓	-	2	75	75	3	-	-	-	3	-	-	2	-	✓
CLO-3	Understand the concept of lattice energy using Born-Landé and Kapustinskii expression and Born-Haber cycle	✓	✓	✓	✓	3	75	70	-	3	3	2	-	-	-	-	-	✓
CLO-4	Perceive the importance of structures and geometries of molecules using VSEPR and MO	✓	✓	✓	✓	3	75	75	-	-	3	-	-	-	-	3	-	✓
CLO-5	Rationalize the properties of semiconductor using metallic bonding and gaseous behavior using weak chemical forces	✓	✓	✓	✓	3	75	70	3	-	3	-	-	-	-	-	3	✓

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	Atomic structure	Periodic properties	Chemical bonding	VSEPR theory	Band theory
	12	12	12	12	12

SLO-1	Introduction to atomic structure, Bohr's atomic model and limitations	Introduction to periodic properties, Groups and periods in the periodic table	Introduction to chemical bonding, types of bonding with examples	Introduction to covalent bonding.	Introduction to metallic bond, Electron Sea theory
SLO-2	Line spectrum of hydrogen atom	Slater rules, Effective nuclear charge, Shielding constant	Definition and general characteristics of Ionic bond, Ionic crystal formation: closed packing	Lewis's theory-octet rule, Valence bond theory - postulates and limitations	Band theory, Conductor, Semicoductor and insulator
SLO-3	Wave mechanics – duality of matter, de Broglie equation, Heisenberg's Uncertainty principle	Slater rules, Effective nuclear charge, shielding constant	Radius ratio rule and its applications	Modified VB theory: Types of hybridization, VSEPR theory	Band theory, Conductor, Semicoductor and insulator
SLO-4	Tutorial: Solving problems in de Broglie equation	Tutorial: Solving problems in effective nuclear charge	Tutorial: Solving problems in chemical bonding	Tutorial: Solving problems related to octet rule	Tutorial: Solving problems in conductor, semicoductor and insulator
SLO-5	Failure of Bohr's atomic model, Quantum mechanical concept of atom	Trend of the periodic table properties, factors affecting periodic properties	Derivation for AX3 type compound, Lattice energy	VSEPR theory to predict the type of hybridization	Definition and types of forces: Van der Waals, ion-dipole force, dipole-dipole forces
SLO-6	Schrödinger's wave equation, (time-independent), Significance of ψ and ψ2	Atomic radii, Ionic radii, Vander waals radii	Born-Lande equation, Kapustinskii equation, Madelung constant	Geometry of molecule, Molecular Orbital theory	Definition and types of forces: Van der Waals, ion-dipole force, dipole-dipole forces
SLO-7	Probability distribution curves, Radial wave functions and nods. Angular wave functions and nods	Ionization energy, Successive ionization energy, Electron affinity	Born-Haber cycle and its applications	LCAO method	Dipole-induced dipole forces, instant dipole-Induced dipole forces, London forces
SLO-8	Tutorial: Solving problems in Schrödinger's wave equation	Tutorial: Solving problems in periodic properties	Tutorial: Solving problems related to latice energy	Tutorial: Solving problems in VSEPR theory	Tutorial: Solving problems related to different forces
SLO-9	Shapes of orbitals, Significance of quantum numbers	Electronegativity, Variartion of electronegativity with bond order	Relationship between lattice energy and solubility of ionic compounds, Covalent character in ionic compounds	Formation of bonding, anti-bonding and nonbonding molecular orbitals, Types of overlapping - s-s, s-px, px-px, py-py and pz-pz	Hydrogen bonding and its various types
SLO-10	Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle, Electronic configuration of elements	Electronegativity scales: Pauling, Allred Rochow, Mulliken's scales of electronegativity	Fajan's rule and applications	MO diagram for homonuclear and heteronuclear diatomic molecule	VB approach of hydrogen bonding, Effects of hydrogen bonding in density
SLO-11	Pauli's exclusion principle,	Metallic and non-metallic	Polarization and polarizing	Calculation of bond order.	Solubility, melting point and

	Hund's rule of maximum multiplicity, Aufbau principle, electronic configuration of elements	character, Variation of oxidation state in periodic table	power, dipolemoment	H2+,H2, He2+, He2 , Li2, B2, C2, N2, O2, O2-, O22-, CO, HCl molecules	boiling point
SLO-12	Tutorial: Solving problems inelectronic configuration, Quantum numbers	Tutorial: Solving problems in electronegativity	Tutorial: Solving problems related polarization and dipolemoment	Tutorial: Solving problems in bond order	Tutorial: Solving problems related hydrogen bonding

Resources

1.	J. D. Lee, Consise Inorganic Chemistry, Wiley, 5th Edition, 2021.	5.	P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, F.A. Armstrong and M. Hagerman, Shriver and Atkins' Inorganic Chemistry, W. H. Freeman and Company, 5th Edition, 2010.
2.	J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry-Principles of Structure and Reactivity, Pearson, 4th Edition, 2022	6.	R. P. Sarkar, General and Inorganic Chemistry: Volume II, New Central Book Agency (P) Limited, 2009
3.	R. D. Madan, Modern Inorganic Chemistry, S. Chand and Company Limited, 2017.	7.	B.E. Douglas, D. H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., John Wiley & Sons, Inc. 1993.
4.	L. G. Miessler, J. P. Fischer, D. A. Tarr, Inorganic Chemistry, Fifth edition, Pearson, 2014.		

Assessment							Strategies					
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)	Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *		Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)	(10 %)	(20 %)	(10%)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	15	15	10	10	15			Debate	✓		
2	Understand	15	15	10	10	15			Interactive Lecture	✓		
3	Apply	20	25	25	25	25			Brainstorming	✓		
4	Analyze	20	25	25	25	25						
5	Evaluate	15	10	15	15	10						
6	Create	15	10	15	15	10						
	Total (%)	100	100	100	100	100						

*****The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
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2	Dr. Ravikiran Allada Head Analytical R&D and ASAT (AVP) || Steriscience (Strides) Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24102J	Course Title	Basic Reactions in Organic Chemistry	Category	C	Core	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			Programme Learning Outcomes									
CLR-1	Learn how to prepare the reaction intermediate and their stability	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Gain knowledge about the mechanism and use of addition reaction																	
CLR-3	Know the mechanism and use of elimination reaction																	
CLR-4	Understand the aliphatic substitution reaction																	
CLR-5	Learn the mechanism of aromatic electrophilic and nucleophilic substitution reaction																	
CLO	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Apply the concepts of reaction intermediates and their use	✓	✓	✓	-	3	85	75		3	-	2	-	-	3	-	-	-
CLO-2	Use addition reaction in organic transformation	✓	✓	✓	-	3	85	70		3	-	3	-	-	-	-	-	2
CLO-3	Prepare unsaturated compounds	✓	✓	✓	✓	4	85	70		3	-	3	-	-	3	-	-	-
CLO-4	Apply the concepts converting functional group in aliphatic compounds	✓	✓	✓	✓	4	85	70		3	-	2	-	-	-	-	-	3
CLO-5	Apply the concepts converting functional group in aromatic compounds	✓	✓	✓	✓	4	85	60		3	-	3	-	-	-	-	-	-

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	Reactive intermediates in organic reactions	Addition reactions	Elimination reactions	Aliphatic substitution reactions	Aromatic substitution reactions
	15	15	15	15	15

SLO-1	Introduce reactive intermediates, Importance of these, how affecting the rate of a reaction	Introduce addition reaction, electrophilic addition to alkenes and alkynes, compare the reactivity of alkenes and alkynes	Elimination reactions and their types, different types of elimination	Introduce SN2 mechanism, explain stereochemical outcomes	Mechanism of nitration, reagents for nitration
SLO-2	Carbocation (classical and nonclassical), structure, carbocation Synthesis and stability	Dihalogens and stereoselectivity, reaction with haloacids and stereoselectivity, regioselectivity	E1, and E2 mechanisms, E1CB mechanism and their comparative study	proof of mechanism, compared oxo-and halo-nucleophiles	Effect of external functional groups in product distribution, sulphonation, reagents
SLO-3	Carbanion, structure, synthesis, stability	Hydration to alkene and alkynes, oxymercuration and demercuration and their use	Stereoelectronic criteria of E1, E2 and E1CB elimination, use examples of acyclic and cyclic halocompounds, explain the steric effects in product distribution using projection formula	Nucleophilicity of chalcogens, nucleophilicity of amines, ambient nucleophiles	Sulphonation mechanism, stability, synthetic utility of sulphonic acid group
SLO-4-5	Practice: Introduction, safety measures	Practice: Lassaigne's test for N, S, Cl, Br, I	Practice: Functional group test for amine and nitro	Practice: Preparation of derivatives of amine	Practice: Single detection of organic compounds
SLO-6	Carbene, structure, synthesis, stability, evidence for singlet and triplet carbenes	Addition of hydroborane, stereoselectivity, regioselectivity and hydrolysis	Explain Hoffmann and Saytzeff products, substitution vs elimination (substrate, nucleophile/base, solvents)	Effect of substrates, solvent, leaving groups in mechanisms, transforming a bad leaving group into good leaving group	Aromatic nucleophilic substitution reaction, activation of substrates, reactivity of haloarenes
SLO-7	Nitrene, structure, stability and reactions	Addition to alkynes, synthetic utility scope of hydroboration reaction (functional group interconversion)	pyrolytic elimination stereoselctivity of products	Nucleophilic catalysts	Types: Carbanion intermediate, types: benzyne mechanism
SLO-8	Benzyne: structure, synthesis, stability (orbital pictures), trapping of benzynes, reactions using benzynes	Ozonolysis of alkenes and alkynes, addition of radicals	Chugaev reaction, Cope elimination	Introduce SNi mechanism, NGP	Types: Diazonium salt, orientation effect Grignard reagents, synthesis, structure, Mechanism, reactivity of aliphatic and aromatic halides, halides
SLO-9-10	Practice: Lassaigne's test for N, S, Cl, Br, I	Practice: Functional group test for alcohol, phenol, carboxylic acid	Practice: Preparation of derivatives of alcohol, phenol	Practice: Preparation of derivatives of carbonyls	Practice: Single detection of organic compounds
SLO-11	Radicals, synthesis, structure, reactions	Hydrogenation reaction, Willkinson’s catalyst, Lindlar’s	Introduce nucleophilic substitution reactions,	Aromatic electrophilic substitution reaction, reactivity	Reactions with ketone, epoxide, ester 1,2- vs 1,4 addition,

		catalyst	nucleophiles, electrophilic centers, leaving groups, types of substitution in aliphatic compounds	of substituted arenes, □-, □-complex	dialkylcuprate reagent
SLO-12	Redox reaction, determination of oxidation states	Birch reduction of alkenes and alkynes benzylic halogenation	Introduce SN1 mechanism, explain stereochemical outcomes	Friedel-Craft alkylation and acylation, merits and demerits, orientation effect	Organolithium compounds, synthesis and use
SLO-13	Oxidation of alcohols, alkenes, reduction of ketones, alkenes	Addition to allenes and conjugated alkenes, nucleophilic addition to conjugated alkenes	Effect of substrates, nucleophiles, solvent, leaving group, salt effect, Ritter reaction	Halogenation reaction, different reagents, reactivity of halogens as electrophiles	Organozinc compounds, synthesis and use
SLO-14-15	Practice: Lassaigne's test for N, S, Cl, Br, I	Practice: Functional group test for carbonyls, ester, unsaturation	Practice: Preparation of derivatives of alcohol, phenol	Practice: Single detection of organic compounds	Practice: Repeat experiment

Resources

1.	M. B. Smith and J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc 2006	6	J. Clayden, N. Greeves, and S. Warren, Organic Chemistry 2nd Ed., Oxford University Press 2012
2.	J. McMurry, Organic Chemistry 5th Ed., Thomson business information 2007	7	T. W. G. Solomons and C. B. Fryhle, Organic Chemistry 10th Ed., John Wiley and Sons, Inc 2011
3.	I. L. Finar and A. L. Finar, Organic Chemistry Vol. 2, Addison-Wesley 1988	8	D. N. Nasipuri, Stereochemistry of Organic Compounds: Principles & Applications, 3rd edition, South Asia Books 2012
4.	B. S. Furniss, A. J. Hannaford, P. w. G. Smith and A. R. Tatchell, Vogel's text book of organic chemistry, 5th edition, John Wiley and Sons, 1989	9	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, Practical Organic Chemistry, 5th Ed., Pearson, 2012
5.	V. K. Ahluwalia, R. Aggarwal, Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2000.	10	V. K. Ahluwalia, S. Dhingra, Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press 2000.

Assessment											
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)	
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*			
		(10 %)		(10 %)		(20 %)		(10%)			
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	15	15	15	15	10	10	10	10	15	15
2	Understand	15	15	15	15	10	10	10	10	15	15
3	Apply	20	25	25	20	25	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10	10
6	Create	15	10	10	15	15	15	15	15	10	10
	Total (%)	100	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	-	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	-	Gender Equality	✓
		Debate	-		
		Interactive Lecture	✓		
		Brainstorming	✓		

***The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments**

Designers					
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2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24103J	Course Title	States of Matter, Chemical and Phase Equilibria	Category	C	Core	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Prerequisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			Programme Learning Outcomes									
CLR-1	Gain knowledge about matter in gaseous state, solid state and their applications	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Acquire knowledge about the properties of liquids and applications																	
CLR-3	Gain knowledge about solid state, crystal packing in solids importance of crystal engineering in semiconductor devices																	
CLR-4	Understand the laws and principles of chemical equilibrium.																	
CLR-5	Understand the phase rules of various systems and applications.																	
CLO	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural Inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Apply laws of gaseous state, laws of liquefaction of gasses and identify the types of crystals	✓	✓	✓	-	3	85	75	4	-	-	-	-	2	-	-	-	3
CLO-2	Utilize the concepts of colligative properties and express the concentrations of solutions in suitable units	✓	✓	✓	-	3	85	70	4	-	3	-	-	3	-	-	3	-
CLO-3	Differentiate the types of solutions and its separation techniques	✓	✓	✓	✓	4	85	70	4	3	3	-	-	-	-	-	3	-
CLO-4	Implement the laws governing progress of a reaction, thermodynamic and rate laws associated within a reaction.	✓	✓	✓	✓	4	85	70	3	-	-	3	-	-	-	-	3	-
CLO-5	Illustrates the existence of phase equilibria and constructs & interprets the phase diagram.	✓	✓	✓	✓	4	85	60	4	-	3	3	-	-	-	-	-	3

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	Gaseous and solid states	Liquid state	Solutions	Chemical equilibrium	Phase equilibria
	15	15	15	15	15
SLO-1	The gas laws, Boyle's law, Charles's Law, Gay Lussac's Law, Avogadro law	Liquid state: The origin of intermolecular forces, Ion-dipole forces. Dipole-dipole forces, London forces	Raoults law, Ideal solution	Introduction, reversible and irreversible reactions	Phase equilibria, phase component

SLO-2	The ideal gas equation, derivation. Dalton's law of partial pressure, Graham's law of diffusion.	Solutions: concentration terms, molality, molarity, normality	Vapor pressure of ideal solution	Laws of mass action	Degrees of freedom, derivation of phase rule
SLO-3	Kinetic molecular theory of gases, derivation.	Hydrogen bonding, effect of hydrogen bonding on boiling point.	Chemical potential of Ideal, Non-ideal solutions.	Law of chemical equilibrium and types of equilibrium constant	Activity terms of phase equilibria, one component system.
SLO-4-5	Introduction to the lab, discussion on lab and safetry protocols and evaluation	Identification of the density of unknown liquid using pycnometer.	Determination of critical solution temperature and composition at CST of the phenol water system	Practice problems and training on equilibrium constant of important reactions.	Determination of transition temperature of the hydrated salt
SLO-6	Distribution of molecular velocities, collision properties	Vapor pressure, Determination of vapor pressure - Static method	Gibbs- Duhem – Margules Equation with derivation.	Thermodynamic derivation of law of chemical equilibrium	Zn-Cd system, interpretation with diagram,
SLO-7	Deviation from ideality, van der Waals Equation	Dynamic method, effect of vapor pressure on boiling point.	Vapour pressure of ideal and non-ideal solutions	Relationship between Kp and Kc	Two component system with a solid compound.
SLO-8	Liquification of gasses – critical phenomenon, laws of corresponding states	Surface tension, determination of surface tension. Colligative properties, Raoult's law	Fractional distillation of Binary miscible liquid, Solution of type I, II and III, Lever rule	Le-Chatelier's principle	Two component system with a solid compound, congruent melting point.
SLO-9-10	Construction of isotherms (P-V curves) of CO2 for a series of temperature.	Determination of relative surface tension of the given liquid using Stalagmometer.	Study of the effect of impurity NaCl on CST of the phenol water system	Partition Coefficient of Iodine between Chloroform and water	Construction of phase diagram of simple eutectic system
SLO-11	Solid state: Types of solids, symmetry of crystals,	Determination of molecular mass from vapor pressure lowering measurement of lowering of vapor pressure	Distillation of immiscible liquids	Van't Hoff isotherm and Van't Hoff isochore	Mg-Zn system, incongruent melting point
SLO-12	Crystal lattice, unit cells. Miller indices, determination of Miller indices. Classification of	Elevation of boiling point, determination of molar mass from elevation of boiling point	Solubility of partially Miscible liquids	Clapeyron Equation	Ferric chloride-water system, interpretation with diagram

	crystals				
SLO-13	X-ray crystallography, Bragg's equation, derivation	Freezing point depression, activity, and activity coefficient	CST and Phenol – water system, Aniline- Hexane system, Triethylamine- Water system	Integrated form of Clausius-Clapeyron Equation	Ternary phase diagram, three component mixtures
SLO-14-15	Indexing of a given powder diffraction pattern of a cubic crystalline system.	Determination of relative viscosity of the given liquid using Ostwald viscometer.	Study of the effect of impurity succinic acid on CST of the phenol water system	Distribution of acetic acid/benzoic acid between water and benzene or chloroform or cyclohexane	Construction of phase diagram for ternary system.

Resources			
1	P.W. Atkins, L.L. Jones, Chemical Principles: The quest for insight. H. Freeman and Company, New York, 2010	3	B. R. Puri, L. R. Sharma, and M. S. Pathania, Principles of Physical Chemistry, 35th Edition, New Delhi ShobanLal Nagin Chand and Co., 2013 (Ed. 46)
2	P. L. Soni, A Textbook of Inorganic Chemistry, Sultan Chand and Co., 1977 (Ed. Addnl 20th)	4	R. Gopalan, Textbook of Inorganic Chemistry, 2nd Edition, Hyderabad, Universities Press, India, 2012.

Assessment											
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)	
		CLA – 1		CLA – 2		CLA – 3		CLA – 4			
		(10 %)		(10 %)		(20 %)		(10%)			
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	15	15	15	15	10	10	10	10	15	15
2	Understand	15	15	15	15	10	10	10	10	15	15
3	Apply	20	25	25	20	25	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10	10
6	Create	15	10	10	15	15	15	15	15	10	10
Total (%)		100	100	100	100	100	100	100	100	100	100

✓

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	-	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	-	Gender Equality	✓
		Debate	-		
		Interactive Lecture	✓		
		Brainstorming	✓		

***The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments**

Designers					
Professional Experts		**Higher Institution Experts**		**Internal Experts**	
1	Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia ravianalytical@gmail.com	1	Prof. G Sekar, Department of Chemistry, IIT Madras, gsekar@iitm.ac.in	1	Dr. Sivaramapanicker Sreejith, Dept. of Chemistry, SRMIST, Email: sreejits@srmist.edu.in
2	Dr. Sudarshan Mahapatra, General Manager at EncubeEthicals Private Limited, Mumbai, Maharashtra, sudarshan.m@encubeethicals.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER, Thiruvananthapuram, sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCD24S01J	Course Title	Verbal Ability and Skill Development	Category	S	Skill Enhancement Courses	L	T	P	C
							1	0	2	2

Course Offering Department	Career Guidance	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Expose students to right attitudinal and behavioral aspects and to build the same through activities
CLR-2	Develop and nurture interpersonal skills of the students through individual and group activities.
CLR-3	Increase efficiency and leadership skills to improve team results.
CLR-4	Use the basic mechanics of Grammar.
CLR-5	Instill confidence in students and develop skills necessary to face the challenges of competitive exams and placements

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Bloom's Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Problem Solving, Critical Thinking, Creativity	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	4 Leadership Qualities, Professionalism, Autonomy, Accountability	5 Digital Technology Skills	6 Value Inculcation, Multicultural inclusivity	7 Environmental Action, Community Engagement	8 Entrepreneurial Risk Taking	9 PSO - 1	10 PSO -2
CLO-1	Re-engineer their attitude and understand its influence on behaviour	✓	✓	-	-	2	85	75	2	3	2	2	-	1	2	3	-	-
CLO-2	Acquire inter-personal skills and be an effective goal-oriented team player	✓	✓	✓	-	2	85	75	3	3	2	3	-	1	2	1	-	-
CLO-3	Learn the importance of inner management and creativity	✓	✓	✓	✓	3	85	75	3	2	2	3	-	1	2	2	-	-
CLO-4	Understand the correct usage of grammar	✓	✓	✓	✓	3	85	75	3	-	3	-	3	1	1	-	-	-
CLO-5	Help the students succeed in competitive exams and placements	✓	✓	✓	✓	3	85	75	3	-	3	-	3	1	1	-	-	-

Sessions	CLO – 1	CLO - 2	CLO – 3	CLO – 4	CLO - 5
	9	9	9	9	9
SLO-1	Introduction to IKIGAI, IKIGAI – Key concepts	Networkingskills – relationship building, value exchange, active listening, friendliness and	Time management skills - ValueofTime, Pomodoro technique.	Basics of Grammar	Sentence Correction

		positivity, clear communication			
SLO-2	Attitude, Attitude formation and FactorsinfluencingAttitude	Negotiationskills – building rapport and problem-solving	Weekly Planner, Todolist, Prioritizing work, Time management activity	Spotting Errors	Sentence completion (Grammar based)
SLO-3	SWOTAnalysis, individualSWOTAnalysis-SWOTAnalysis activity	Entrepreneurial Skills, Entrepreneurial knowledge, Focus, Investment, Risk tolerance, Resilience, Ethics	Creative thinking skills – divergent thinking, Synthesis and collaboration, out-of -the - box thinking	Error spotting based on Parts of Speech	Sentence completion (Vocabulary based)
SLO-4	Presentation skills, Types of presentation, Structure of presentation, Delivery techniques	Creating brands–activity (posters, flyers, business cards)	Creative thinking skillsActivity session	Errors how to avoid in Nouns & Pronouns	Cause and Effect - Introduction
SLO-5	ExtemporePracticeSession I	Stress Management - CausesofStressandItsImpact	Brainstorming, use of group and individual brainstorming techniques to promote idea generation	Common Errors: Subject - verb Agreement	Cause and Effect – Practise Session
SLO-6	ExtemporePracticeSession II	HowtoManageStressand distress, Understanding the circle of control, stress busters	Intercultural communication – beliefs, customs and attitudes of people in different countries (US, UK, Japan, West Asia, China, Russia), Social and cultural etiquettes	Vocabulary - Synonyms - Antonyms - Phrasal verbs-	Theme detection – Introduction - Practice session
SLO-7	InterpersonalSkills, EmotionalIntelligence	Conflict Management - Conflict in human relations – reasons, Approaches to conflict resolution	Communicationetiquettes, Telephoneetiquettes	One Word Substitution - Homophones – Homonyms	Critical Reasoning and Verbal deduction
SLO-8	ImportanceofTeamWork, TeamBuilding activity	Conflict resolutions – Case studies	Icebreaking, Designingicebreakergames	Words often confused	Types of Critical Reasoning-Tips and Tricks
SLO-9	Leadershipskills, Leadershipskills -based activity	Importance of decision making, Process of decision making, Practical ways of decision making, weighing positives and negatives	Resume writing skills	Idioms and Idiomatic Expressions – Introduction	Word Analogy - Types of Word analogy

Resources			
1	Jeff Butterfield, Soft Skills for Everyone, CENGAGE, India,2015	5	Thomas A Harris, Iamok, you are ok, Arrow, London,2012
2	Dr. K. Alex, Soft Skills, S. Chand Publishing & Company, India, 2014	6	Daniel Coleman, Emotional Intelligence, Bloomsbury, India, 2016
3	Covey Sean, Seven habits of highly effective teens, Simon & Schuster, New York, 2014	7	Norman Lewis, Word Power Made Easy New Revised and Expanded Edition, Goyal publication, 2011
4	Carnegie Dale, how to win friends and influence people, Simonand Schuster, New York, 2016	8	Bhatnagar R P, English for Competitive Examinations, Trinity Press, 2016.

Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (100% weightage)							
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*	
		(20 %)		(20 %)		(30 %)		(30%)	
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	20	20	15	15	20	20	20	20
2	Understand	20	20	15	15	20	20	20	20
3	Apply	15	15	15	15	15	15	20	20
4	Analyze	15	15	15	15	15	15	20	20
5	Evaluate	15	15	20	20	15	15	10	10
6	Create	15	15	20	20	15	15	10	10
	Total (%)	100	100	100	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
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1	Mr. P. Chockalingam, Senior Lead Software Engineer, Virtusa Consulting Services Private Ltd, DLF IT Park SEZ, Chennai – 600089 p.chockalingam1986@gmail.com -	1	Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeetham, Coimbatore - 641112 g_saravanaprabu@cb.amrita.edu -	1	Dr. Sathish K, HOD, Department of Career Guidance Cell, FSH, SRMIST hod.dcgc.ktr@srmist.edu.in
				2	Mrs.Deepalakshmi S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST, deepalas@srmist.edu.in
				3	Dr. Sam Israel S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST, samisras@srmist.edu.in

SEMESTER - II

Course Code	ULT24AE2J	Course Title	Tamil – II	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	Tamil	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	சங்கஇலக்கியங்கள்வழிதொன்மைஅக, புறவாழ்வியலைஅறியச்செய்தல்
CLR-2	தமிழ்ச்சமூகத்தின்அறவியல்குறித்துதெரியச்செய்தல்
CLR-3	பக்திஇலக்கியங்கள்போதித்தமனிதமாண்புகளைஉணரச்செய்தல்
CLR-4	பண்டைத்தமிழ்ச்சமூகத்தின்தொல்இலக்கியங்கள்வளர்ச்சிபெற்றவரலாற்றைப்புரியச் செய்தல்
CLR-5	சிறுகதைகள்சொல்லும்வாழ்வியல்நெறி, மொழியின்நுட்பங்கள்ஆகியவற்றைத்தெரியச்செய்தல்

CLO	At the end of this course, learners will be able to:	Depth: Conceive	Design	Implement	Operate	Attainment: Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	PLO 1: Problem Solving, Critical Thinking, Creativity	PLO 2: Communication Skills, Collaborating Skills	PLO 3: Independent Thinking, Analytical Reasoning,	PLO 4: Leadership Qualities, Professionalism,	PLO 5: Digital Technology Skills	PLO 6: Value Inculcation, Multicultural inclusivity	PLO 7: Environmental Action, Community	PLO 8: Entrepreneurial Risk Taking	PSO - 1	PSO -2
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLO-1	பண்டைத்தமிழ்ச்சமூகத்தின்அக, புறவாழ்வியல்இன்றையசமூகமேம்பாட்டிற்குவழிகாட்டிநிற்பதைஅறிந்துகொள்ளுதல்	✓	✓	-	-	2	75	60	-	3	3	-	-	-	3	-	-	-
CLO-2	தமிழ்ச்சமூகம்அறத்தைவலியுறுத்தியசமூகம்என்பதன்வழிமானுடஅறத்தைத்தெரிந்து கொள்ளுதல்	✓	✓	✓	-	2	80	70	2	-	3	-	-	3	-	-	-	-
CLO-3	பக்திஇலக்கியம்மூலம்இறைத்தந்துவங்களைஅறிந்துமானுடஒற்றுமைமேம்பாட்டைஅறிந் துகொள்ளுதல்	✓	✓	✓	✓	2	70	65	-	3	-	3		1	-	-	-	-
CLO-4	தொல்தமிழ்ச்சமூகம்இலக்கியம், அரசியல், அறம், பக்திஆகியவற்றில்தழைத்தோங்கியதைத்தெரிந்துகொள்ளுதல்	✓	✓	✓	✓	2	70	70	3	-	3	-	-	3	-	-	-	-
CLO-5	வாழ்வியலின்நெறிகளைச்சொல்லும்கதைகளைப்படைக்கும்திறனோடுமொழிஆளுமை யையும்அறிந்துகொள்ளுதல்	✓	✓	✓	✓	3	80	70	3	-	-	2	-	-	-	3	-	-

Sessions	CLO – 1	CLO – 2	CLO – 3	CLO – 4	CLO - 5
	12	12	12	12	12
SLO-1	காலந்தோறும்தமிழ்அகத்திணைமரபு- உள்ளடக்கம்	சங்கமருவியகாலம் அறமும்வாழ்வியலும்	பல்லவர்காலஇலக்கியங்கள்	பண்டைக்காலத்தமிழகம் சங்ககாலமக்களின்வாழ்வியல்	தமிழ்ச்சிறுகதையும்தமிழ்ச்சமூகவாழ்வியலும்
SLO-2	எட்டுத்தொகைநூல்களும் பகுப்புமுறையும்	உலகப்பொதுமறை - திருக்குறள்கட்டமைப்பு	பக்தியும்தமிழும் - பக்திஇலக்கியத்தோற்றநிலை	முச்சங்கஅறிமுகமும் வரலாறும்	புதுமைப்பித்தன்- சங்குத்தேவனின்தர்மம்
SLO-3	ஐங்குறுநூறு – 375, 391	திருக்குறள்வான்சிறப்பு (2)	சைவசமயஇலக்கியங்கள் - சைவக்குரவர்நால்வர்	சங்கஇலக்கியப்பாடுபொருளும்வடிவமும்	ந. பிச்சமூர்த்தி – வேப்பமரம் - மரபும்நம்பிக்கைகளும்
SLO-4	குறுந்தொகை – 02, 03	திருக்குறள் – புலவிநுணுக்கம் (132) -	தேவாரம் – திருஞானசம்பந்தர்- 2834 திருநாவுக்கரசர் - 4262	எட்டுத்தொகைநூல்களின்வரலாறும்கட்டமைப்பும்	தமிழருவிமணியன் – ஒற்றைச்சிறகு - உறவின்மேன்மை
SLO-5	அகநானூறுநூல்கட்டமைப்பு	தமிழ்இலக்கியமரபில்நீதிஇலக்கியங்கள்	திருவாசகம்- மாணிக்கவாசகர்ஆனந்தபரவசம் – பாடல் 10	பத்துப்பாட்டுநூல்களின்வரலாறும்வாழ்வியலும்	ஆர். சூடாமணி – மூடநம்பிக்கை.

SLO-6	அகநானூறு -238	நாலடியார் வைகலும்- பாடல்எண் 39	வைணவசமயவளர்ச்சிப்போக்கு	பதினெண்கீழ்க்கணக்கும்தமிழர்அறமரபும்	கிருஷ்ணாடாவின்ஸி – காலாஅருகேவாடா
SLO-7	கலித்தொகை – 11	நீதிஇலக்கியத்தில்மருந்துநூல்கள்	நாலாயிரத்திவ்யப்பிரபந்தம் குலசேகராழ்வார்பாடல் - 678	பதினோருநீதிஇலக்கியங்கள்	மொழிப்பயிற்சி சொற்களை உருவாக்குதல்
SLO-8	தமிழர்புறமரபு- புறநானூறு-107	சிறுபஞ்சமூலம் -64	ஆண்டாள்பாடல் – 574. திருமழிசைஆழ்வார்பாடல்	காப்பியஇலக்கணம் - காப்பியங்களின்வகைமை	எழுத்துகளில்இருந்து சொற்களைக்கண்டுபிடித்தல்
SLO-9	புறநானூறு -110, 112	பழமொழிநானூறுஅறிமுகம் – தனித்தன்மைகள்	தமிழில்இஸ்லாமிய இலக்கியங்கள்	ஐம்பெருங்காப்பியங்கள்	படம்பார்த்துக்கதைஎழுதுதல்
SLO-10	பத்துப்பாட்டும்ஆற்றுப்படைநூல்களும்	பழமொழிநானூறு - 184	சீறாப்புராணம் - விடமீட்டப்படலம் -10 பாடல்கள்	தமிழ்ச்சமூகமும்சமயத்தத்துவங்களும்	படம்பார்த்துக்கவிதைஎழுதுதல்
SLO -11	சிறுபாணாற்றுப்படை: 84-115	பண்டைக்காலப்போரும் வாழ்வும் - புறம்	தமிழில்கிறித்தவ இலக்கியங்கள்	பன்னிருதிருமுறை – அறிமுகம், வரலாறு	கற்பனையும்படைப்பும் - தமிழில்வாசகம்
SLO -12	பட்டினப்பாலை: 40-50	களவழிநாற்பது - 40	கிறித்துவின்அருள்வேட்டல் – திரு.வி.க. அலகிலொளி- 5 பாடல்	நாலாயிரத்திவ்வியப்பிரபந்தம் – அறிமுகம், வரலாறு	விளம்பரத்திற்குவாசகம் எழுதுதல்

Resources			
1	கொன்றை, தொகுப்பும்பதிப்பும் - தமிழ்த்துறைஆசிரியர்கள், தமிழ்த்துறை, எஸ். ஆர்.எம். அறிவியல்மற்றும்தொழில்நுட்பக்கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2023	4	தமிழண்ணல், புதியநோக்கில்தமிழ்இலக்கியவரலாறு, மீனாட்சிபுத்தகநிலையம், மதுரை, 2017
2	மு. அருணாசலம், தமிழ்இலக்கியவரலாறு, நூற்றாண்டுமுறை(9ஆம்நூ. முதல் 16 வரை), திபார்க்கர், சென்னை, 2005	5	தமிழ்இலக்கியத்தொடரடைவு – http://tamilconcordance.in/
3	மதுரைதமிழ்இலக்கியமின்தொகுப்புத்திட்டம் - https://www.projectmadurai.org/	6	தமிழ்இணையக்கல்விக்கழகம் - http://www.tamilvu.org/

Assessment										
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
		(10 %)		(10 %)		(20 %)		(10%)		
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1	Remember	15	15	15	15	10	10	10	10	15
2	Understand	15	15	15	15	10	10	10	10	15
3	Apply	20	25	25	20	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10
6	Create	15	10	10	15	15	15	15	15	10
Total (%)		100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
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				4	Dr. T.R. Hebzibahbeulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
				5	Dr.S. Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

Course Code	ULH24AE2J	Course Title	Hindi – II	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	Hindi	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	They get to learn Ancient, Medieval, and Modern poetry
CLR-2	To understand the Significance of poems of great poets like Kabir, Tulsidas,Bihari and Dhananand
CLR-3	To Enhance and Enrich their knoeledge through poetry
CLR-4	Media based understanding for employability
CLR-5	Job Oriented writing skills

CLO	At the end of this course, learners will be able to:	Depth: Conceive	Depth: Design	Depth: Implement	Depth: Operate	Attainment: Bloom's Level of Thinking	Attainment: Expected Proficiency (%)	Attainment: Expected Attainment (%)	PLO 1: Problem Solving, Critical Thinking, Creativity Solving	PLO 2: Communication Skills, Collaborating Skills	PLO 3: Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	PLO 4: Leadership Qualities, Professionalism, Autonomy, Accountability	PLO 5: Digital Technology Skills	PLO 6: Value Inculcation, Multicultural inclusivity	PLO 7: Environmental Action, Community Engagement	PLO 8: Entrepreneurial Risk Taking	PLO 9: PSO - 1	PLO 10: PSO -2
CLO-1	They get to learn Ancient, Medievaland Modern poetry	✓	✓	-	-	2	85	75	3	2	3	-		2	-	-	-	-
CLO-2	To understand the Significance of poems of great poets like Kabir, Tulsidas, Bihari and Dhananand	✓	✓	✓	-	2	85	75	3	-	2	-	3	-	3	-	-	-
CLO-3	To Enhance and Enrich their knoeledge through poetry	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-
CLO-4	Media based understanding for employability	✓	✓	✓	✓	3	85	75	2	-	2	3			2	-	-	-
CLO-5	Job Oriented writing skills	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-

Sessions	CLO - 1	CLO - 2	CLO – 3	CLO - 4	CLO – 5
	12	12	12	12	12
SLO-1	BHAKTI KALIN KAVITA	RITI KALIN KAVITA	ADHUNIK KAVITA	VIGYAPAN	PATRA LEKHAN & PARIBHASHIK SHABDAVALI
SLO-2	BHAKTIU KALIN KAITA KI AVADHARNA	AVADHARNA EVM SAWROOP	AVADHARNA EVM SAWROOP	AWADHARNA EVM SAROOP	AVADHARNA EVM SAROOP
SLO-3	SWARUP EVM MAHATWA	RITI KAL VIBHAJAN	MAHATVA EVM UDDESHYA	ARTH EVM PARIBHASHA	ARTH EVM PARIBHASHA

SLO-4	BHAKTIKAL KI PRASANGIKTA	MAHATVA EVM UDDESHYA	MATHLI SHARAN GUPT-NAR HO NA NIRASH KARO MAN KO	VIGYAPAN KE PRAKAR	PRAYOJAN EVM PRYOG
SLO-5	DOHE- KABIRDAS	DOHE- BIHARI	KAVI PARICHAYA EVM KAVITA KA VISHLESHAN	VIGYAPAN KI VISHESHTAYEN	PRAKAR EVM MAHATVA
SLO-6	SANT PARICHAY	KAVI PARICHAYA	SURYAKANT TRIPATHI NIRALA- VAR DE VEENAVADINI VAR DE	VIGYAPAN KA MAHATVA	VYAKTIGAT PATRA
SLO-7	DOHE KA VISLESHAN	DOHE KA VISLESHAN	KAVI PARICHAYA EVM VISHLESHAN	VIGYAPAN KI BHASHA	AUPCHARIK PATRA
SLO-8	GURU KA MAHATVA	DOHE- GHANANAND	NAGARJUN-- AKAL AUR USKE BAD	VIGYAPAN AUR ROZGAR	PARIBHASHIK SHABDAVALI
SLO-9	DOHE- TULSHIDAS	SNEH KI SARLTA KA VARNAN	AKAL KA VASHTAVIK CHITRAN	PRINT EVM ELECTRONIC VIGYAPAN	SHABDAVALI KI AVSHYAKTA
SLO-10	DOHE KA VISLESHAN	PREM KA MAHATVA	KATTIS- BADRINARAYAN	VIGYAPAN KI VYAPAKTA	KARYALYIN SHABDAVALI
SLO-11	DAYA KA MAHATVA	GHANANAND KI KAVYA SHAILI KA MAHATVA	SAMBAND VICCHED KI PARICHARCHA	VIGYAPANLEKHAN KI KALA	EK DIN EK SHABD
SLO-12	RAM KI MAHIMA	DHOHA PARICHARCHA	KAVYA PARICHARCHA	UDDESHYA	HINDI SE ANGREJI AUR ANGREJI SE HINDI SHABD

Resources			
1	“Samanya Hindi”, Srijonlok Publication, 2023, New Delhi.	4	Bhakti Andolan Aur Surdas Ka Kavya – Manager Pandey
2	Kabir – Hazari Prasad Dwedi	5	Bihari – Vishvnath Prasad Mishr
3	Surdas – Ram Chandra Shukl	6	Aadhunik Vigyapan Aur Jansampark – Taresh Bhatia

Assessment										
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
		(10 %)		(10 %)		(20 %)		(10%)		
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1	Remember	15	15	15	15	10	10	10	10	15
2	Understand	15	15	15	15	10	10	10	10	15
3	Apply	20	25	25	20	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10
6	Create	15	10	10	15	15	15	15	15	10
	Total (%)	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
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				3	Dr. S. Razia Begum, Assistant Professor, SRM IST raziabes@srmist.edu.in
				4	Dr. NishaMurlidharan Assistant Professor, VDP, SRM IST Murulidharan- nishamup@srmist.edu.in

Course Code	ULF24AE2J	Course Title	French – II	Category	A	Ability Enhancement Course	L	T	P	C
							2	0	2	3

Course Offering Department	French	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Strengthen the language of the students both in oral and written
CLR-2	Express their sentiments, emotions, and opinions, reacting to information, situations
CLR-3	Make them learn the basic rules of French Grammar.
CLR-4	Develop strategies of comprehension of texts of different origin
CLR-5	Enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity Solving	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO - 1	PSO -2
CLO-1	To acquire knowledge about French language	✓	✓	-	-	2	85	75	3	2	3	-	-	2	-	-	-	-
CLO-2	To strengthen the knowledge on concept, culture, civilization, and translation of French	✓	✓	✓	-	2	85	75	3	-	2	-	3	-	3	-	-	-
CLO-3	To develop content using the features in French language	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-
CLO-4	To interpret the French language into other language	✓	✓	✓	✓	3	85	75	2	-	2	3	-	-	2	-	-	-
CLO-5	To improve the communication, intercultural elements in French language	✓	✓	✓	✓	3	85	75	-	3	-	3	3	2	-	-	-	-

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO - 4	CLO - 5
	12	12	12	12	12
SLO-1	Temps libre	Le pronomindéfini on	Vendre	Il faut	Les gallicismes
SLO-2	Les loisirs	Les adjectifsinterrogatifs	Acheter	Le verbe devoir	Les pronoms personnels COI
SLO-3	Les moments de la journée	Les prépositions avec les noms géographiques	Les aliments	Le verbepouvoir	Le pronom Y
SLO-4	Les matières scolaires	Les verbes prendre et sortir	Les emballages	Le verbevouloir	Des pronomscompléments

SLO-5	Les activités quotidiennes, Les quotidiennes	Les sons	Les quantités	Demander et dire le prix	Les nombresordinaux
SLO-6	Le temps, L'heure	Parler de ses gouts	Les commerces	Faire des achats	Les verbes écrire et voir
SLO-7	La fréquence	Parler de sespréférences	Les commerçants	Les activités	Le E caduc ou instable
SLO-8	Les sons [u], Les sons [y]	Parler de sa routine	L'impératif	Les activités	Présentersesvœux
SLO-9	L'heure, Quelle heure est-il ?	A la recherche d'un cadeau	Les articles partitifs	Mots et expressions	Présentersesfélicitations
SLO-10	Les pronoms personnels COD	Temps libre	Très ou beaucoup (de)	Communication	Répondre à une invitation
SLO-11	Les pronominaux, Se promener, se coucher etc…,	Mots et expressions	Le pronom en (la quantité)	Les sorties	Écrire un message amical
SLO-12	Les verbes du premier groupe, Parler, Demander, Poser	Grammaire– Communication	La phrase négative (2	Les fêtes	Parler au téléphone

Resources			
1	"La Nouvelle Génération-AI" Méthode de français, Marie-Noëlle COCTON, P. DAUDA, L. GIACHINO, C. BARACCO, Les éditions Didier, Paris, 2018.	4	https://www.elearningfrench.com/learn-french-grammar-online-free.html
2	Cahier d'activités avec deux discs compacts.	5	https://www.lawlessfrench.com/grammar
3	https://www.fluentu.com/blog/french/french-grammar	6	https://blog.gymglish.com/2022/12/15/basic-french-grammar

Assessment										
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*		
		(10 %)		(10 %)		(20 %)		(10%)		
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)
1	Remember	15	15	15	15	10	10	10	10	15
2	Understand	15	15	15	15	10	10	10	10	15
3	Apply	20	25	25	20	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10
6	Create	15	10	10	15	15	15	15	15	10
	Total (%)	100	100	100	100	100	100	100	100	100

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi)Presentation of Research Work in Conferences, (vii) Assignments

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
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2	Mr. Shrivathsan S, Journalist, Senior Sports Reporter/Sub-Editor, Times of India, Chennai shrivathsangilramhanga@gmail.com			2	Miss. Abigail A, Assistant Professor, SRMIST, VDP abigaila@srmist.edu.in
				3	Mrs.M. Mahalakshmi, Assistant Professor, SRMIST, RMP mahalakm2@srmist.edu.in

Course Code	UCY24201J	Course Title	Chemistry of s and p - Block Elements	Category	C	Core	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			Programme Learning Outcomes									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	Explore the general principles of s-block elements in Metallurgy																	
CLR-2	Utilize the general properties of s-block elements in Industry																	
CLR-3	Acquire knowledge on metals and non-metals to prepare different alloys																	
CLR-4	Address the physical and chemical properties of p-block elements																	
CLR-5	Employ the basic nuclear chemistry principles for modern science advancement																	

CLO	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Explore the general principles of metallurgy	✓	✓	✓	-	2	75	75	3	3	-	-	-	2	-	-	-	-
CLO-2	Perceive the importance of periodicity of the s-block elements	✓	✓	✓	-	2	75	70	-	3	-	-	-	3	-	-	2	-
CLO-3	Apply the chemical properties of alkali and alkaline earth metals	✓	✓	✓	✓	3	75	75	-	-	3	3	2	-	-	-	-	-
CLO-4	Gaining the knowledge about hydrides, oxides and oxoacids of p-block elements	✓	✓	✓	✓	3	75	60	3	-	-	3	-	-	-	-	3	-
CLO-5	Design and develop industrially valuable p-block element compounds	✓	✓	✓	✓	3	75	70	-	3	-	3	-	-	-	-	-	3

	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	Introduction	Alkali metal compounds	Alkaline earth metal compounds	p-Block elements-I	p-Block elements-II
	15	15	15	15	15
SLO-1	General principles of metallurgy	Relationship between lattice energy, hydration energy and solubility	Thermal stability of salts of alkaline earth metals	Hydrides of Group 13, hydrides of Group 14, Trend of thermal stability of hydrides of alkali metal compounds	Halides of silicon, halides of phosphorus.

SLO-2	Electrolytic reduction, chief modes of occurrence of metals based on standard electrode potentials.	Trend of thermal stability of oxides, hydroxides, peroxides of alkali metal compounds.	Solubility of salts of alkaline earth metal compounds	Hydrides of Group 15 (EH3 where E = N, P).	Preparation, structure, and uses of borazine.
SLO-3	Hydrometallurgy with reference to cyanide process for silver and gold.	Trend of thermal stability of carbonates and nitrates of alkali metal compounds.	Important alkaline earth metal compounds, structure and uses of beryllium nitrate	Hydrides of Group 15 (EH3 where E = As, Sb, Bi).	Preparation and structure of silicates. preparation, structure, properties, and uses of silicones.
SLO-4-5	Laboratory: Lab introduction, safety measures	Laboratory: Acid-base titrations: principles estimation of sodium carbonate using standardized HCl	Laboratory: Estimation of carbonate and bicarbonate present together in a mixture	Laboratory: Oxidation-reduction titrimetry: estimation of oxalic acid using standardized KMnO4	Laboratory: Estimation of Fe (II) with K2Cr2O7 using internal indicator (diphenylamine, N-phenylanthranilic acid)
SLO-6	Methods of purification of metals, electrolytic process	Trend of thermal stability of sulfates and halides of alkali metal compounds.	EDTA complexes of Ca and Mg, determination of hardness.	Hydrides of Group 16.	Preparation and properties of phosphonitrilic halides {(PNCl2) n where n = 3 and 4}.
SLO-7	vanArkel-de Boerprocess, Zonerefining	Structure and importance of alkali metal compounds	Chemistry of p-block elements: electronic configuration, atomic and ionic size, metallic/non-metallic character, melting point	Hydrides of Group 17.	Structure and uses of phosphonitrilic halides {(PNCl2) n where n = 3 and 4}
SLO-8	Chemistry of s-block elements: general characteristics, melting point and flame colour	Coordination complexes of Li, anomalous behaviour of Li, diagonal relationship of Li with Mg	Electronegativity, catenation, ionization enthalpy, electron gain enthalpy	Oxides of phosphorus.	Preparation, structures, uses, and properties of Interhalogen compounds.
SLO-9-10	Practice: Preparation of solutions of titrants of different Molarity/Normality.	Laboratory: Estimation of carbonate and hydroxide present together in a mixture	Laboratory: Estimation of amount of chloride content of a water sample	Laboratory: Estimation of Hardness of water using EDTA	Laboratory: Estimation of Fe(II) with K2Cr2O7 using external indicator.
SLO-11	Trend of atomic size, ionization energy, density, reducing power, melting and boiling points	Crown ethers, cryptands	Allotropy of C, P and S, inert pair effect	Oxides of sulphur and chlorine	Preparation, structures, uses, and properties of pseudohalogen compounds,
SLO-12	Reactions of alkali earth metals with oxygen, hydrogen and nitrogen.	Properties of alkali metals in liquid ammonia, biological importance of alkali metals	Diagonal relationship between B, Si and anomalous behaviour of first member of each group.	Peroxoacids of sulphur	Preparation and properties of Clathrate compounds of noble gases, structure, and uses of clathrate compounds of noble gases.

SLO-13	Reactions of alkali earth metals with water and liquid ammonia.	Chemical and periodic properties of alkaline earth metals.	Structure, bonding and properties: acidic/basic nature, stability.	Ionic/covalent nature, oxidation/reduction, hydrolysis, action of heat of hydrides	Preparation and properties of xenon fluorides, structure and uses of xenon fluorides, MO treatment of XeF2.
SLO-14-15	Practice: Repeat of experiments	Laboratory: Oral examination	Laboratory: Repeat of experiments	Laboratory: Estimation of Fe(II) with KMnO4 using internal/external indicator.	Laboratory: Repeat of experiments

Resources			
1	J. D. Lee, Concise Inorganic Chemistry, Fifth Ed., Wiley India 2006.	5	J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry-Principles of Structure and Reactivity, Pearson Education 2009.
2	B.E. Douglas, D. H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Ed., John Wiley & Sons, Inc. 1993.	6	P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, and F.A. Armstrong, Shriver and Atkins' Inorganic Chemistry, 5th Ed. W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010 2010. www.whfreeman.com.
3	L. G. Miessler, J. P. Fischer, D. A. Tarr, Inorganic Chemistry, 5th Ed., Pearson, 2014.	7	P.L. Soni, Textbook of Inorganic Chemistry, Mohan Katyal, Sultan Chand & Sons Publishers 2006.
4	S. Prakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I, Sultan Chand & Sons Publishers 2008.	8	Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, 5th Ed., Longman Scientific & Technical, England, (John Wiley and Sons Inc, 605 Third Avenue, NewYork NY 10158).

Assessment											
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)	
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*			
		(10 %)		(10 %)		(20 %)		(10%)			
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	15	15	15	15	10	10	10	10	15	15
2	Understand	15	15	15	15	10	10	10	10	15	15
3	Apply	20	25	25	20	25	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10	10
6	Create	15	10	10	15	15	15	15	15	10	10
	Total (%)	100	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	-	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	-	Gender Equality	✓
		Debate	-		
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi)Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Ravikiran Allada, Director, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka Email: Ravikiran.Allada@Steri-science.com	1	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. Rajorshi Das, Department of Chemistry, SRMIST Email: rajorshd@srmist.edu.in
2	Dr. Sudarshan Mahapatra, General Manager at EncubeEthicals Private Limited, Mumbai, Maharashtra, Email Id: sudarshan.m@encubeethicals.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24202J	Course Title	Functional Groups in Organic Chemistry and Spectroscopy	Category	C	Core courses	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			Programme Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	Gain knowledge on the importance of functional groups																	
CLR-2	Acquire knowledge of alcohols, ethers, thiols, phenols, and reaction mechanism																	
CLR-3	Promote the importance of carbonyl, carboxylic acid, and 'N' containing functional groups																	
CLR-4	Acquire knowledge regarding NMR and FTIR spectroscopy and analysis																	
CLR-5	Acquire knowledge in the fundamentals of mass spectroscopy																	

CLO	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Understand the basic concepts of functional groups	✓	✓	✓	-	3	85	75	3	-	3	-	-	3	-	-	-	-
CLO-2	Gain knowledge about the alcohol and organic reaction mechanism	✓	✓	✓	-	3	85	70	3	-	3	-	-	-	-	-	2	-
CLO-3	Understand the importance of diverse chemistry of carbonyl, carboxylic acid, and 'N' containing compounds	✓	✓	✓	✓	4	85	70	3	-	-	-	-	3	-	-	-	3
CLO-4	Apply the concepts of NMR and FTIR spectroscopy to apply on unknown organic compounds	✓	✓	✓	✓	4	85	70	3	-	3	-	2	-	-	-	3	-
CLO-5	Acquaint the fundamental concepts of mass spectroscopy to analyze organic compounds	✓	✓	✓	✓	4	85	60	3	-	3	-	-	-	-	-	-	3

Sessions	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	Functional alcohols and reaction mechanism	Functional carbonyl and reaction mechanism	Functional carboxylic acid, "N" containing reaction mechanisms	Fundamentals of NMR and FTIR spectroscopy	Fundamentals of Mass spectroscopy
	15	15	15	15	15
SLO-1	Introduction of functional group: Alcohols: 1°, 2°, 3° alcohols.	Aldehyde and ketone: Polarization of carbonyl bond and its reactivity,	Carboxylic Acid: Mono and dicarboxylic acids reactions properties;	Introduction of FTIR: Basic principles and uses	Mass spectrometry: Basic principles: Molecular ions and Metastable ions Reactions of ions in gas phase

SLO-2	Synthesis and reactions of diols, triols, and thiols.	Synthesis using oxidation reactions, reduction, and hydration reactions.	Amines: Preparation and Physical properties; Basicity of amines; Effect of substituent Solvent and steric effects;	FTIR: Absorption of light and spectral properties IR active/inactive bonds, selection rules Modes of stretching, and bending vibrations.	Effect of isotope; Isotope abundances; Nitrogen rule, Determination of molecular formula and Fragmentations.
SLO-3	Acidity and reactivity of thiols and Phenols.	Tautomerization; Schiff base formation and their stability, Reduction of the carbonyl group to alkane and alcohol.	The distinction between 1o, 2o, and 3o amines using Hinsberg‟s and nitrous acid method,	FTIR: Stretching/bending frequency of alkanes, alkenes, alkynes, aromatic rings,	Fragmentation of organic compounds Instrumentation: Various methods of ionization
SLO-4-5	Practice: Introduction and safety measures: Distillation at normal pressure: Single and mixture of compounds	Practice: Isolation of natural product: caffeine from tea leaves	Practice: Orthogonal protection of amine and acid functional groups	Practice: Multistep synthesis: Cyclohexanone → cyclohexanone oxime → caprolactone	Practice: Multicomponent synthesis: Mannich reaction
SLO-6	Reaction Mechanism: Reimer–Tiemann, Kolbe's–Schmidt and Vilsmeier–Haack reaction.	Addition of Grignard and Gilman reagents.	Preparation and reactions of acid chlorides, esters, and amides.	Functional group identification of organic compounds (Ex. Carbonyl, carboxylic acids, Amine, Nitro, Cyano, isocyanate groups)	Mass spectral fragmentation of organic compounds with common functional groups.
SLO-7	Fries and Claisen rearrangements with mechanism	Reaction Mechanism: Aldol condensation, Cannizzaro reaction, Benzoin condensation. .	Comparative study of nucleophilic substitution in acyl group Mechanism of acidic and alkaline hydrolysis of esters.	Introduction of NMR: Basic principles and uses: Effect of external magnetic field on the population and correlation with field strength.	Molecular ion peak; metastable peaks.
SLO-8	Ethers: synthesis and properties; Williamson ether synthesis.	Knoevenagel condensation and Claisen–Schmidt condensation.	Gabriel Phthalimide Synthesis, Hoffmann Bromamide reaction, Carbylamine Reaction, Hoffmann's exhaustive methylation and elimination reaction.	1H NMR: Chemical shifts, dependency on the external field; Shielding, deshielding. and scale.	Rules of fragmentation of different functional factors controlling fragmentation.
SLO-9-10	Practice: Distillation at reduced pressure: Single and mixture of compounds	Practice: Piperene from black pepper	Practice: Oxidation of alcohol: Benzyl alcohol → benzyl aldehyde	Practice: Chalcone → chalcone dibromide → Isozazole	Practice: Green chemistry: Direct Oxidative esterification of Aldehyde
SLO-11	Synthesis and hydrolysis of t-butyl ethers.	Mannich reaction, Stork enamine reactions, Wittig reaction, and α-substitution reactions	Reactions of hydroxy and unsaturated acids Succinic/phthalic acid, Lactic, maleic acid Tartaric, citric acids Maleic and fumaric acids.	NMR: Chemical shifts of protons attached to functional groups; Multiplicity of signals, calculation of coupling constants.	General principles and ionization of alcohol, Amines, halides, and carbonyls.

SLO-12	Epoxide: synthesis, opening in the presence and absence of Lewis acid.	Oxidations and reductions: Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, PDC, and PCC)	Nitriles and Isonitriles: Nomenclature and uses; dehydration of amides, and aldoximes, Thorpe Nitrile Condensation with mechanism.	Introduction of 13C NMR and Multiplicity of signals, chemical shifts.	Alpha cleavage of triethylamine, McLafferty rearrangements, and McLafferty rearrangement of 4-methyl-2-pentanone.
SLO-13	Reactions of epoxides with alcohols, ammonia derivatives, and LiAlH4.	Addition reactions of unsaturated carbonyl compounds: Michael addition	Carbylamine reaction for isonitrile, substitution in alkyl halides, and dehydrogenation of N-substituted formamides	NMR spectrum of compounds with symmetry: Basics of COSY and NOESY NMR spectrum.	Cyclotron analyser, HRMS and Applications
SLO-14-15	Practice: Separation using column chromatography-melting point measurement	Practice: Extraction of Eugenol from Cloves	Practice: Reduction of carbonyl compound: 4-nitrobenzaldehyde → 4-nitrobenzyl alcohol	Practice: Benzophenone → benzopinacol → benzopinacolone	Practice: Organic synthesis in water

Resources			
1	R.T. Morrison and R.N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th edition, Pearson India, 2011.	5	J. Clayden, N. Greeves, and S. Warren, Organic Chemistry (Second Edition) Oxford publication 2012.
2	I. L. Finar, Organic Chemistry, Vol. 1, 6th edition, Pearson Education India 2002.	6	Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc 2017.
3	W. Kemp, Organic Spectroscopy, Palgrave Macmillan, 1991.	7	M-M. Cid, J. Bravo, Structure Elucidation in Organic Chemistry: The search for the right tools, Wiley-VCH, 2015.
4	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, Practical Organic Chemistry, 5th Ed., Pearson, 2012.	8	V. K. Ahluwalia, R. Aggarwal, Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2000.

Assessment											
		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)	
		CLA – 1		CLA – 2		CLA – 3		CLA – 4*			
		(10 %)		(10 %)		(20 %)		(10%)			
	Bloom's Level of Thinking	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	15	15	15	15	10	10	10	10	15	15
2	Understand	15	15	15	15	10	10	10	10	15	15
3	Apply	20	25	25	20	25	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10	10
6	Create	15	10	10	15	15	15	15	15	10	10
	Total (%)	100	100	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	-	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	-	Gender Equality	✓
		Debate	-		
		Interactive Lecture	✓		
		Brainstorming	✓		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
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2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP), Steriscience (Strides), Bengaluru, Karnataka, Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram, sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24203T	Course Title	Chemical Kinetics and Surface Chemistry	Category	C	Core	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Understand the fundamental principles governing reaction rates and kinetics
CLR-2	Analyze and interpret complex reaction mechanisms in chemical processes
CLR-3	Apply kinetic principles to real-world scenarios in industry, environment, and biology
CLR-4	Investigate surface chemistry phenomena such as adsorption and catalysis
CLR-5	Integrate theoretical knowledge with practical experimentation for comprehensive understanding.

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Quantify and analyze reaction rates using rate laws and experimental data	✓	✓	✓	-	3	85	75	3	-	3	-	-	-	2	-	-	-
CLO-2	Identify and propose plausible reaction mechanisms for various chemical processes	✓	✓	✓	-	3	85	70	3	-	-	-	-	3	-	-	2	-
CLO-3	Apply kinetic principles to predict and explain the behavior of chemical systems in diverse contexts	✓	✓	✓	✓	4	85	70	3	-	3			-	-	-	-	2
CLO-4	Demonstrate proficiency in experimental techniques for studying surface chemistry phenomena	✓	✓	✓	✓	4	85	70	3	2	-	-	-	-	-	-	3	-
CLO-5	Integrate theoretical understanding with practical skills to solve complex problems in chemical kinetics and surface chemistry	✓	✓	✓	✓	4	85	60	-	3	-	2	-	-	-	-	-	3

	CLO-1	CLO-2	CLO-3	CLO-4	CLO-5
	Fundamentals of Chemical Kinetics	Theories of reaction rates	Kinetics of photochemical reactions	Kinetics of catalytic reactions	Surface Chemistry
	12	12	12	12	12
SLO-1	Basics of chemical kinetics, integrated rate laws for zero, first and second-order reactions, and pseudo-first-order reactions	collision theory of bimolecular gaseous reactions	Consequences of light absorption: The Jablonski diagram	Characteristics of catalytic reactions	Surface Chemistry - Introduction Adsorption by solids Chemisorption
SLO-2	nth order reaction, Determination of order of a reaction: Half-life method, integrated rate law method, isolation and initial rate method,	Activated complex theory (ACT) of bimolecular gaseous reactions	Photochemical reactions, photochemical rate law	general catalytic mechanisms, acid-base catalysis	Adsorption of gases by solids Calculate the volume of the gas
SLO-3	Factors affecting the rate of a reaction. concentration, pressure, catalyst	Eyring's equation	kinetics of hydrogen-chlorine reaction, kinetics of hydrogen-bromine reaction		Factors influencing adsorption
SLO-4	Tutorial: Exercise on rate laws	Tutorial: Exercise on the application of collision theory and ACT to different reactions	Tutorial: Solving problems on the kinetics of photochemical reactions	Tutorial: Solving problems related to kinetics of catalytic reactions	Tutorial: Solving problems related to fundamentals of adsorption
SLO-5	Effect of temperature on reaction rates, Arrhenius equation	Theories of unimolecular gaseous reactions, Lindemann's theory	Kinetics of decomposition of HI	Enzyme catalysis, mechanism	The Langmuir theory of adsorption
SLO-6	Kinetics of complex reactions: Kinetics of opposing reactions	Hinshelwood theory	Energy transfer in photochemical reactions: photosensitization and quenching	catalysis by Kinetics of enzyme-catalyzed reactions	The Freundlich adsorption isotherm
SLO-7	Kinetics of consecutive reactions	Kinetics of reactions in solution: diffusion-controlled reactions in solution	Quenching of fluorescence: Stern-Volmer equation	influence of The Michaelis-Menton equation	The BET theory of multilayer adsorption, Derivation of the BET equation
SLO-8	Tutorial: Solving problems on kinetics of complex reactions	Tutorial: Solving problems on theories of reaction rates	Tutorial: Solving problems using the Stern-Volmer equation	Tutorial: Solving problems related to kinetics of enzyme catalysis	Tutorial: Practice on different types of BET isotherms
SLO-9	Kinetics of parallel	Calculation of ionic strength	Life time of an exited state		Adsorption from solution and

	reactions, Kinetics of chain reaction	in a solution		Heterogeneous catalysis: kinetics of surface reactions	
SLO10	Mechanism of complex reactions: equilibrium approximation, steady-state approximation	Influence of ionic strength on reaction rates, primary and secondary salt effects on reaction rate in ionic reactions	Rates of intramolecular photophysical processes	HeterogeneoKinetics of unimolecular surface reactions	Insoluble surface films on liquids
SLO11	Application of steady-state approximation to different reaction mechanisms	Influence of solvent on reaction rates	Rate of intermolecular energy transfer	pH-dependence of rate constants of catalyzed reactions	Langmuir monolayer adsorption isotherm
SLO12	Tutorial: Solving problems on kinetics of complex reactions and their mechanism	Tutorial: calculation of ionic strength of solutions	Tutorial: Solving problems on kinetics of photochemical reactions	Tutorial: Solving problems on kinetics of heterogeneous catalysis	Tutorial: solving problems on adsorption from solution and monolayer adsorption isotherm

Resources			
1	P.W. Atkins, L.L. Jones, Chemical Principles: The Quest for insight. H. Freeman and Company, New York, 2010	3	B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, New Delhi ShobanLal Nagin Chand and Co, 35th edition, 2013
2	P. W. Atkins, J. De Paula, Physical Chemistry, Oxford University Press, Oxford, 9th Edition, 2010	4	P.C. Hiemenz, Principles of colloids and surface chemistry, Marcel Dekker NC, 2ndEd., 1986

Assessment							Strategies					
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)	Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA – 3	CLA – 4*		Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)	(10 %)	(20 %)	(10%)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	15	15	10	10	15			Debate	✓		
2	Understand	15	15	10	10	15			Interactive Lecture	✓		
3	Apply	20	25	25	25	25			Brainstorming	✓		
4	Analyze	20	25	25	25	25						
5	Evaluate	15	10	15	15	10						
6	Create	15	10	15	15	10						
	Total (%)	100	100	100	100	100						

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra, General Manager at EncubeEthicals Private Limited, Mumbai, Maharashtra, sudarshan.m@encubeethicals.com	1	Prof. G. Sekar, Department of Chemistry, IIT Madras , gsekar@iitm.ac.in	1	Dr. Srinivasarao Kancharla, SRMIST Email: srinivak5@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP), Steriscience (Strides), Bengaluru, Karnataka, Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram, sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCD24V01T	Course Title	Essentials of Artificial Intelligence	Category	V	Value Added Course	L	T	P	C
							1	0	0	1

Course Offering Department	Computer Applications	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			Programme Learning Outcomes									
CLR-1	Study the basics of designing intelligent agents that can solve general purpose problems	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Discover appropriate AI methods to solve a given problem	Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO- 1	PSO- 2
CLR-3	Perform intellectual task as decision making, problem solving, perception, understanding																	
CLR-4	Formalize a given problem using different AI methods																	
CLR-5	Provides adaptive learning																	
CLO	At the end of this course, learners will be able to:																	
CLO-1	Demonstrate fundamental understanding of the history of artificial intelligence and its foundations	✓	✓	-	-	2	85	75	3	-	-	1	2	1	-	-	-	1
CLO-2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	✓	✓	✓	-	2	85	75	2	-	1	-	2	2	-	1	-	1
CLO-3	Identify systems with Artificial Intelligence. evaluation of different algorithms on a problem formalization	✓	✓	✓	✓	3	85	75	2	2	2	-	2	1	-	1	-	2
CLO-4	Use classical Artificial Intelligence techniques, such as search algorithms	✓	✓	✓	✓	3	85	75	3	-	2	-	2	2	-	2	-	-
CLO-5	Ability to apply Artificial Intelligence techniques for problem solving.	✓	✓	✓	✓	3	85	75	2	2	-	-	2	-	-	-	-	-

Sessions	CLO – 1	CLO – 2	CLO - 3	CLO - 4	CLO – 5
	Introduction to Artificial Intelligence	Logical Reasoning and First order logic	Unification and State Space Search	Planning Graphs	Probability Theory and Temporal Models
	3	3	3	3	3
SLO-1	Introduction to Artificial Intelligence, History of Artificial Intelligence- AI models,	Logical Reasoning- Introduction- Knowledge Representation	Unification and Conditions, Unification algorithm	Partial-order planning, planning graphs	Probability Theory, Uncertain Knowledge, Axioms of probability.
SLO-2	Problem Solving with Artificial Intelligence- ProblemSolving Process	Logical Agents, Knowledge basedAgents, Syntax of First order logic, Basic elements of First order logic	Planning: designing programs to search for data or solutions to problem.	Uses of planning graph, Planning and acting in the realworld	Bayes Theorem, Bayes' Rules & uses, Bayesian networks, Types of Bayesian Network
SLO-3	Problem Types, Characteristics and Representation-Agents-Examples of Agents, Types of agents	Forward chaining andBackward Chaining-Properties Examples	State-space search, Problems to solve: Water Jug Problem, State representation: Initial, operator, goal state	Forward march, Backward march and Limited resources	Temporal models, Hidden Markov models, HMM components

Resources			
1	Russel.SandNorvig. P, (2003), "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education	2	S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education

Assessment						Strategies					
		Continuous Learning Assessment (CLA) (100% weightage)				Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA – 3	CLA – 4*	Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
		(20 %)	(20 %)	(40 %)	(20 %)	Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	15	15	10	10			Debate	✓		
2	Understand	15	15	10	10			Interactive Lecture	✓		
3	Apply	20	25	25	25			Brainstorming	✓		
4	Analyze	20	25	25	25						
5	Evaluate	15	10	15	15						
6	Create	15	10	15	15						
	Total (%)	100	100	100	100						

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Mr. JothiPeriaswamy, Founder/Chief Data Scientist, DeepSphere AI, 2 Venture Drive, #13-26 Vision Exchange, Singapore, 608526	1	Dr.S. Gopinathan, Professor and Head, Department of Computer Science, University of Madras, Guindy Campus, Chennai-600025	1	Dr.S.Belina V J Sara, SRMIST Kattankulathur

Course Code	UCD24S02L	Course Title	Quantitative Aptitude and Logical Reasoning	Category	S	Skill Enhancement Courses	L	T	P	C
							0	0	2	1

Course Offering Department	Career Guidance	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			Programme Learning Outcomes									
CLR-1	Illustrate the application of different principles in solving mathematical problems	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Foster students' curiosity and understanding of concepts related to profit/loss, interest computation, and averages																	
CLR-3	Analyze fundamental mathematical concepts concerning permutation and combination, as well as time and work, with a critical perspective																	
CLR-4	Equip students with the abilities essential for generating and comprehending data, focusing on topics such as cubes, dices and blood relations																	
CLR-5	Illustrate the application of different principles in solving mathematical problems																	
CLO	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Bloom's Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Grasp, evaluate, and tackle problems involving numbers and percentages	✓	✓	-	-	2	85	75	3	1	3	-	2	2	-	-	-	-
CLO-2	Develop, solve, interpret, and apply fundamental mathematical models relevant to everyday situations	✓	✓	✓	-	2	85	75	3	1	3	-	2	2	-	-	-	-
CLO-3	Realize the principles of permutation and combination, probability, time and work, and adopt simplified and innovative approaches to problem- solving	✓	✓	✓	✓	3	85	75	3	1	3	-	2	2	-	-	-	-
CLO-4	Comprehend the concepts of data interpretation, data sufficiency, coding and decoding	✓	✓	✓	✓	3	85	75	3	1	3	-	2	2	-	-	-	-
CLO-5	Solve logical puzzles and reasoning challenges	✓	✓	✓	✓	3	85	75	3	1	3	-	2	2	-	-	-	-

Sessions	CLO – 1	CLO - 2	CLO – 3	CLO - 4	CLO - 5
	6	6	6	6	6
SLO-1	Classification of numbers and Test of divisibility	Profit and Loss	Permutation and Combination	Cubes and Dice	Direction Sense
SLO-2	Unit digit and Trailed zeroes	Ratio and Proportions	Problems on Probability	Data Interpretation	Number Series and Word Series
SLO-3	Problems on HCFand LCM	Simple Interest and Compound Interest	Time and work - Men and Work	Data sufficiency	Odd man out Missing Number and Wrong Number
SLO-4	Problems on Partnership	Word problems on Linear and Simultaneous Equations	Time and Work - Pipes and Cisterns	Seating Arrangements – Linear and Circular	Puzzles - Concepts & Problems Syllogisms - Concepts & Problems
SLO-5	Problems on Percentage	Problems on Averages	Time, Speed and Distance - Problems on Trains	Problems on Blood Relations	Problems on Clocks
SLO-6	Percentage - Increasing & Decreasing functions	Mixtures and Alligations	Time, Speed and Distance - Boats & Streams	Coding – Decoding	Problems on Calendars

Resources			
1	Abhijit Guha, QuantitativeAptitudeforCompetitiveExaminations, TataMcGrawHill,5thEdition	4	EdgarThrope, TestofReasoningforCompetitiveExaminations, TataMcGrawHill,6thEdition
2	Dr. Agarwal. R. S, QuantitativeAptitudeforCompetitiveExaminations, S. ChandandCompanyLimited,2018Edition	5	DineshKhattar, ThePearsonGuidetoQuantitativeAptitudeforcompetitiveexaminations, Pearson,3rdEdition
3	ArchanaRam, Place Mentor: TestsofAptitudeforPlacementReadiness, OxfordUniversityPress, Oxford,2018	6	PAAnand, QuantitativeAptitudeforcompetitiveexaminations, Wileypublications, ebook,2019

Assessment						Strategies					
		Continuous Learning Assessment (CLA) (100% weightage)				Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA – 3	CLA – 4*	Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	
	Bloom's Level of Thinking	(20 %)	(20 %)	(30 %)	(30%)	Presentation Tools	✓	Group Discussion		Quality Education	✓
		Practice (%)	Practice (%)	Practice (%)	Practice (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	
1	Remember	20	10	20	10			Debate			
2	Understand	20	10	20	10			Interactive Lecture	✓		
3	Apply	20	20	20	20			Brainstorming	✓		
4	Analyze	20	20	20	20						
5	Evaluate	10	20	10	20						
6	Create	10	20	10	20						
	Total (%)	100	100	100	100						

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Mr. P. Chockalingam, Senior Lead Software Engineer, Virtusa Consulting Services Private Ltd, DLF IT Park SEZ, Chennai – 600089 p.chockalingam1986@gmail.com	1	Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeetham, Coimbatore - 641112 g_saravanaprabu@cb.amrita.edu	1	Dr. Sathish K, HOD, Department of Career Guidance Cell, FSH, SRMIST hod.dcgc.ktr@srmist.edu.in
				2	Dr. Aarthi S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST aarthis4@srmist.edu.in

Course Code	UNS24Y01L/UNC24Y01L/UNO24Y01L/UYG24Y01L	Course Title	NSS/NCC/NSO/YOGA	Category	Y	Mandatory Course	L	T	P	C
							0	0	0	0

Course Offering Department	NSS	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Understand themselves in relation to their community
CLR-2	Develop among themselves a sense of social and civic responsibility
CLR-3	Utilize their knowledge in finding practical solution to individual and community problems
CLR-4	Develop competence required for group-living and sharing of responsibilities
CLR-5	Acquire leadership qualities and democratic attitude

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Program Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Problem Solving, Critical Thinking,	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning,	4 Leadership Qualities Professionalism,	5 Digital Technology Skills	6 Value Inculcation, Multicultural inclusivity	7 Environmental Action, Community	8 Entrepreneurial Taking	9 PSO 1	10 PSO 2
CLO-1	realize themselves in relation to their community	✓	✓	-		2	85	75	3	-	-	1	-	3	3	2	-	-
CLO-2	Develop among themselves a sense of social and civic responsibility	✓	✓	✓		2	85	75	3	2	1	2	-	3	3	1	-	-
CLO-3	find practical solution to individual and community problems	✓	✓	✓	✓	3	85	75	3	1	3	1	-	3	3	1	-	-
CLO-4	Develop competence required for group-living and sharing of responsibilities	✓	✓	✓	✓	3	85	75	3	3	2	3	-	3	3	2	-	-
CLO-5	develop leadership qualities and democratic attitude	✓	✓	✓	✓	3	85	75	3	3	2	3	-	3	3	3	-	-

Assessment is Fully Internal

Assessment					
Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)			
		CLA – 1 * (20%) Practice (%)	CLA – 2 * (30%) Practice (%)	CLA – 3 * (30%) Practice (%)	CLA – 4 * (20 %) Practice (%)
1	Remember	20	20	20	20
2	Understand	20	20	20	20
3	Apply	40	40	40	40
4	Analyze	20	20	20	20
5	Evaluate				
6	Create				
Total (%)		100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses		Good Health & Well Being	✓
Presentation Tools		Group Discussion	✓	Quality Education	
Learning Management System		Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming			

*CLA s are evaluated based on (i) participation in awareness programmes, (ii) participation in outreach programme, (iii) Community Services (iv) Camps (National, State, Regional)

Resources	
1.	NSS Manual (Revised), Government of India

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr Samuel Chellaiya C Regional Director, NSS Government of India	1	State Officer, NSS Tamil Nadu NSS	1	Dr Prakash V, NSS Coordinator, SRMIST, AP, department of Economics, FSH, SRMIST,Prakashv2@srmist.edu.in
				2	Dr Yogalakshmi, NSS Programme Officer, FSH, SRMIST.

SEMESTER – 3

Course Code	UCY24301J	Course Title	Transition Metals and Coordination Chemistry	Category	C	Core	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course learning Rationale (CLR)	*The purpose of learning this course is to:*
CLR-1	Exploit concepts related to coordination chemistry to manifold applications in diverse areas like qualitative and quantitative analysis
CLR-2	Distinguish and intervene the theories of coordination complexes of d-block elements with variable configurations.
CLR-3	Identify as well as to predict the feasibility and stability of coordination complexes.
CLR-4	Compare the physicochemical properties of the complexes against color of complexes and magnetic properties.
CLR-5	Study the synthetic strategies based on the reactivity with respect to structural and fundamental factors.

Course learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Depth: Conceive	Design	Implement	Operate	Attainment: Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	PLO 1: Problem Solving, Critical Thinking, Creativity	PLO 2: Communication Skills, Collaborating Skills	PLO 3: Independent Thinking, Analytical Reasoning, Research Skills	PLO 4: Leadership Qualities, Professionalism, Autonomy, Accountability	PLO 5: Digital Technology Skills	PLO 6: Value Inculcation, Multicultural inclusivity	PLO 7: Environmental Action, Community Engagement	PLO 8: Entrepreneurial Risk Taking	PLO 9: PSO-1	PLO 10: PSO-2
CLO-1	Apply the basic terms and use standard rules to name coordination compounds.	✓	✓	-	-	2	75	75	3	3	-	-	-	2	-	-	-	-
CLO-2	Discuss the various types of isomerism possible in a metal complex.	✓	✓	✓	-	2	75	70	-	3	-	-	-	3	-	-	2	-
CLO-3	Correlate the gradational development of theories of coordination complexes due to splitting of orbitals.	✓	✓	✓	-	3	75	60	-	-	3	3	2	-	-	-	-	-
CLO-4	Gaining the knowledge of magnetic properties and color of complexes.	✓	✓	✓	✓	3	75	75	3	-	-	3	-	-	-	-	3	-
CLO-5	Realize the important properties of transition metals and use Latimer diagrams to predict and identify different types of species.	✓	✓	✓	✓	3	75	75	-	3	-	3	-	-	-	-	-	3

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Coordination chemistry	Stability of coordination complexes	Theory of coordination complexes	Reaction mechanism of coordination complexes-I	Reaction mechanism of coordination complexes-II
	15	15	15	15	15

SLO-1	Introduction to coordination chemistry: Ligands-monodentate, bidentate, and polydentate ligands, coordination sphere, coordination number, ambidentate ligands, bridging ligands	Introduction of stability of coordination complexes: Stability of complexes	Introduction of theory of coordination complexes, VSEPR theory	Introduction of reaction mechanisms in coordination compounds-I, labile and inert complexes on the basis of valence bond theory	Introduction of reaction mechanisms in coordination compounds-II: Electron transfer reactions
SLO-2	Nomenclature of coordination compounds, Werner ‘s coordination theory-salient features and limitations, designation and formation of Co(III) ammines and experimental verifications	Thermodynamic stability-atable and unstable complexes. Kinetic stability-labile and inert complexes	Valence bond theory (VBT): Assumptions, VBT as applied to octahedral, tetrahedral and square planer complexes	Ligand substitution reactions in octahedral complexes. Ligand Dissociation, association mechanism and Interchange mechanisms	One electron transfer reaction, inner sphere mechanism and outer sphere mechanism
SLO-3	Sidgwick’s electronic concepts of coordination bond in coordination compounds, Sidgwick’s effective atomic number (EAN) rule	Stepwise and overall formation of coordination complexes, relation between stepwise and overall stability constant, factors affecting stability of coordination compounds	Magnetism and drawbacks of VBT, crystal field theory (CFT): salient features	Reaction profile of dissociative and association mechanisms, factors affecting rates of substitution reactions	Marcus’s theory and its applications
SLO-4&5	Laboratory: Introduction and safety measures	Laboratory: Flame test (Na, K, Li, Ca, Sr, Ba, Cu)	Laboratory: Qualitative ananlysis of inorganic sample [Cu(II), Mn(II)]	Laboratory: Qualitative ananlysis of inorganic sample [Ca(II), Mg(II)]	Laboratory: Qualitative ananlysis of inorganic sample [Cr(III), Ni(II)]
SLO-6	Application of EAN rule in coordination complexes, limitations of Sidgwick’s concept	Stepwise and overall formation of coordination complexes, relation between stepwise and overall stability constant, factors affecting stability of coordination compounds	Crystal field splitting of d-orbitals in square planar, tetrahedral and octahedral complexes	Reaction profile of dissociative and association mechanisms, factors affecting rates of substitution reactions	Two electron transfer reactions, complementary and non-complementary electron transfer reactions
SLO-7	Isomerism in coordination compounds: Structural isomerism	Properties of metal ions and ligands, stability of chelates, steric effects on chelates	Factors influencing the magnitude of CFT, crystal field stabilization energy (CFSE) of dx ions	Mechanism of hydrolysis reactions, acid hydrolysis of octahedral complexes with and without π-donor, Π-acceptor inert ligands	Complementary and non-complementary electron transfer reactions
SLO-8	Ligand coordination, coordination position	Electron delocalization, methods for the determination	High-spin and low-spin complexes	Mechanism of hydrolysis reactions, acid hydrolysis of	Molecular rearrangements of four-coordinate and six-

	polymerization isomerisms	of stability constants		octahedral complexes with and without π-donor, Π-acceptor inert ligands	coordinate complexes
SLO-9&10	Practice: Qualitative ananlysis of acid radicals (F-, Cl-)	Laboratory: Qualitative ananlysis of acid radicals (Fe(CN)63-, Fe(CN)64-)	Laboratory: Qualitative ananlysis of inorganic sample Fe(II) and Fe(III)	Laboratory: Qualitative ananlysis of inorganic sample [Ba(II), Sr(II)]	Laboratory: Repeat of experiment
SLO-11	Conformation linkage, ionization and hydrate	Composition of a complex-spectrophotometric method	Applications of CFT-colour in coordination compounds, Magnetic moment values of complex, Limitations of CFT	Experimental tests of mechanisms and stereochemistry, base hydrolysis-associative SN2	Synthesis of coordination compounds using electron transfer reactions
SLO-12	Stereoisomerism: geometrical isomerism,	Continuous variation method (Job's method)	Jahn-teller theorem-crystal field splitting,	Dissociative SN1CB mechanisms	Metal-assisted reactions
SLO-13	Optical isomerisms-4 and 6 coordinate complexes	Bjerrum’s method and Irving method, Rossotti method and limitations	Jahn-teller splitting in tetragonally distorted octahedral, square planar geometry	Stereochemistry of dissociative mechanism, racemization reaction	Template effect, synthesis of macrocyclic ligands
SLO-14&15	Practice: Qualitative ananlysis of acid radicals (Br-, I-)	Laboratory: Qualitative ananlysis of acid radicals (NO3-, NO2-)	Laboratory: Qualitative ananlysis of inorganic sample Zn(II) and Cd(II)	Laboratory: Oral examination	Laboratory: Repeat of experiment

Resources

1	*J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry-Principles of Structure and Reactivity, Pearson, 4th Edition, 2022*	5	*P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, F.A. Armstrong and M. Hagerman, Shriver and Atkins' Inorganic Chemistry, W. H. Freeman and Company, 5th Edition, 2010*
2	*R.D. Madan, Modern Inorganic Chemistry, S.Chand & Company limited, 2017*	6	*Vogel’s Qualitative Inorganic Analysis, 7th Edition, Pearson Education Ltd., 2009*
3	*J. D. Lee, Consise Inorganic Chemistry, Wiley, 5th Edition, 2021*	7	*R. L. Dutta, Inorganic Chemistry Part-I, The New Book Stall, 1999*
4	*R. P. Sarkar, General and Inorganic Chemistry: Volume II, New Central Book Agency (P) Limited, 2009*	8	*F. A. Cotton, G. W. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, Wiley, 6thEdition, 2008*

Assessment									
Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)						Final Assessment (50 % weightage)	
		CLA – 1 (10 %)		CLA – 2 (10 %)		CLA – 3 (30 %)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	20	20	20	20	15	15	20	20
2	Understand	20	20	20	20	15	15	20	20
3	Apply	20	20	20	20	20	20	20	20
4	Analyze	20	20	20	20	20	20	20	20
5	Evaluate	10	10	10	10	15	15	10	10
6	Create	10	10	10	10	15	15	10	10
	Total	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	-		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
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2	Dr. Ravikiran Allada Head Analytical R&D and ASAT (AVP) || Steriscience (Strides) Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24302T	Course Title	Physical Organic Chemistry and Stereochemistry	Category	C	Core	L	T	P	C
							3	1	0	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*	Data Book / Codes/Standards	Nil

Course learning Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes (PLO)										
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	
CLR-1	Understand the basics of stereochemistry																		
CLR-2	Gain knowledge in nomenclature and conformational analysis of organic molecules																		
CLR-3	Understand the thermodynamic and kinetic factors controlling organic reactions																		
CLR-4	Understand reaction mechanism and molecular interactions utilizing physical organic concepts																		
CLR-5	Understand the interrelationship between structure and physical properties and reactivity of organic molecules																		

Course learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Determine the 3-dimensional structure of molecules	✓	✓	-	-	*2*	*85*	*70*		*3*	-	*3*	-	-	-	-	-	*3*
CLO-2	Differentiate the rates of a reaction depending on the 3D arrangement of substituents in a molecule	✓	✓	✓	-	*2*	*85*	*70*		*3*	-	*3*	-	-	-	-	-	-
CLO-3	Analyse the rate of a reaction based on kinetics and thermodynamics	✓	✓	✓	-	*3*	*85*	*70*		*3*	-	*3*	-	-	-	-	-	-
CLO-4	Predict organic reaction mechanism	✓	✓	✓	-	*3*	*85*	*75*		*3*	-	*3*	-	*3*	-	-	-	-
CLO-5	Explain the physical properties of organic molecules	✓	✓	✓	-	*3*	*85*	*75*		*3*	-	*3*	-	*2*	-	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Concept of chirality and symmetry	Identification of stereoisomers	Thermodynamics and kinetics of organic reactions	Selectivity in organic reactions	Relationship between structure and reactivity/ physical properties
	12	12	12	12	12

SLO-1	Optical activity of organic compounds	Concept of chiral plane, examples	Energy profile diagram in organic reactions	Origin of Kinetic isotope effects	Intermolecular vs intermolecular organic reactions, examples
SLO-2	Concept of chirality	Axial chirality. Biphenyl derivatives and atropisomerism	Thermodynamic factors governing organic transformations	Primary kinetic isotope effect Some examples	High Dilution Technique
SLO-3	Symmetry Operations and symmetry elements	Configurational nomenclature, D-L, R-S, E-Z,	Thermodynamic factors governing organic transformations	Secondary Kinetic isotope effect Some examples	Curtin-Hammett Principal
SLO-4	Tutorial: Solving Problems on optical activity	Tutorial: Finding the configuration of organic compounds	Tutorial: Solving problems on calculation of bond dissociation energy	Tutorial: Discussion on isotopic substitution to understand reaction mechanism	Tutorial: Discussion on the applications of Curtin-Hammett Principal in common organic reactions (diazotization of aromatic amines)
SLO-5	Discussion on symmetry point groups	R-S for molecules with chiral plane or chiral axis, P-M for helical systems	Hammonds postulate to predict reaction mechanism	Discussion on solvent isotope effect with examples and Heavy atom isotope effect	Curtin-Hammett Principal Applications in different types of reactions
SLO-6	Discussion on symmetry point groups	Dihedral angle and Tortion angle, Confirmation analysis of butane	Kinetic factors governing organic transformations	Kinetically and thermodynamically controlled organic reactions	Discussion on kinetic quenching
SLO-7	Dissymetry and asymmetry, classification scheme	Conformations of haloalkanes, effect of hydrogen bonds	Kinetic factors governing organic transformations	Explanation with energy profile diagram: Reaction of HBr with butadiene	Hammet Equation (basic understanding)
SLO-8	Tutorial: Finding the symmetry elements in complex molecules	Tutorial: Solving problems based on conformational analysis	Tutorial: Solving problems on calculation of Gibbs free energy	Tutorial: Higher -level discussion on thermodynamic and kinetic control on complex chemical processes (polymerization)	Tutorial: Taft Equation (basic understanding)
SLO-9	Flying wedge representation, Fischer projection formula, Newman projection	Confirmation analysis of cycloalkanes: cyclohexane	Catalysis, Nucleophilic catalysis, Asymmetric catalysis (basic understanding)	Explanation with energy profile diagram: Sulfonation of naphthalene	Physical properties: Dipole moment and polarity of organic c ompounds

SLO-10	Concept of diastereoisomers	Topicity of ligands, prochiral centre, topicity of faces	Other Catalysis types: Catalysis in biphasic systems, Autocatalysis	Explanation with energy profile diagram: Conjugate (1.4) Vs direct (1,2) addition of nucleophile to a α,β-unsaturated carbonyl compound	Short introduction to intermolecular forces
SLO-11	Compounds containing similar asymmetric carbon atoms, meso variety	On the process of racemization and optical resolution, optical purity	Biological catalysis Michaelis-Menten kinetics	Principal of microscopic reversibility Examples	melting point. And boiling point of organic compounds
SLO-12	Tutorial: Finding the structure of possible stereoisomers in compounds containing multiple stereocenters.	Tutorial: Solving problems on calculation of optical purity	Tutorial: Solving problems on calculation of Michaelis-Menten equation	Tutorial: Discussion on microscopic reversibility and the second law of thermodynamics	Tutorial: Solving problems based on the effect of structure on the physical properties of organic molecules.

Resources

1	*D. Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications New Age International(P) Ltd., 2nd Ed.,1991*	5	*E. L. Eliel, Stereochemistry, of Carbon Compounds, Tata McGraw Hill Education, 1962*
2	*C. Saha and co-workers, Study Guide to Organic Chemistry, Techno World, Vol-1, 2017*	6	*E. V. Anslyn and D. A. Dougherty, Modern Physical Organic Chemistry, Oxford University Books, 2006*
3	*E. L. Eliel and S. H. Wilen, Topics in Stereochemistry John Wiley and Sons, Vol-21, 1994*	7	*J. I. Seeman, Effect of conformational change on reactivity in organic chemistry: Evaluations, applications, and extensions of Curtin–Hammett and Winstein–Holness kinetics, Chem. Rev., 1983, 83, 83*
4	*S. Chakraborty and C. Saha, The Curtin–Hammett Principle: A Qualitative Understanding, Resonance, 2016, 21, 151*	8	*J. W. Steed and J. L. Atwood, Supramolecular Chemistry Wiley, 3rd Ed.,2022*

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, sudarshan.m@encubeethicals.com	1	Prof. G. Sekar Department of Chemistry, IIT Madras gsekar@iitm.ac.in	1	Dr. Rahul Dev Mukhopadhyay, Department of Chemistry, SRMIST, rahuldem@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) | Steriscience (Strides), Bengaluru, Karnataka, Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal Department of Chemistry, IISER, Thiruvananthapuram sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24303T	Course Title	Thermodynamics and Electrochemistry	Category	C	Core	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course learning Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	Understand the laws of thermodynamics and their applications to chemical systems																	
CLR-2	Analyze the thermodynamic properties of chemical substances and reactions																	
CLR-3	Apply thermodynamic principles to understand Carnot cycle and adiabatic/isothermal processes.																	
CLR-4	Understand the principles of electrochemistry, including Nernst equation, redox reactions and electrode potentials																	
CLR-5	Analyze electrochemical cells and their applications																	

Course learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking,	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Apply thermodynamic laws to analyze and predict the behavior of chemical systems	✓	✓	-	-	4	85	75		3	-	-	2	-	3	-	-	3
CLO-2	Understand the relationship between energy, entropy, and spontaneity in chemical reactions	✓	✓	✓	-	3	85	75		3	-	-	-	-	3	-	2	-
CLO-3	Explain various electrochemical concepts of conductance and activity co-efficient	✓	✓	✓	✓	4	85	75		-	-	3	-	2	-	3	-	-
CLO-4	Interpret electrochemical processes such as redox reactions, electrochemical cells, and corrosion	✓	✓	✓	✓	3	85	75		3	-	-	3	-	3	-	-	-
CLO-5	Solve problems involving thermodynamics and electrochemistry	✓	✓	✓	✓	3	85	75		3	-	-	3	-	3	-	4	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Introduction and first law of thermodynamics	Second law of thermodynamics	Second and third law of thermodynamics	Introduction to electrochemistry	Electrochemical cells and basic concepts
	12	12	12	12	12
SLO-1	Basic concepts and definitions, system- open, closed and isolated system	Need for second law of thermodynamics, entropy and entropy changes spontaneous process, standard entropy	Gibbs-Helmholtz equation, thermodynamics of open systems, entropy, molar properties and free energy	Introduction to electrochemistry: Specific conductance, equivalent conductance, molar conductance, Faraday's laws of electrolysis	Introduction to electrochemical cell: Galvanic cell
SLO-2	Macroscopic properties, phase, variable and state of a system	Cyclic process - Carnot cycle - Efficiency of heat engine, Entropy changes in an isothermal expansion of. an ideal gas	Gibbs-Duhem equation	Variation of molar conductance with dilution	Reversible electrodes, metal – metal ion electrodes, gas electrode, metal – insoluble metal salt electrode
SLO-3	Applications and limitations of thermodynamics	Entropy change, isothermal, isobaric and isochoric process. Entropy changes accompanying changes of phase	Dependence of thermodynamic parameter on composition, temperature, pressure	Cell constant - Arrhenius theory Ostwald‟s dilution law	Single electrode potential, thermodynamics of reversible electrodes and cells
SLO-4	Tutorial: Applying concepts of macroscopic system	Tutorial: Applying concepts of expansion of ideal gas	Tutorial: Problem solving of Gibbs-Duhem equation	Tutorial: Practicing calculation of molar ionic conductance	Tutorial: Problem solving of Nernst equation
SLO-5	Thermodynamics equilibrium, processes and properties of the system	Calculation of entropy changes of an ideal gas with change in P, Vand T	Chemical potential in case of adsorption of gases on solids	Determination of ionic mobility	Nernst equation, standard electrode potential, electrochemical series, oxidation-reduction electrodes
SLO-6	First law of thermodynamics - Internal energy, State functions	Work. done in reversible isothermal expansion	Clapeyron-Clausius equation - derivation	Applications of Kohlrausch law	Effect of concentration of electrolyte on cell potential
SLO-7	Heat capacity - relationship between Cp and Cv in	Entropy of mixture of ideal gas	Application of Clapeyron-Clausius equation for liquid –	Conductometric titrations	Electromotive force (EMF) of a Galvanic cell

	gaseous system.		vapour equilibria		
SLO-8	Tutorial: Problem solving of heat and work	Tutorial: Practicing calculation of work done in reversible processes	Tutorial: Applying concepts of Clapeyron- Clausius equation for liquid – vapour equilibria	Tutorial: Applying concepts of conductometric titrations – Precipitation titrations	Tutorial: Practicing determination of electromotive force of a given cell
SLO-9	Isothermal expansion, work done in reversible isothermal expansion	Standard entropy and physical significance of entropy	Fugacity and activity, Activity coefficient and standard states	Ionic activity Mean ionic activity of an electrolyte	Concentration cells, electrode & electrolyte concentration cells
SLO-10	Work done in irreversible isothermal expansion and adiabatic expansion	Free energy function	Introduction to third law of thermodynamics, Nernst heat theorem	Debye-Huckel theory	Liquid junction potential
SLO-11	Joule-Thomson effect and coefficient of ideal/real gas	Variation of free energy with *T* and *P*	Determination of absolute entropies, entropies of real gases, The Boltzmann entropy equation and residual entropy	Activity coefficients of strong electrolytes	Applications of EMF measurements
SLO-12	Tutorial: Practicing calculation of change of internal energy	Tutorial: Problem solving of standard entropy and physical significance of entropy	Tutorial: Practicing determination of fugacity of a gas	Tutorial: Problem solving of determination of activity coefficients of strong electrolytes	Tutorial: Applying concepts of EMF measurements for the determination of various thermodynamic parameters

Resources			
1	A. Bahl, B. S. Bahl, G. D. Tuli, Essentials of Physical Chemistry, Multicolor edition, S. Chand Publishing, 2009	4	B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLal Nagin Chand and Co, 2013
2	Atkins, P., de Paula, J., Atkins' Physical Chemistry (8th ed.). Oxford University Press, 2006	5	Levine, I. N., Physical Chemistry (6th ed.). McGraw-Hill Education, 2008
3	Christopher M. A. Brett and Ana Maria Oliveira Brett, Electrochemistry: Principles, Methods, and Applications, Oxford University Press, 1993	6	Vladimir S. Bagotsky, Fundamentals of Electrochemistry (2nd ed.), Wiley-Interscience, 2005

Assessment						
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, sudarshan.m@encubeethicals.com	1	Prof. G. Sekar Department of Chemistry, IIT Madras gsekar@iitm.ac.in	1	Dr. Vedhanarayanan B, SRMIST Email: vedhanab@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) | Steriscience (Strides), Bengaluru, Karnataka, Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal Department of Chemistry, IISER, Thiruvananthapuram sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24I01L	Course Title	Internship – I	Category	P	Project Work / Internship (P)	L	T	P	C
							-	-	-	1

Course Offering Department	English	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Gain practical experience within the business environment.
CLR-2	Acquire knowledge of the industry in which the internship is done.
CLR-3	Apply knowledge and skills learned in the classroom in a work setting
CLR-4	Develop a greater understanding about career options while more clearly defining personal career goals
CLR-5	Experience the activities and functions of business professionals.

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Bloom's Level of Thinking	2 Expected Proficiency (%)	3 Expected Attainment (%)	1 Problem Solving, Critical Thinking, Creativity, Solving	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning,	4 Leadership Qualities, Professionalism, Autonomy,	5 Digital Technology Skills	6 Value Inculcation,	7 Environmental Action, Community Engagement	8 Entrepreneurial Risk Taking	9 PSO - 1	10 PSO -2
CLO-1	Identify areas for future knowledge and skill development	✓	✓	-	-	2	75	75										✓
CLO-2	understanding of what is expected in the job market and what their standard of performance should be	✓	✓	✓	-	2	75	75										✓
CLO-3	Build professional, as well as academic, contacts and begin the process of networking and support for your future careers.	✓	✓	✓	✓	3	75	70										✓
CLO-4	Acquire knowledge of the industry in which the internship is done.	✓	✓	✓	✓	3	75	75										✓
CLO-5	practical experience within the business environment	✓	✓	✓	✓	3	75	70										✓

PROCESS	
Stage I	Identifying area of interest
Stage II	Review I
Stage III	Review II
Stage IV	Project report preparation
Stage V	Final Submission of the Project Report

	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
	Review – 1	Review – 2	Project Report	Viva-Voce
Project Work / Internship	*20%*	*30 %*	*30 %*	*20 %*

Designers					
Professional Experts		**Higher Institution Experts**		**Internal Experts**	
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2	Dr. Ravikiran Allada Head Analytical R&D and ASAT (AVP) || Steri science (Strides) Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Semester-IV

Course Code	UCY24401L	Course Title	Physical Chemistry Practical	Category	C	Core	L	T	P	C
							0	2	4	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	Acquire knowledge about the partition coefficient of a substance between two immiscible liquids																	
CLR-2	Understand the reaction kinetics of first, pseudo first aand second order reactions																	
CLR-3	Recognise and relate phase transitions with temperature																	
CLR-4	Reproduce the concepts related to critical solution temperature and the potentiometry																	
CLR-5	Enable the students to explore various applications of conductometric titrations																	

Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Asses the distribution of a substance between any two immiscible liquids	✓	-	-	✓	3	85	75	2	-	3	-	-	-	-	-	-	3
CLO-2	Formulate the reaction kinetics of various types of reaction	✓	-	✓	✓	4	85	75	3	-	3	-	-	-	-	-	-	-
CLO-3	Describe the phase transitions with the change in temperature	✓	-	✓	-	3	85	75	3	-	3	-	-	-	-	-	2	-
CLO-4	Apply potentiometry and determine CST of real time solutions	✓	✓	✓	✓	4	85	75	3	-	-	-	3	-	-	-	-	-
CLO-5	Employ conductometric methods to access various properties of strong and weak electrolytes	✓	-	✓	✓	4	85	70	3	-	-	-	3	-	1	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Solutions	Chemical kinetics	Phase transitions	Critical solution temperature and potentiometric titration	Conductometric measurements
	18	18	18	18	18
SLO-1 - 4	Introduction to the lab, discussion of all the experiments	Determination of Rate constant acid catalysed hydrolysis of an	Determination of transition temperature of the hydrated salt	Determination of critical solution temperature and composition at	Determination of Equivalent conductance of a strong

		ester		CST of the phenol water system	electrolyte
SLO-5	Tutorial: Discussion on lab protocols and evaluation	Tutorial: Activity related to the concepts of reaction kinetics	Tutorial: Activity related to the bahaviour of hydrated salts with the raise in temperature	Tutorial: Concepts of binary mixtures – CST	Tutorial: Activity related to cell constant, specific conductance and equivalent conductance
SLO-6	Tutorial: Demo on handling of Weighing balance and safety protocols	Tutorial: Problems related to the determination of rate of the reaction – first and Pseodo first order reactions	Tutorial: Problems related to the Thermodynamic concepts pertaing to phase transitions of the hydrated salts	Tutorial: Graphical representation of immiscible liquids with temperatue	Tutorial: Problems related to conductance measurements.
SLO-7 - 10	Partition Coefficient of Iodine between CCl4 and water	Kinetic study of Iodination of acetone	Determination of molecular weight of a compound by Rast method	Study of the effect of impurities NaCl / succinic acid on CST of the phenol water system	Determination of strength of an acid
SLO-11	Tutorial: Activity related to the concepts of partition coefficient	Tutorial: Activity related to the concepts of order of the reaction	Tutorial: Concepts of colligative properties	Tutorial: Concepts of binary mixtures – CST	Tutorial: Activity based on conductometric titrations
SLO-12	Tutorial: Problems related to the distribution coeffients of Iodine between two immiscible liquids	Tutorial: Problems related to the determination of rate of the reaction – second order reactions	Tutorial: Problems related to the colligative properties	Tutorial: Graphical representation of immiscible liquids with temperature	Tutorial: Problems related to the determination of concentration of an acid/ mixture of acids by conductometric methods
SLO-13 - 16	Distribution of acetic acid/benzoic acid between water and benzene or chloroform or cyclohexane	Kinetic study of Persulphate-Iodide reaction	Construction of phase diagram of simple eutectic system	Precipitation titration by potentiometric method	Determination of Dissociation constant of a weak acid
SLO-17	Tutorial: Principle behind the distribution of a chemical between two immiscible liquids	Tutorial: Activity- persulphate - Iodine reaction mechanism	Tutorial: Phase diagram construction of two component system	Tutorial: Activity related to different potentiometric titrations	Tutorial: Activity related to the Kohlrauch's law
SLO-18	Tutorial: Problems related to the distribution coeffient	Tutorial: Problems related to second order kinetics-different reactants	Tutorial: Problems related to the Phase, components, Degree of freedom	Tutorial: Problems based on Nernst equation	Problems related to the equivalent conductance and the degree of dissociation

Resources			
1	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of practical chemistry, Suntan Chand & Sons, 2nd Edition, 2012	4	Daniels et al., Experimental Physical Chemistry, 7th edition, New York, McGraw Hill, 1970.
2	D.A. Skoog, D.M. West and F.J. Holler, Analytical Chemistry: An Introduction, 5th edition, Saunders college publishing, Philadelphia, 1990	5	Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C., Vogel's Textbook of Quantitative Chemical Analysis, 5th edition., Longman Scientific & Technical, England, 1989 (John Wiley and Sons Inc, 605 Third Avenue, NewYork NY 10158)
3	Practical Physical Chemistry by B. Vishwanathan and P. S. Raghavan, Viva Publishers, 2012	6	Instrumental Methods of Analysis, 7th edition, Willard, Merritt, Dean, Settle, 2004

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1 (10 %)	CLA – 2 (10 %)	CLA – 3 (20 %)	CLA – 4 * (10%)	
		Practice (%)	Practice (%)	Practice (%))	Practice (%)	Practice (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers

Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email Id: sudarshan.m@encubeethicals.com	1	Prof. G. Sekar Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. T. Pushpa Malini Department of Chemistry, SRMIST Email: pushpamt@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) | Steriscience (Strides), Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24D01T	Course Title	Analytical Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	*1*	*0*	*4*

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	understand the fundamental principles of analytical chemistry and data analysis	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLR-2	gain knowledge about modern spectroscopic techniques and their applications																	
CLR-3	learning basics of UV-visible and IR spectroscopy in analytical chemistry																	
CLR-4	understand the basics of nuclear magnetic resonance (NMR) spectroscopy and Raman spectroscopy																	
CLR-5	learn about microscopy and mass spectrometry																	

Outcomes (CLO)	*At the end of this course, learners will be able to:*																		
CLO-1	develop methods of analysis for different samples independently	✓	✓	✓	-	2	85	75	3	3	-	-	3	-	-	-	-	-
CLO-2	acquire knowledge about different spectroscopic techniques.	✓	✓	✓	-	2	85	75	3	3	-	-		3	-		3	
CLO-3	develop skills for characterizing samples using UV-visible and IR spectroscopy	✓	✓	✓	-	3	85	75	-	3	-	-	3	3	-	-	2	
CLO-4	acquire knowledge about NMR and Raman spectroscopy	✓	✓	✓	-	3	85	75	3		-	-	3	3	-	-	-	-
CLO-5	acquire knowledge about microscopy and mass spectrometry	✓	✓	✓	-	3	85	75	3	-	-	-	3	3	-	-	-	3

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	An introduction to analytical chemistry	Characterization techniques	IR, NMR and Raman spectroscopy	Microscopy	Mass spectrometry
	12	12	12	12	12

SLO-1	Introduction to analytical chemistry. Role of analytical chemistry in everyday life. Chemical analysis – quantitative and qualitative analysis.	Characterization – meaning – different techniques – examples	A brief introduction to Infra-red (IR) spectroscopy.	A brief introduction to microscopy	Introduction to mass spectrometry
SLO-2	Mole concept and concentration units. Principles of titrimetric analysis.	Introduction to spectroscopy - Electromagnetic waves - width of spectral lines – reasons	Instrumentation of IR spectroscopy	Basics of optical microscopy	Instrumentation of Mass spectroscopy
SLO-3	Errors in chemical analysis. Statical treatment of analytical data.	A brief description about different spectroscopic techniques	Analysis of IR spectra – applications of IR spectroscopy.	Bright field optical microscopy and applications	Classical ionization sources in mass spectrometry
SLO-4	Tutorial; Analysis of errors	Tutorial: Spectroscopic techniques	Tutorial: Analysis of IR spectra	Tutorial; Optical microscopy	Tutorial: Fundamentals of mass spectrometry
SLO-5	Laboratory reagents and solvents – an introduction	Rotational spectroscopy – an introduction	A brief introduction to NMRspectroscopy.	Dark field microscopy and applications	Ambient ionization sources in mass spectrometry
SLO-6	Reagents – classification – primary and secondary standards – examples	Analysis of rigid rotator and non-rigid rotator	NMR spectrometer and its parts.	Phase contrast microscopy and applications	Electrospray ionization and matrix-assisted laser desorption ionization (MALDI),
SLO-7	Solvents – classification with atleast one example	Analysis of rotational spectra. Applications of rotational spectroscopy	Analysis of NMR spectra – applications of NMR spectroscopy.	Fluorescence microscopy: Principles	Analyzers used in mass spectrometry
SLO-8	Tutorial: Laboratory reagents and solvents	Tutorial: Rotational spectroscopy	Tutorial: Analysis of NMR spectra	Tutorial: Fluorescence microscopy	Tutorial: Various ionization methods of mass spectrometry
SLO-9	Separation Techniques: Introduction, classification of separation techniques.	A brief introduction to UV-visible (UV-vis) spectroscopy	A brief introduction to Raman spectroscopy	Confocal microscopy: Introduction	Detectors used in mass spectrometry
SLO-10	Introduction to chromatographic techniques: Classification and applications	Instrumentation of UV-vis spectroscopy	Rotational Raman spectroscopy - Vibrational Raman spectrosocpy	An introduction to electron microscopy	Analysis of mass spectra of various organic compounds
SLO-11	Purification methods used in organic chemistry – Sublimation, distillation,	Analysis of UV-visspectra – applications of UV-vis spectroscopy	Applications of Raman spectroscopy.	Scanning electron microscopy (SEM)Transmission electron microscopy (TEM): Introduction	Applications of mass spectrometry

	fractional distillation and crystallization.				
SLO-12	Tutorial: Chromatographic techniques	Tutorial: Analysis of UV-vis spectra	Tutorial: Analysis of Raman spectra	Tutorial: Electron microscopic techniques	Tutorial: Analysis of mass spectra with selected examples

Resources			
1	*Douglas A. Skoog and Donald M. West, Fundamentals of Analytical Chemistry 10th edition, 2022.*	5	*Daniel C Harris, Quantitative chemical analysis 7th edition, 2006.*
2	*R.V. Dilts, Analytical Chemistry – Methods of Separation, 1974.*	6	*Colin N Banwell and Elaine M. MccashFundamentals of molecular spectroscopy, 4th edition, 2017.*
3	*Donald L Pavia, Gary M. Lampman, George S. Kriz: Introduction to spectroscopy, 5th edition, 2015.*	7	*Marek Domin; Robert Cody: Ambient ionization mass spectrometry, 2014.*
4	*Elizabeth M. Slayter, Henry S. Slayter: Light and Electron microscopy, 1st edition, 1992.*		

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers

Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email: sudarshan.m@encubeethicals.com	1	Prof. G. Sekar Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. Rahul Narayanan, Department of Chemistry, SRM IST E-mail: rahuln@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka. Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Curse Code	UCY24D02T	Course Title	Nanomaterials and Nanochemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	Understand the significance of nanochemistry in emerging technologies	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Learn the characteristics and applications of nanoscale materials																	
CLR-3	Identify the optimal strategies for the synthesis of nanomaterials																	
CLR-4	Implement effective techniques for characterizing nanomaterials																	
CLR-5	Address the multi-disciplinary problems in the area of nanotechnologies by applying the nanochemistry concepts																	
Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Explain various nanoscale phenomena	✓	✓	✓	-	*3*	*85*	*75*	3	-	2	-	-	-	-	-	3	-
CLO-2	Compare the structure and properties of different nanomaterials	✓	✓	✓	-	*3*	*85*	*70*	3	-	3	-	-	-	-	2	-	-
CLO-3	Apply the knowledge of synthetic methods to design nanomaterials	✓	✓	✓	-	*4*	*85*	*70*	3	-	3	-	-	-	2	-	-	-
CLO-4	Analyze and interpret the physicochemical properties of nanomaterials using various characterization techniques	✓	✓	✓	-	*4*	*85*	*70*	3	-	3	-	-	-	-	-	3	-
CLO-5	Demonstrate the unique application of nanomaterials in various fields	✓	✓	✓	-	*4*	*85*	*60*	-	-	3	-	-	-	3	-	-	3

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Fundamentals of nanochemistry	Properties of nanomaterials (NMs)	Synthesis of NMs	Characterizations of NMs	Applications of nanoscale materials
	12	12	12	12	12

SLO-1	Historical development of nanotechnology and classification of nanostructures	Relationship between structure and properties of NMs	Top-down and bottom-up approaches	Importance and advancements in characterization techniques	Nanomaterials used in electronic devices
SLO-2	Surface area to volume ratio (SAVR)	Bonding in NMs	Room temperature synthesis: Nucleation and growth mechanism of nanoparticles	X-ray diffraction (XRD) technique	Nanocatalysis: Design principles
SLO-3	Calculation of SAVR for cubes and spheres	Carbon nanotubes (CNTs) and graphene: Synthesis and properties	Hydrothermal and solvothermal methods	Phase, crystallinity, and particle size analyses	Functional nanomaterials for heterogeneous catalysis
SLO-4	Tutorial: Problem-solving for SAVR	Tutorial: Assignment work on CNTs and graphene	Tutorial: Demonstration of solvothermal method	Tutorial: Interpretation of XRD data	Tutorial: Assignment work on nanocatalysis
SLO-5	Quantum confinement effect	Interactions at the nanoscale	Difference between solvothermal and hydrothermal synthetic methods	Microscopic Characterizations: Types and significance Scanning electron microscopic (SEM) technique	Electrocatalysts: Design principles
SLO-6	Nanostructures exhibiting quantum confinement effect with examples	Introduction to electrical properties of NMs	Template-assisted synthesis of nanostructures	Transmission electron microscopic (TEM)technique: Functional features	Electrolysis: Hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) processes
SLO-7	Energy diagrams for nanostructures	Illustrations of electrical properties of NMs with examples	Examples of different templates, merits, and demerits	Selected area electron diffraction (SAED) and energy dispersive spectroscopic (EDS) techniques	Fuel cell reactions: Oxygen reduction reactions (ORR) and hydrogen oxidation reaction (HOR)processes
SLO-8	Tutorial: Group discussion on the quantum confinement effect	Tutorial: Quiz on the properties of NMs	Tutorial: Assignment work on the preparation methods of nanomaterials	Tutorial: Interpretation of SEM/TEM data	Tutorial: Quiz on electrocatalysis topics
SLO-9	Surface plasmon resonance (SPR) effect	Electronic properties of NMs	Electrodeposition methods	Scanning probe microscope	Nanostructures for photocatalysis and water treatment
SLO-10	Examples of SPR effect	Illustrations of electronic properties of NMs	Sol-gel methods	AFM analyses	Nanomaterials used in healthcare products
SLO-11	Self-assembly at the nanoscale	Photo-induced charge transfer processes in semiconductors	Chemical vapor deposition methods	Surface charge analyses: Zeta potential analyzer	Nanostructure-mediated drug delivery processes with selected examples
SLO-12	Tutorial: Test on SPR effect	Tutorial: Quiz on nano-semiconductors	Tutorial: Test on strategies for the synthesis of NMs	Tutorial: Classroom assigment work on TEM technique	Tutorial: Test on nanomaterials for electrocatalysis

Resources			
1	*Much, R. A., Winkelmann, K., & Hugerat, M, Nanochemistry for Chemistry Educators, Royal Society of Chemistry, First edition, 2022*	4	*Bekyarova, E., et al. Effect of covalent chemistry on the electronic structure and properties of carbon nanotubes and graphene. Accounts of chemical research, 2013, 46, 65-76.*
2	*Bishop, K. J. et al. Nanoscale forces and their uses in self-assembly. small, 2009,5, 1600-1630*	5	*Rao, C. N. R., Müller, A., & Cheetham, A. K., The Chemistry of Nanomaterials., Wiley VCH, (Eds), first edition, 2004*
3	*Pradeep, T. Nano: the essentials: understanding nanoscience and nanotechnology, Tata McGraw Hill, New Delhi, First edition, 2007.*	6	*Alonso-Vante, N., Roldán, C. A. C., Huerta, R. D. G. G., Sánchez, G. R., & Robledo, A. M. Fundamentals of Electrocatalyst Materials and Interfacial Characterization: Energy Producing Devices and Environmental Protection. John Wiley & Sons. First edition,2019*

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
Total (%)		100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		**Higher Institution Experts**		**Internal Experts**	
1	Dr. Sudarshan Mahapatra General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email: sudarshan.m@encubeethicals.com	1	Prof. G. Sekar Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. N. Clament Sagaya Selvam Department of Chemistry, SRMIST Email: clamentn@srmist.edu.in
2	Dr. Ravikiran Allada Head Analytical R&D and ASAT (AVP) || Steriscience (Strides) Bengaluru, Karnataka, Email: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UEN24S01L	Course Title	Communication Skills	Category	S	Skill Enhancement Course	L	T	P	C
							0	0	4	2

Course Offering Department	English, FSH, KTR	Pre-requisite Courses	Nil	Co-requisiteCourses	Nil	ProgressiveCourses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:	Depth				Attainment			PLO										
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	
CLR-1	Bridge the theoretical language knowledge with practical communication skills, essential for academic and professional contexts.																		
CLR-2	focus on enhancing listening, speaking, reading, and writing skills, crucial for effective interaction and teamwork.																		
CLR-3	prepare students for employability by building competence in interviews, group discussions, and professional communication.																		
CLR-4	promote understanding and sensitivity towards linguistic and cultural diversity, key to thriving in a globalized world.																		
CLR-5	articulate ideas and emotions clearly, overcoming language barriers.																		
CLO	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity Solving	Communication Skills,	Independent Thinking, Analytical	Leadership Qualities,	Digital Technology Skills	Value Inculcation, Multicultural	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO - 1	PSO - 2	
CLO-1	acquire basic proficiency in listening, speaking, reading, and writing, enabling effective interaction in everyday and academic scenarios.	☐	☐	-	-	2	85	75	3	-	-	1	3	3	-	2	2	1	
CLO-2	express ideas clearly using appropriate verbal cues and non-verbal signals in social, academic, and professional contexts.	☐	☐	☐	-	2	85	75	3	-	1	2	3	3	-	1	2	1	
CLO-3	enhance their ability to comprehend, evaluate, and respond to diverse forms of written and spoken communication critically.	☐	☐	☐	☐	3	85	75	3	-	3	1	3	3	-	1	1	2	
CLO-4	produce well-organized written documents and oral presentations, showcasing logical thinking and clarity of expression.	☐	☐	☐	☐	3	85	75	3	-	2	3	2	3	-	2	3	3	
CLO-5	demonstrate awareness and sensitivity towards linguistic and cultural diversity, effectively navigating multicultural interactions.	☐	☐	☐	☐	3	85	75	3	3	2	3	2	3	-	3	3	3	

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO - 4	CLO – 5
	12	12	12	12	12
SLO-1	Introduction to Communication. Types of Communication-	Introduction to Reading Skills. Discussion of techniques of Reading Skill	Introduction to Speaking Skills. Explaining the importance of phonetics and vocabulary	Introduction to Writing Skills Importance of writing skills	Introduction to appreciation of texts.

	verbal and non-verbal communication				
	Barriers of Communication dynamics of interpersonal communication, Interpret Cross-Cultural Differences in Non-Verbal Communication Develop and Demonstrate Effective Non-Verbal Communication Skills	Reading Skills. (Barriers of reading skills and strategies of effective communication through reading) Identifying common reading problems in students after making them read a few passages.	Speaking Skills. (Barriers of speaking skills and strategies of effective communication through speaking) Explaining the usage of the Oxford Learner's Dictionary to learn phonetics of the words at the fundamental level.	Writing Skills. (Barriers of writing skills and strategies of effective communication through writing) Explaining various forms of writing with examples.	Encouraging the students to share a few of their favourite lines from any sources they have read or sharing a few lines from paditthadhil piditthadhu.
SLO-2	Introduction to Digital language lab/ usage of mobile applications	Learners are enabled to record their speech and listen to it in order to correct their problematic areas	The right enunciation of certain words to be taught through phonetic representation and decoding the phonetic symbols by learning to use the dictionary.	Introduction to letter writing. Types of letters- Formal and Informal letters with examples. Learning E-mail etiquette.	Explaining why appreciating texts creates a good reader.
	Equipping the listening skill of the learners Listening Skills. (Barriers of listening skills and strategies of effective communication through listening) Exploring Effective Ways of Listening.	repetitive practices of reading select paragraphs from web resources, their standard will be measured.	Observe and repeat and learn the phonetic pronunciation of words by practicing continuously.	Class Assignment - write a formal letter and informal letter and check for e-mail etiquettes in writing.	Enabling the students to reflect in the classroom about any of their favourite books/ articles or magazines.
SLO-3	Introducing google podcasts.	The speed, fluency, pronunciation, comprehension of the words in the paragraph	Teaching the usage of Thesaurus to understand and develop various words and improve vocabulary.	Enabling the students to unleash their potentials in creative writing through writing transcripts for advertisements of any product.	Introducing the text of Letters by Mathrubootham published in the Hindu.
SLO- 4	Task to write down the words from the audio they have listened to. This activity should be done in two steps. 1. Jotting	hints and tricks to follow where the pauses are to be followed.	Identifying common errors in concord, preposition, direct speech and indirect speech.	write a review of any book or a movie or an interview or a debate.	Reading and recitation of the text of the first letter-Enjoy within limits, says Mr. Mathrubootham

	down the words simultaneously as they listen to the speaker. 2. Writing the transcript of the audio through repetitive play and pause.				Understanding characters by analyzing the usage of their style of language
SLO-5	Imitating the speakers by listening to them and attempting to learn the pronunciation of the words uttered in the audio.	Students group 1- reads – group 2 identifies the flaws in reading.	Identifying common errors in tenses, punctuation, and syntactical errors.	Mechanics of writing like capitalization, punctuation, spelling, correct pronoun, preposition, concord usage can be taught.	Reading of the second letter- Nobel? What Nobel, asks Mr. Mathrubootham.
	Repetitive listening to enhance pronunciation skills	The roles have to be exchanged between the two groups and the activity should be practiced.	Rectifying the common errors and instructing the learners about the right usage in order to avoid common errors.	meachnaics of writing - assessed and evaluated.	Mathrubootham's humour and the language of code switching from Tamil to English and vice –versa.
SLO-6	Introducing to the audios of TED TALK American Speakers. Listening to the native speakers of English Language through TED TALKS.	Identify the key arguments in a passage -introductory point, lead point, supportive argument statement, concluding point and the common connecting word between all the key words in the passage.	Practicing how to avoid common errors.	Teaching effective writing by learning to avoid common errors in concord, preposition, conjunction, relative pronouns, question tags.	Reading of the third letter -Mr. Mathrubootham is fully supporting all new technologies
	Introducing to the audios of TED TALK British Speakers. Listening to the native speakers of English Language through TED TALKS.	encouraged to identify the key arguments in other passages on their own.	The learners are introduced to collocations for quick choice of learning how to speak in short time and how to speak effectively.	Practicing effective writing by learning to avoid common errors in concord, preposition, conjunction, relative pronouns, question tags.	Mathrubootham's frustration over the failure of technologies and the language that he positively uses to denote hopelessness over technologies.
SLO-7	American and British styles can be differentiated.	Guiding the act of reading through scanning and skimming by model reading of the passages by the instructor.	Practice collocations	common errors in tenses, direct and indirect speech and syntax structure.	Reading of the fourth letter in the classroom and discussion Pizza maavu: Welcome to Mr. Mathrubootham food recipe website,
SLO-8	The recognition of different accents should be practiced by	scanning and skimming activities	Idioms and phrases	Practicing effective writing by learning to avoid common errors	Mathrubootham's love for food and the miscommunication

	speaking after listening.			in tenses, direct and indirect speech and syntax structure.	about food.
SLO-9	Learning advanced pronunciation and vocabulary through various computer applications like Woodpecker.	Loud reading and slow mind reading	A speaking task to learn- collocations, idioms and phrases, vocabulary and phonetic pronunciation	Teaching how to write statement of purpose for admission to higher educations, and practicing the same.	Analyisng the text for regional relevance and National significance.
	imitate the different sounds and accents - repeat it after listening to any of the videos from the library based on individual interest.	Pauses, pronunciation, comprehension and fluency can be checked for improvement at this stage through repetitive practices.	Their speaking activity is to be recorded and played again to rectify the errors and highlight the problematic areas in speaking.	Teaching how to write a story by looking at a picture. Developing the writing skill through word ladders.	Appreciating the aesthetics of the comic element and the embodiment of humour in the narrative in the letter
SLO-10	Repeat listening to the same time frames and move from 02.01 to 03.00	Students -groups -checking the comprehension skills. Analyse the text of a passage.	Automating vocabulary through engaging the students in various activity games like solving crossword puzzle and playing scattergories.	Introduction to blog writing and steps to become an effective blog writer.	importance of bringing in the Indianized way of speaking the English Language in order to depict the character called Mathrubootham.
	Choosing any particular time frame and practicing it.	Brainstorming the comprehension skills-questioning the key points in the passage.	Engaging the students to play the games in order to learn the vocabulary.	Encourage the readers to create their own blogs and post articles on a regular basis.	relatable characters of both formal and informal everyday life experiences.
SLO-11	Interested students can complete listening and reflecting the complete audio listening practice and speaking.	Cross check with misunderstanding if any and rectify- match the question and answers.	Spur of the moment speech.:	Selecting any news article and learning the writing style in it.	Talk about their favourite letter from the letters of Mathrubootham by recollecting the appreciation of the text according to their perception and understanding.
SLO-12					

	Group activities and games can be conducted to test the listening skills by responding to the speech given by other students	Passages for reading comprehension are to be given for practice that tests their reading skills.	Prepared speech: Giving a speaking task to the students to speak on their own choice	Students are given chances to write reports on various topics.	Enabling the students to share their appreciation of any of their favourite lines form the books they have read.

Resources

1	Horizon- English Text Book – Compiled and Edited by the Faculty of English Departement, FSH, SRMIST, 2023	5	The Art of Public Speaking by Stephen E. Lucas- 2019
2	The Creative Writing Coursebook: Forty Authors Share Advice and Exercises for Fiction and Poetry by Julia Bell and Paul Magrs- 2001	6	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds by Carmine Gallo – 2014
3	On Writing: A Memoir of the Craft by Stephen King 2000	7	The Anatomy of a Book Review: A Guide for College Students by Ronald J. Weber 1994
4	The Writing Life: Writers on How They Think and Work edited by Marie Arana - 2003	8	How to Write a Simple Book Review: It's easier than you think! by Allyson R. Abbott 2013

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA)(50%weightage)								Final Assessment (50 %weightage)	
		CLA–1 (10%)		CLA–2 (10%)		CLA– 3 (20%)		CLA– 4* (10%)			
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	-	20	-	20	-	15	-	20	-	20
2	Understand	-	20	-	20	-	15	-	20	-	20
3	Apply	-	20	-	20	-	20	-	20	-	20
4	Analyze	-	20	-	20	-	20	-	20	-	20
5	Evaluate	-	10	-	10	-	15	-	10	-	10
6	Create	-	10	-	10	-	15	-	10	-	10
Total (%)		100		100		100		100		100	

Strategies

Technology		Pedagogy/ Andragogy		Sustainable Development	
Simulations	☐	Clarification/Pauses	☐	GoodHealth&Well Being	☐
PresentationTools	☐	Group Discussion	☐	QualityEducation	☐
Learning Management System	☐	Hands-onPractice	☐	GenderEquality	☐
		Debate	☐		
		InteractiveLecture	☐		
		Brainstorming	☐		

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences

Designers					
Professional Experts		**Higher Institution Experts**		**Internal Experts**	
1	Krishna Raj Sutherland, Krishna.Raj1@sutherlandglobal.com	1	Dr. J Mangayarkarasi Associate Professor and Head, Department of English, Ethiraj College for Women, Chennai	1	Dr. Pushpanjali Sampathkumar, Assistant Professor, Department of English, FSH, SRMIST
		2	Dr. K S Antonysamy Loyola College Chennai antonysamyks@loyolacollege.edu	2	Dr. Shanthichitra, Professor, Department of English, FSH, SRMIST

Course Code	UCD24S03J	Course Title	Industry Oriented Employability and Leadership Skills	Category	S	Skill Enhancement Courses	L	T	P	C
							1	0	2	2

Course Offering Department	Career Guidance	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes									
CLR-1	Help students to develop essential skills to influence and motivate others																	
CLR-2	Inculcate emotional and social intelligence and integrative thinking for effective leadership																	
CLR-3	Create and maintain an effective and motivated team to work for the society																	
CLR-4	Nurture a creative and entrepreneurial mindset																	
CLR-5	Make students understand the personal values and apply ethical principles in professional and social contexts																	
Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity Solving	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to	Leadership Qualities, Professionalism, Autonomy,	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entreprenuerial Risk Taking	PLO-9	PLO-10
CLO-1	Examine various leadership models and understand/assess their skills, strengths and abilities that affect their own leadership style and can create their leadership vision	✓	✓	-	-	2	85	80	3	2	3	2	-	-	2	3	-	-
CLO-2	Learn and master a set of practical skills such as time management, self-management, handling conflicts, team leadership	✓	✓	✓	-	3	85	80	2	2	1	2	2	1	2	3	-	-
CLO-3	Understand the basics of entrepreneurship and develop business plan	✓	✓	✓	✓	3	85	80	2	3	3	3	-	3	2	3	-	-
CLO-4	Apply the design thinking approach for leadership	✓	✓	✓	✓	3	85	80	-	3	2	-	2	2	1	1	-	-
CLO-5	Appreciate the importance of ethics and moral values for making of a balanced personality & be an integral human being	✓	✓	✓	✓	3	85	80	3	3	2	2	2	2	2	3	-	-

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO - 4	CLO - 5
	9	9	9	9	9

SLO-1	Leadership - definition & Qualities	Team building & dynamics	Management – definition & Manager traits	Innovative leadership – Concept of emotional and social intelligence	Entrepreneurship
SLO-2	Leadership – styles	Work delegation with activity	Work schedule with activity	Synthesis of human and Artificial intelligence	Successful Indian entrepreneurs – case study
SLO-3	Difference between leader and boss	Decision making with activity	Strategic planning	Design thinking	Ethics – definition & Corporate ethics
SLO-4	Case study (based on leadership styles)	Motivation & Motivation for results	Conflict management	Measuring and Sustaining innovation	Importance of ethics
SLO-5	Leadership in diverse organizational hierarchy, cultures and communications	Argumentation, Persuasion, Negotiation, Networking	Energy Management & Novel Ways to manage energy in work place – activity	Case study: Organizations with sustained innovation.	Essential elements of business ethics
SLO-6	Leading the organisation through stability and turbulence	Interpersonal communication	Workforce management	Key elements of design thinking	Creating a harmonious life with work-life balance
SLO-7	Understanding Leadership and its importance.	Budget planning	Time Management	How to transform challenges into opportunities	Ethics and Conduct : Ethical decision-making
SLO-8	Models of Leadership	Workflow optimization	Recruiting and Retaining Talent	How to develop human-centric solutions for creating socially good humans	Importance of ethical principles in professional and social contexts.
SLO-9	Basic Leadership Skills	Critical thinking and Multitasking	Conflict & Stress Management	Emerging trends in design thinking	Building ethical culture: promoting ethical behavior in organization.

Resources

1	Craig E Johnson, Meeting the ethical challenges of leadership, Sage publications, 2018	4	Alexander Osterwalder, Business Model Generation, Wiley, 2013
2	T V Rao, Managers who make a difference: Sharpening your management skill, Random House India, 2016	5	Deborah Tannen, Talking from nine to five: Women and men in the workplace, Harper Collins Publishers, 2010
3	Allan R Cohen, David L Bradford, Influence without authority, Wiley, 2018	6	Dr Carrie Picardi Leadership Essentials you always wanted to know Vibrant Publishers,2021

Assessment									
Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)							
		CLA – 1		CLA – 2		CLA – 3		CLA – 4	
		(20 %)		(20 %)		(30 %)		(30%)	
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	5	5	5	5	15	15	10	10
2	Understand	5	5	5	5	15	15	10	10
3	Apply	25	25	25	25	20	20	20	20
4	Analyze	25	25	25	25	20	20	20	20
5	Evaluate	20	20	20	20	15	15	20	20
6	Create	20	20	20	20	15	15	20	20
Total (%)		100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Mr. P. Chockalingam, Senior Lead Software Engineer, Virtusa Consulting Services Private Ltd, DLF IT Park SEZ, Chennai – 600089 p.chockalingam1986@gmail.com -	1	Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeetham, Coimbatore - 641112 g_saravanaprabu@cb.amrita.edu -	1	Mrs.Deepalakshmi S, HOD, Department of Career Guidance, FSH, SRMIST hod.dcgc.ktr@srmist.edu.in
				2	Dr. Elamathiyan E, Assistant Professor, Department of Career Guidance, FSH, SRMIST, elamathe1@srmist.edu.in

Course Code	UMI24Y01L	Course Name	My India Project	Course Category	*P*	Internship/ Project/ Community Outreach	L	T	P	C
							0	0	0	0

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Chemistry*	Data Book / Codes/Standards	*Nil*		

(Assessment Method – Fully Internal)

	Continuous Learning Assessment	
	Review – 1 (Activities)	**Review – 2** (Project report and Presentation)
Project Work	50%	50%
Total	100%	

Semester -V

Course Code	UCY24D04J	Course Title	Instrumental Methods of Analysis	Category	D	Discipline Specific Elective	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	Gain practical knowledge of Instrument handling, sample preparation, data recording, maintenance, and interpretation	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Learn the principle, instrumentation, and basic applications of infra-red (IR) spectroscopy and interpretation of an IR spectrum																	
CLR-3	Learn the principle, instrumentation, and basic applications of ultraviolet-visible (UV-vis) spectroscopy and interpretation of a UV spectrum																	
CLR-4	Understand the concept of chromatography and simple applications of thin-layer chromatography (TLC)																	
CLR-5	Acquire knowledge about the electroanalytical techniques and their applications																	
Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Prepare sample for IR analysis, collect data and interpret the resulted IR spectrum for simple molecules	✓	✓	✓	✓	3	85	75	3	-	3	-	-	-	-	-	-	3
CLO-2	Prepare sample for UV-vis analysis, collect data and interpret the UV-vis spectrum for simple molecules	✓	✓	✓	✓	3	85	70	3	-	3	-	-	-	-	-	-	3
CLO-3	Perform TLC analysis and resolve different components of a multi component mixture (plant extract or chemical reactions)	✓	✓	✓	✓	4	85	70	3	-	2	-	-	-	-	-	2	-
CLO-4	Analyze and identify pH of a given sample	✓	✓	✓	✓	4	85	70	2	-	3	-	-	-	-	-	-	3
CLO-5	*Estimate the ions present in given solution using electroanalytical methods*	✓	✓	✓	✓	*4*	*85*	*60*	*3*	-	*3*	-	-	-	-	-	*2*	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	IR spectroscopic analysis	UV-vis spectroscopic analysis	TLC analysis	Electroanalytical methods - 1	Electroanalytical methods - 2
	15	15	15	15	15
SLO-1	Treatment of analytical data, including error analysis, classification of analytical methods, and various types of instrumental methods	Fluorescence, photoacoustic excitation sources – lasers, time resolution	Detection: simple vs. specific (gas and liquid)	Atomic absorption spectroscopy (AAS) : Introduction and Working principle	Electroanalytical methods: Potentiometry – principles
SLO-2	Consideration of electromagnetic radiation, interaction of radiations with molecules, special problems for portable instrumentation and rapid detection, and Advantages of Fourier-Transform Infrared (FTIR) spectroscopy	Wavelength dispersion (gratings, prisms, interference filters, laser, placement of sample relative to dispersion, resolution)	Mass spectroscopy – Instrumentation	AAS – Instrumentation, single beam double beam, sensitivity and detection limit	Potentiometry – Instrumentation and types of electrodes
SLO-3	Means of excitation (light sources) and separation of the spectrum (wavelength dispersion and time resolution)	Detection of signals (photocells, photomultipliers, diode arrays, sensitivity and signal-to-noise ratio)	Ionization Techniques: Introduction	AAS – Interferences and applications in AAS	Electroanalytical methods: Potentiometry – applications
SLO-4-5	Practice: Introduction – Lab safety/protocol	Practice: Validating Beer-Lambert law by finding the absorbance of a dye in UV-vis spectrophotometer	Practice: Separation, Identification, and reporting Rf values of ingredients present in the mixture – Monosaccharides present in the given mixture (glucose & fructose) by paper chromatography	Practice: Determination of the concentration of acid by pH meter	Practice: Estimation of ions by potentiometric titration (acid-base reaction)
SLO-6	Sample preparation for IR measurement – precautions	Single and Double Beam UV-vis instruments:	Making liquids and solids into ions (electrospray and electrical	Atomic Emission spectroscopy – Principles	Radiochemical Methods: Introduction

	and limitations	Interpretations (quantification, mixtures, absorption vs. fluorescence, use of time, photoacoustic, and fluorescent tags)	discharge methods)		
SLO-7	Functional group identifications using IR technique	Separation techniques – TLC, preparative TLC	Making liquids and solids into ions (laser desorption and fast atom bombardment)	Atomic Emission spectroscopy: Instrumentation	Radiochemical Methods: Instrumentation
SLO-8	Applications: Issues of quality assurance (QA) and quality control (QC)	Separation techniques – Gas chromatography	Separation of ions on the basis of mass-to-charge ratio	Atomic Fluorescence spectroscopy: Applications	Radiochemical Methods: Neutron Activation Methods
SLO9-10	Practice: Analysis of IR spectra of various compounds with aldehyde and ketone functionalities	Practice: Determination of a mixture of cobalt and nickel ions using a UV-vis experiment	Practice: Separation, Identification, and reporting Rf values of ingredients present in the mixture – Active ingredients of plants, flowers, and Juices by TLC	Practice: Cyclic voltammetry of the ferrocyanide/ferricyanide couple	Practice: Estimation of ions by potentiometric titration (precipitation reaction)
SLO-11	Detection of signal (heat and differential detection)	Separation techniques - Liquid chromatography: Importance of column chromatography (packing and capillary)	Separation of ions on - Effect of magnetic field and time of flight	Electroanalytical methods: Voltammetry – Introduction	Radiochemical Methods: Isotope dilution methods
SLO-12	Interpretation of spectrum (qualitative mixtures and resolution)	Separation based on increasing number of factors (volatility and solubility)	Electric quadrupole, resolution, and tandem mass spectrometry	Electroanalytical methods: Voltammetry – instrumentation, limitations	X-ray analysis (surface analysis)
SLO-13	Sample preparation for UV-vis measurement – precautions and limitations	Separation based on increasing number of factors (interactions with stationary phase and size)	Mass spectra and their interpretations	Voltammetry – Interpretation of a voltammogram	Electron spectroscopy (surface analysis)
SLO-14-15	Practice: Study the effect of different solvents on UV-vis spectra of organic molecules (i.e., solvent mixture of acetone and water) using UV-vis spectrophotometer	Practice: Quantitative analysis of mixtures by gas chromatography (i.e., mixture of chloroform and carbon tetrachloride)	Practice: Determination of concentration of mixture of acids by conductometric method	Practice: Estimation of ferrous ions by potentiometry (using potassium dichromate solution)	Practice: Estimation of ions by potentiometric titration (redox reaction)

Resources			
1	*Douglas A. Skoog, F. James Holler, and Stanley Crouch, Principles of Instrumental Analysis -6th edition, 2007*	5	*Willard, Merritt, Dean, Instrumental Methods of Analysis, Settle 7th edition, 1988*
2	*P.W. Atkins: Physical Chemistry, 8th edition, 2006*	6	*G.W. Castellan: Physical Chemistry*
3	*C.N. Banwell: Fundamentals of Molecular Spectroscopy, 3rd edition, 1972*	7	*Y.R. Sharma, Elementary Organic Spectroscopy: Principles and Chemical Applications, 5th edition, S. Chand and Company Ltd., Ram Nagar, New Delhi, 2010*
4	W.J. Moore: Physical Chemistry, 4th edition, 1972	8	*D.A. Skoog, D.M. West, and F.J. Holler, Analytical Chemistry: An Introduction, 5th edition, Saunders College publishing, Philadelphia, 1990*

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)								Final Assessment (50 % weightage)	
		CLA – 1 (10 %)		CLA – 2 (10 %)		CLA – 3 (20 %)		CLA – 4* (10%)			
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	15	15	15	15	10	10	10	10	15	15
2	Understand	15	15	15	15	10	10	10	10	15	15
3	Apply	20	25	25	20	25	25	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15	10	10
6	Create	15	10	10	15	15	15	15	15	10	10
	Total (%)	100	100	100	100	100	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	-		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra* *General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra,* *Email Id: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar* *Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. M.R. Ganesh,* *Department of Chemistry, SRM IST* *Email: ganeshm1@srmist.edu.in*
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Course Code	UCY24D03J	Course Title	Computational Modeling in Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	0	2	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*	Data Book / Codes/Standards	Nil

Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	Understand the foundational concepts and principles of quantum mechanics, including the inadequacies of classical mechanics and the motivation for quantum theory.	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	*Gain knowledge of the force field and electronic structure methods.*																	
CLR-3	*Acquire knowledge about correlation method and basis set.*																	
CLR-4	*Promote the use of DFT and wave function principle*																	
CLR-5	*Acquire a practical understanding of employing these methods.*																	

Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Facilitate students in cultivating a thorough comprehension of the fundamental principles of quantum mechanics in the context of exploring atomic and molecular structures.	✓	✓	-	-	*2*	*85*	*75*	*3*	-	*3*	-	-	-	-	-	*3*	-
CLO-2	*Gain knowledge about the correlation method and basis set*	✓	✓	✓	-	*2*	*85*	*75*	*3*	-	*3*	-	-	-	-	-	-	*3*
CLO-3	*Understand about DFT and other methods*	✓	✓	✓	✓	*3*	*85*	*75*	*3*	-	*3*	-	-	-	-	-	-	*3*
CLO-4	Understand the wave function principles and computable molecular properties	✓	✓	✓	✓	*3*	*85*	*75*	*3*	-	*3*	-	-	*3*	-	-	*3*	-
CLO-5	Acquire a *practical understanding of employing electronic structure methods.*	✓	✓	✓	✓	*3*	*85*	*75*	*3*	-	*3*	-	-	-	-	-	*3*	*3*

Title & Content	Introduction: Quantum Chemistry	Electronic Structure Methods	Basis Sets and DFT Methods	Force Field Methods	Illustrating The Concepts
Duration (hour)	15	15	15	15	15
SLO-1	A Brief Review of Elementary Quantum Chemistry	Electronic Structure Methods	Slater and Gaussian Type Orbitals	An Introduction to Force Field Methods	Wave Function Analysis

SLO-2	Introduction to Quantum Mechanics	The Adiabatic and Born–Oppenheimer Approximations	Classification of Basis Sets	The Force Field Energy	Illustrating the Concepts: Geometry, total energy
SLO-3	Black Body radiation, Planck's radiation law, Photoelectric effect and Bohr's Model	Self-Consistent Field Theory Koopmans' Theorem	Contracted Basis Sets	The stretch energy, the bending energy and the out-of-plane bending energy, The torsional energy	Geometry Convergence and Total Energy Convergence
SLO-4-5	**Practice:** Introduction to Computational Experiments	**Practice:** Spectral Analysis for Aromatic and Aliphatic Derivatives	**Practice:** Preparation of Dimer Clusters eg. Water-Water and Benzene-Water Dimer	**Practice:** Introduction to Databases	**Practice:** Potential energy surface of small molecues (eg. H2, O3)
SLO-6	Compton effect, de-Broglie's hypothesis,	The Basis Set Approximation	Density Functional Methods and Kohn–Sham Theory	The van der Waals energy, The electrostatic energy: charges and dipoles, The electrostatic energy: multipoles and polarizabilities	symmetry analysis
SLO-7	Heisenberg's uncertainty principle	An Alternative Formulation of the Variational Problem	Reduced Density Matrix Methods	Force Field Parameterization	harmonic vs fundamental-frequencies
SLO-8	Postulates of quantum mechanics and need for quantum mechanical operators	Restricted and Unrestricted Hartree–Fock SCF Techniques	Exchange and Correlation Holes and Exchange–Correlation Functionals	Differences in Force Fields and Computational Considerations	Dipole Moment Convergence and Vibrational Frequency Convergence
SLO-9-10	**Practice**: Molecular Representaion and Building a Small Molecules and Atomic Coordinates	**Practice:** NMR Analysis for Aromatic and Aliphatic Molecules	**Practice:** Binding Energy Analysis of Dimer using Counterpoise and BSSE Methods	**Practice:** CCDC and PDB Data Base	**Practice:** Transition State Analysis.
SLO-11	Introduction to degeneracy	Periodic Systems	Performance and Properties of Density Functional Methods	Validation of Force Fields	Bond Dissociation Curves
SLO-12	Schrödinger equation	Semi-Empirical Methods	DFT Problems	Advantages and Limitations of Force Field Methods	Angle Bending Curves
SLO-13	Quantization of energy levels, Zero-Point Energy (ZPE), wavefunctions, probability distribution functions and nodal properties	Parameterization, Performance of Semi-Empirical Methods Huckel theory	Computational Considerations	Transition Structure Modelling and Hybrid Force Field Electronic Structure Method	Problematic Systems, FOOF, CO, O3 and Relative Energies of C4H6 Isomers

SLO-14-15	**Practice**: Small Molecules Optimzations and Frequency Analysis (eg., IR)	**Practice:** UV-Visible Absorption Analysis	**Practice:** Benchmark Studies on Dimer Clusters with Different Method and Basis sets.	**Practice:** Protein-Ligand Preparation Using PDB Data Base & Force Field Types	**Practice:** Electrostatic Potential of Small Molecules.

Resources			
1	Peter Atkins & Julio De Paula, *Physical Chemistry 8th* Ed., Oxford University Press (2008).	5	*Frank Jensen, Introduction to Computational Chemistry, John Wiley & Sons,1999*
2	Cramer, C.J., Essentials of Computational Chemistry, John Wiley & Sons, 2004	6	Lewars, E., Computational Chemistry, Kluwer Academic Publisher, 2003
3	A. Szabo and N. S. Ostlund, Modern Quantum Chemistry, Introduction to Advanced Electronic Structure Theory, 1st ed., revised (Dover, 1989). More mathematical detail for many of the ab initio electronic structure methods	7	D. A. McQuarrie, Quantum Chemistry (University Science Books, Mill Valley, CA, 1983). Very readable introductory text for undergraduate-level quantum chemistry
4	Physical Chemistry: A Molecular Approach [1 ed.] - Donald A. McQuarrie, John D. Simon, University Science Books, 1997	8	Elements of physical chemistry, 5th Edition - Peter William Atkins, Julio De Paula, Oxford University Press, 2009

Assessment

Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)						Final Assessment (50 % weightage)	
		CLA – 1 (10 %)		CLA – 2 (10 %)		CLA – 3 (30 %)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	40%	40%	40%	40%	30%	30%	40%	40%
2	Understand								
3	Apply	40%	40%	40%	40%	40%	40%	40%	40%
4	Analyze								
5	Evaluate	20%	20%	20%	20%	30%	30%	20%	20%
6	Create								
Total		100 %		100 %		100 %		100 %	

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	✓	Clarification/Pauses	✓	Good Health & Well Being	
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar, Department of Chemistry, IIT Madras, Pgsekar@iitm.ac.in*	1	*Dr. E. Varathan, Res. Asst. Prof., varathae@srmist.edu.in*
2	*Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka, Ravikiran.Allada@Steri-science.com*	2	*Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, kanishka@jncasr.ac.in*	2	*Prof. M. Arthanareeswari, Department of Chemistry, SRMIST* *Email: arthanam@srmist.edu.in*

Course Code	UCY24D06J	Course Title	Organometallics and Bioinorganic Chemistry	Category	D	Discipline-Specific Elective	L	T	P	C
							3	0	2	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	Gain knowledge of the basic concepts of organometallic chemistry																	
CLR-2	Address concepts related to organometallic chemistry using stability based on 18-electron rule																	
CLR-3	Get knowledge on organometallic compounds as various types of catalyst																	
CLR-4	Employ various organic reactions towards the design of fine chemical and drug molecules for industries																	
CLR-5	Utilize the bioinorganic chemistry in various pharmaceutical problems and identify appropriate solutions																	

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural Inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Employ 18-electron rule to rationalize the stability of organometallic compounds	✓	✓	✓	-	2	75	75	3	3	-	-	-	2	-	-	-	-
CLO-2	Apply concepts of organometallic chemistry in fine chemical for industry	✓	✓	✓	-	2	75	70	-	3	-	-	-	3	-	-	2	-
CLO-3	Develop a general idea of catalysis and describe the mechanism in detail	✓	✓	✓	✓	3	75	75	-	-	3	3	2	-	-	-	-	-
CLO-4	Solve periodically by incorporation of organometallic compounds into organic synthesis problems	✓	✓	✓	✓	3	75	60	3	-	-	3	-	-	-	-	3	-
CLO-5	Explain the sources and consequences of excess and deficiency of trace metals and learn about the toxicity of certain metal ions	✓	✓	✓	✓	3	75	70	-	3	-	3	-	-	-	-	-	3

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Introduction to organometallic chemistry	Organometallic chemistry with π-systems	Catalytic reactions	Bioinorganic chemistry-I	Bioinorganic chemistry-II
	15	15	15	15	15
SLO-1	Introduction to organometallic chemistry, type of ligands and coordination-hapticity.	Introduction of organometallic compounds containing π-systems, synthesis, and properties	Introduction: catalytic reactions and their applications, homogeneous catalysis, Wilkinson catalyst.	Introduction to bioinorganic chemistry: porphyrin systems and their functions	Introduction of non-porphyrin systems and their functions
SLO-2	Transition metal carbonyl complexes-synthesis and	Organometallic compound synthesis, structure, bonding.	Hydroformylation and acetic acid synthesis	Porphyrins in photosynthesis photosystems I and II.	Non-heme proteins-hemocyanin and hemerythrin, electronic

	reactivity				structure and oxygen bindings
SLO-3	MO of carbonyl ligand, eighteen electron rule-electron counting and limitations	Reactivity of transitional metal complexes with alkynes	Feedstocks for chemical industry metathesis and hydrogenation	Essential and non–essential metals Toxicity of metals – Cd, Hg and Cr toxic effects with specific examples	Ion (Na+ and K+) transport-ion channel ion carrier and ion pump
SLO-4-6	Laboratory: Introduction and safety measures	Laboratory: How to use air-sensitive compounds. Schlenk flask/line techniques.	Laboratory: Preparation of 1M solution of *n*-BuLi.	Laboratory: Synthesis of 1,1'-bis(diphenylphosphino)ferrocene	Laboratory: Binding of Ag+ to histidine
SLO-7	Nitrosyl containing complexes, structure of mononuclear and polynuclear metal carbonyl.	Π-allyl, enyl, butadiene, pentadienyl, cyclobutadiene complexes	Metal-carbenes, synthesis and reactivity.	Chlorophylls and their coordination geometry	Electron transfer proteins: active site structure and functions of ferredoxin and rubredoxin
SLO-8	Ligand substitution reactions and ligand insertion reactions	Π-allyl, enyl, butadiene, pentadienyl, cyclobutadiene complexes	Heterogeneous catalysis: Fischer-Tropsch reaction	Hemoglobin, and their coordination geometry, electronic structure and co-operativity	Nitrogen fixation.
SLO-9	Ligand substitution reactions and ligand insertion reactions	Metallocenes complexes and benzenoid complexes	Ziegler-Natta polymerization and polymer-bound catalysts	Hemoglobin, and their coordination geometry, electronic structure and co-operativity	Metalloenzymes containing molybdenum and iron.
SLO-10-12	Laboratory: Preparation of absolute solvents	Laboratory: Preparation of Ferrocene	Laboratory: Synthesis of bromoferrocene (mono or di)	Laboratory: Synthesis of [Pd(dppf)Cl2]	Laboratory: Repeat of experiments
SLO-13	Metal dinitrogen and dioxygen complexes	Migratory insertion reaction with alkenes, alkynes	Olefinic oxidation and addition of HX to olefins	Oxygen binding and transport of hemoglobin	Cobalt: cobalamine based enzymes and nickel: urease
SLO-14	Metal hydride complexes. transition metal organometallics	Substitution reactions-electrophilic and nucleophilic attack on coordinated ligands	Carbonyl insertion, hydride elimination and abstraction	Cytochromes-types- structure and electron transfer reactions	Hydrogenases and dehydrogenases copper: electron transport
SLO-15	Square planar complexes. Vaska's complex-synthesis and reactivity	Oxidative addition and reductive elimination	Vollhardt reaction and oligomerization reaction	Cytochrome p-450, monooxygenase, Catalase and peroxidase	Zinc: carboxypeptidase-A and carbonic anhydrase
SLO-16-18	Laboratory: Synthesis of [Pd(allyl)Cl]2 complex	Laboratory: Preparation of [Pd (PPh3)4] complex.	Laboratory: Synthesis of acetylferrocene (mono or di)	Laboratory: Repeat of experiments	Laboratory: Repeat of experiments

Resources

1	*J. E. Huheey, E. A. Keiter, R. L. Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson 2006.*	5	*F. A. Cotton, G. Wilkinson, P. L. Gaus, Basic Inorganic Chemistry 3rd Ed. Wiley India 1998.*
2	*N. N. Greenwood, A. Earnshaw, Chemistry of the Elements 2nd Ed, Elsevier, (Ziegler Natta Catalyst and Equilibria in Grignard Solution), 1997.*	6	*G. O. Spessard, G. L. Miessler, Organometallic Chemistry, Prentice Hall, 1997.*
3	*B. E. Douglas, D. H. McDaniel, J. J. Alexander, Concepts and Models in Inorganic Chemistry 3rd Ed., John Wiley and Sons, NY, 1994.*	7	*W. Kaim, B. Schwederski, B. Bioinorganic chemistry: Inorganic Elements in the Chemistry of Life, Wiley, 2006.*

4	*P. Powell, Principles of Organometallic Chemistry, Chapman and Hall, 1988.*	8	*I. Bertini, H. B. Gray, S. J. Lippard, J. S. Valentine, Bioinorganic chemistry, University Science Books, 1994.*

Assessment									
Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)						Final Assessment (50 % weightage)	
		CLA – 1 (10 %)		CLA – 2 (10 %)		CLA – 3 (30 %)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	40%	40%	40%	40%	30%	30%	40%	40%
2	Understand								
3	Apply	40%	40%	40%	40%	40%	40%	40%	40%
4	Analyze								
5	Evaluate	20%	20%	20%	20%	30%	30%	20%	20%
6	Create								
Total		100 %		100 %		100 %		100 %	

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations	-	Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	-	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Ravikiran Allada, Director, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka Email: Ravikiran.Allada@Steri-science.com	1	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. Rajorshi Das, Department of Chemistry, SRMIST Email: rajorshd@srmist.edu.in
2	Dr. Sudarshan Mahapatra,General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra Email Id: sudarshan.m@encubeethicals.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Course Code	UCY24D05J	Course Title	Polymer and Industrial Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	0	2	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	The purpose of learning this course is to:
CLR-1	Acquire knowledge on synthesis of polymers and determination of their molecular weights and thermomechanical properties.
CLR-2	Understand the properties and applications of commercial polymers
CLR-3	Gain knowledge on specialty polymers, polymer blend and composites and plastic waste management
CLR-4	Gain knowledge on various industrial fuels, basic concepts in water treatment and about pollution control
CLR-5	Study in depth about the use of various fertilizers in agriculture, manufacture of cement and glass

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Can determine Molecular weight, Tg and Tm, and establish structure property relationships of polymers.	✓	✓	✓	✓	2	85	75	3	3	-	-	2	-	-	-	-	-
CLO-2	Learn properties and applications of various useful polymers in our daily life	✓	✓	✓	✓	2	85	75	3	3	-	-	-	-	-	-	3	-
CLO-3	Get knowledge on ionic, conducting and biopolymers	✓	✓	✓	✓	3	85	75	3	3	-	-	-	-	-	-	-	2-
CLO-4	Modern use of polymers for today's on-demand applications	✓	✓	✓	✓	3	85	75	3	-	-	3	-	-	2	-	-	
CLO-5	Gain knowledge about the manufacturing process of cement, glass and ceramics	✓	✓	✓	✓	3	85	75	3	3	-	-	3	-	-	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Polymer types and physico-chemical property relationships	Synthesis of commercial polymers	Specialty polymers	Energy and fuels	Fertilizers, cement and glass

	15	15	15	15	15
SLO-1	Polymers: monomers, oligomer and polymers hierarchy, Nomenclature of polymers.	Commercial Polymers: Plastics –Thermoplastics and themosets: Manufacturing processes, properties and applications of Low-density polyethylene (LDPE) and high-density polyethylene (HDPE) Manufacturing processes, properties and applications of LDPE and HDPE	Specialty polymers – Biopolymers. classification of ionic liquids	Energy sources- Classification of fuels –solid- liquid and gaseous types	Fertilizers- NPK- superphosphate- triple superphosphate- uses of mixed fertilizers
SLO-2	Average molecular weight, molecular weight distribution and polydispersity Index	Polypropylene, Polystyrene Polyvinyl chloride (PVC), Poly (methyl methacrylate) (PMMA).	Engineering polymers and their applications.	Calorific value of fuels and its determination. Solid fuels – coal- lignite- sub-bituminous coal- bituminous coal and anthracite. Coking and non-coking coal. Liquid fuels – petroleum refining and uses.	Micronutrients and their roles. Biofertilizers- plant growth harmones
SLO-3	Determination of molecular weights (Mn and Mw) of polymers based on the given data.	Polyacrylo nitrile (PAN), Polyacrylic acid (PAA), Polymethacrylic acid (PMMA). Advanced polymer synthesis method (CRP) for the preparation of PS, PMMA, PAN, PAA and PMAA.	How engineering polymers cause pollution in rubber industry In what ways engineering polymers are hazardous to the environment and how to control their pollution.	Octane number. Production and uses of tetraethyl lead- ethyl tertiary-butyl ether (ETBE) and methyl tertiary-butyl ether (MTBE). Gaseous fuels - natural gas and gobar gas –production-composition and uses-construction of gobar electric cell.	Discuss the real-life applications of the fertilizers.
SLO-4 ,5	Practical: Determination of molecular weight of a polymer using viscosity measurement.	Practical: To find out the acid number and hydroxyl number of a given polymer (using FTIR or UV)	Practical: To find out conductivity of polymeric sample solution via conductometric titration.	Practical: calculating octane numbers in common cooking oils	Practical: Estimation of metal ions (sodium and potassium) in soil samples

SLO-6	Classification, structurual elucidation and physicocheical property of polymers.	Polyamides –Nylon 6.6 and Nylon 6. Aromatic polyamides –Nomex, Kevlar.	Discussion on specilaity and engineering polymers.	Discuss the green energy and compare with the other fuel-based energy systems available.	Manufacturing methods and uses of insecticides; Herbicides - manufacture of 2,4-D and 2,4,5-T.
SLO-7	Types of polymerizations. polymerization techniques: bulk and solution mechanisms, emulsion and suspension mechanisms, Relative advantages and disadvantages of polymerization techniques.	Polyesters –PET. Unsaturated polyesters. Polycarbonates –Acetal resins –Polysulphones- PPO. Polycarbonates –Acetal resins –Polysulphones-PPO	Plastic Waste management – Chemical recycling Incineration.	Introduction- Hardness of water- temporary and permanent hardness estimation of hardness – EDTA method and alkali titration method.	Fungicides -preparation of Bordeaux mixture-lime-sulphur creosote oil (formula only).
SLO-8	Different types of polymerization techniques, Bulk, Solution, Emulsion and Suspension techniques, with examples.	Polycarbonate-Acetal resins-Polysulphones- PPO - Polycarbonates –Acetal resins –Polysulphones-PPO Phenolic resins –Novalac formation –Resole formation.	Incineration-Pyrolysis –mixed waste Recycling.	Estimation of hardness – EDTA method and alkali titration method. Water softening methods - Zeolite process- ion-exchange demineralisation. mixed bed deionisation.	Discuss in detail the advantages and disadvantages of Fungicides and Herbicides. Pesticides- classification of pesticides with examples Insecticides - stomach poisons. Contact insecticides - fumigants.
SLO-9,10	Determination of number average molecular weight by end group analysis.	Practical: Synthesis of (any two) polymers (eg. polypyyrrole, polyaniline, etc.)	Practical: To find out bio-degradability of polymeric compound.	Practical: Determination of hardness of water- temporary and permanent hardness estimation of hardness – using alkali titration method.	Practical: Estimation of minerals (calcium and magnesium) in water samples
SLO-11	Structure of polymers, amorphous, semicrystalline and crystalline states.	Recent research progress on the design and synthesis of aromatic polyamides and polycarbonates.	Value addition and application of recycled materials.	Domestic waste water treatment. Purification methods – chlorination- break point chlorination. Reverse osmosis - Desalination. Other methods of waste water treatment.	Cement: Manufacturing – wet process and dry process Cement: types- analysis of major constituents- setting of cement-reinforced concrete

SLO-12	Glass transition, melting and crystallization temperature.	Urea – formaldehyde, Melamine – formaldehyde resins. Synthetic Rubbers: Manufacturing steps, general properties and applications of Styrene-butadiene rubber (SBR), Polyisoprene.	Discuss in detail the plastic waste management. Blends/Alloys –Composites – Introduction, classification and synthesis methods.	Pollution: Air pollution –causes and effects. Acid rain-Greenhouse effect (global warming)-ozone layer depletion-Photochemical oxidants. Control measures of air pollution. Water pollution warming)	Glass: Composition and manufacture of glass. Types of glasses- optical glass - coloured glasses and lead glass.
SLO-13	Effect of structure on the chemical, mechanical, electrical and optical properties of polymers, physico-chemical property relationships of polymers.	Butyl rubber, Ethylene–propylene rubber, Neoprene rubber, Speciality rubbers: Silicon rubbers, Nitrile rubbers, Polyacrylic rubbers –Hypalon – Fluorocarbon Elastomers-Thermoplastics Thermoplastic elastomer Detailed discussion on application of rubbers in different areas	Blends/Alloys –Composites – limitations Examples and applications in various engineering fields: Biochemical and Agriculture fields. Examples and application in defense and aerospace departments Discuss the role of different kinds of nanofillers in determining the properties of composites.	Water pollution – organic pollutants- chemical oxygen demand (COD) Biological oxygen demand (BOD) - total organic carbons Carbondioxide capture and sequestration. Discuss more on air and water pollution.	Ceramics: Types- raw materials-white wares manufacturing methods and uses. Understand the differences between ceramic and glassy materials.
SLO-14,15	Practical: To check the solubility of the given polymeric sample in different solvents and to determine the melting point of crystalline polymers.	Practical: Synthesis of Phenol-formaldehyde/Aniline-formaldehyde/Urea-formaldehyde/ resins/Epoxy Resins	Practical: The degradation behavior of polymers as a function of change in temperaturen and pH (temperature and pH induced polymer degradation)	Practical: Determination of COD and BOD in tap water and lake water samples	Practical: Qualitaive analysis of contaminants in industrial waste water

Resources

1	S. Bhandari, P. Gupta, A. Dey, Industrial Applications of Polymer Composites, Vol.1, 2023	6	B. Tylkowski, K. Wieszczycka, R.Jastrząb and X. Montane, Polymer Engineering, 2nd, Revised Edition, 2022.
2	F. W. BillmeyerJr., Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.	7	V. T. Gowariker, N. V. Viswanathan, and J. Sreedar, Polymer Science, 1988.
3	M. Morton, Rubber Technology, Chapman Hall, 1995.	8	J. Brydson, Rubber Chemistry, Butterworths, 1978.
4	*P. Ghosh, Polymer Science and Technology of Plastics and Rubbers, Tata McGraw-Hill Publishing Company 1990.*	9	P. J. Flory, Principles of Polymer Chemistry Springer, 2006.
5	Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965.	10	M. P. Stevens, Polymer Chemistry, Oxford University Press, Inc, 1990

Assessment									
Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)						Final Assessment (50 % weightage)	
		CLA – 1 (10 %)		CLA – 2 (10 %)		CLA – 3 (30 %)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	15	15	15	15	10	10	10	10
2	Understand	15	15	15	15	10	10	10	10
3	Apply	20	25	25	20	25	25	25	25
4	Analyze	20	25	25	20	25	25	25	25
5	Evaluate	15	10	10	15	15	15	15	15
6	Create	15	10	10	15	15	15	15	15
	Total	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email Id: Email: sudarshan.m@encubeethicals.com	1	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. Arun Prakash P, SRMIST Department of Chemistry, SRMIST E-mail: arunprap1@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Dr. Samarendra Maji, SRMIST Department of Chemistry, SRMIST E-mail: samarenr@srmist.edu.in

Course Code	UES24V01T	Course Title	Environmental Studies	Category	V	Value Added Course	L	T	P	C
							2	0	0	2

Course Offering Department	Biotechnology	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	To create awareness on environment and renewable and non-renewable resources
CLR-2	To understand about ecosystem and biodiversity
CLR-3	To understand the natural and anthropogenic impact of the environmental pollution
CLR-4	To create awareness on different environmental problems
CLR-5	To create awareness on various environment protection acts and the impact of human population on environment

CLO	At the end of this course, learners will be able to:	Depth				Attainment			PLO										
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10	
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO 1	PSO 2	
CLO-1	Applying knowledge on renewable and non-renewable resources	✓	✓	-	-	1	75	70		-	1	-	-	2	1	-	-	-	
CLO-2	Understanding about ecosystem and biodiversity	✓	✓	-	-	1	80	75	3	2	-	1	-	-	2	-	-	-	
CLO-3	Gathering knowledge on impact of environmental pollution	-	✓	✓	-	2	80	75	-	3	2	-	3	-	3	-	-	-	
CLO-4	Understanding of different environmental problems	✓	-	✓	-	3	80	75	-	2	3	-	-	3	2	-	-	-	
CLO-5	Having knowledge on various environment protection acts and the impact of human population on environment problems	✓	-	✓	✓	3	80	75	-	-	3	-	3	2	1	-	-	-	

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO – 4	CLO - 5
	6	6	6	6	6
SLO - 1	Multidisciplinary nature of environmental studies, definition, scope and importance of environmental studies	Energy flow in the ecosystem, energy flow in the ecosystem, ecological succession	Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity	Disaster management- floods, earthquakes, cyclones, landslides	Air, water, wildlife - environment protection act
SLO - 2	Need for public awareness. institutions in environment, people in environment	Food chains, food webs and ecological pyramids	Environmental pollution- definition, causes, effects and control measures of air, water, and soil pollution	Social issues and the environment: From unsustainable to sustainable development	Forest conservation act; issues involved in enforcement of environmental legislation, public awareness
SLO - 3	Introduction to natural resources- renewable and nonrenewable resources - associated problems	Ecosystem, introduction, types, characteristic features, structure and functions: forest, grassland and desert ecosystems	Causes, effects and control measures of marine, and noise	Urban problems related to energy, water conservation, rain water harvesting, watershed	Human population and the environment: population growth, variation among nations
SLO - 4	Forest, water, mineral, food resources	Aquatic ecosystems; biodiversity and its	Causes, effects and control measures	Environmental ethics: issues and	Population explosion – family welfare

		conservation- genetic, species and ecosystem diversity	of thermal pollution and nuclear hazards	possible solutions, climate change & global warming	programme, human rights, value education
SLO - 5	Energy and land resources; role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles	Biogeographical classification of India, value of biodiversity, biodiversity at global, national and local levels	Role of individuals in pollution prevention	Acid rain & ozone layer depletion	HIV/AIDS, women and child welfare
SLO - 6	Concept of an ecosystem, structure and functions of an ecosystem, producers, consumers and decomposers	India as a mega diversity nation, hot-spots of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife man-wildlife conflicts, endangered and endemic species of India	Solid waste management Causes, effects and control measures of urban and industrial waste	Nuclear accidents and nuclear holocaust; wasteland reclamation	Role of information technology in environment and human health

Resources

1	Bharucha, E (2013). *Textbook of environmental studies for undergraduate courses* (2nd ed.). Orient BlackSwan.	3	Jeyalakshmi, R. (2014). Text book of environmental studies, Devi publications
2	Basu, M., & Savarimuthu, X., (2017), *SJ Fundamentals of environmental studies*. Cambridge University Press, Cambridge, United Kingdom	4	Bharucha, E (2002). *The Biodiversity of India*, Mapin Publishing Pvt. Ltd.

Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 %weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA– 3 (20%)	CLA– 4 * (10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	20	20	20	20	20
2	Understand	20	20	20	20	20
3	Apply	20	20	20	20	20
4	Analyze	20	20	20	20	20
5	Evaluate	20	-	20	20	20
6	Create	-	20	-	-	-
	Total (%)	100	100	100	100	100

Strategies				
Technology		Pedagogy / Andragogy		Sustainable Development
Presentation Tools	✓	Clarification/Pauses	✓	Good Health & Well Being ✓
Learning Management System	✓	Group Discussion	✓	Quality Education ✓
	✓	Hands-on Practice	✓	Gender Equality ✓
		Debate	✓	Life on Land ✓
		Interactive Lecture	✓	Clean Water and Sanitation ✓
		Brainstorming	✓	Affordable and clean energy ✓

*The evaluation can be done on one or more parameters that include, (i) Seminars, (ii) Mini-Project, (iii) Case-Studies, (iv) MOOC Certification, (v) Publication of Article, (vi) Presentation of Research Work in Conferences, (vii) Assignments

Designers

Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Arumugam Perumal, ARMATS BIOTEK Training and Research Institute, Chennai	1	Dr. N. Banu, Bharathi Women's College (Autonomous), Chennai	1	Dr. P. Parthipan, Assistant Professor, Department of Biotechnology, FSH, SRMIST, KTR

Course Code	UCD24S04J	Course Title	Career Readiness and Professional Skills	Category	S	Skill Enhancement Courses	L	T	P	C
							1	0	2	2

Course Offering Department	Career Guidance	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes										
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking,	Communication Skills,	Independent Thinking, Analytical	Leadership Qualities,	Digital Technology Skills	Value Inculcation, Multicultural	Environmental Action, Community	Entreprenuerial Risk Taking	PLO-9	PLO-10
CLR-1	Develop resume building practice																	
CLR-2	Prepare for interviews and group discussion																	
CLR-3	Understand the significance of team skills																	
CLR-4	Help students improve their speaking and presenting abilities																	
CLR-5	Acquire career planning skills and fully pursue a successful career path																	
Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*																	
CLO-1	Understand the importance of resume preparation and face interview confidently	✓	✓	-	-	*2*	*85*	*80*	2	3	2	3	-	-	-	-	-	-
CLO-2	Perform appropriately and effectively in group discussions	✓	✓	✓	-	*3*	*85*	*80*	2	3	2	3	-	1	2	3	-	-
CLO-3	Empathize with and trust colleagues for improving interpersonal skills	✓	✓	✓	✓	*3*	*85*	*80*	3	3	3	3	1	-	3	2	-	-
CLO-4	Prepare effective presentations considering the important strategies	✓	✓	✓	✓	*3*	*85*	*80*	1	3	2	3	-	2	2	-	-	-
CLO-5	Explore sources of (online/offline) opportunities	✓	✓	✓	✓	*3*	*85*	*80*	-	3	2	3	-	1	2	2	-	-

Sessions	CLO - 1	CLO - 2	CLO - 3	CLO - 4	CLO - 5
	9	9	9	9	9
SLO-1	Introduction of resume and its	Mock interview – face to face	Listening as a Team Skill	Types of Presentation -	Process of Career Exploration -

	Importance - Difference between a CV, Resume and Bio Data			Informative, Instructional, Arousing, Persuasive, Decision-making - Structure of a presentation – Introduction of the event, Introducing the speaker, vote of thanks	Knowing Yourself - Personal Characteristics
SLO-2	Essential components of a good resume, common errors people make while preparing a resume	Mock interview- Feedback	Trust and Collaboration - Importance of Collaboration in Organization	Improvisation and unprepared presentations, man-woman view, feedback – appreciation and critique - Dos and Don'ts	Knowledge about the World of Work - Requirements of Jobs including Self-employment
SLO-3	Resume building format -Video resume – Tips and tricks – Do's and Don'ts	Meaning and Importance of Group Discussion - types of Group Discussion	The Secret to be a high performing Team	PowerPoint presentation–body language and stage etiquette – practice session	Sources of Career Information - Career Opportunities
SLO-4	Meaning and types of interview (face to face, telephonic, video) - Dress code, background research	Procedure of Group Discussion - Ground rules - Evaluation of Group Discussion	Creativity - Meaning - Strategies to increase Creativity - creativity skills at the Workplace	PowerPoint presentation– practice session	Critical Thinking Skills - Problem Solving Skills - Ability to Learn
SLO-5	STAR Technique (situation, task, approach and response) for facing an interview	Group Discussion - Common Errors Group Discussion Rubric	Methods and Process of Creativity Skills	PowerPoint presentation– practice session	Non- Cognitive Skills - Types of non-cognitive Skills and Strategies
SLO-6	Interview procedure (opening, listening skills, closure, asking questions)	Group discussion – Types and Tips to follow	Social Skills - Peer Pressure	Presentation for Internal and External Communication - online & offline Meetings	Non-Cognitive Skills and Gaps I Socio Economic Status
SLO-7	Keys to attain success in an interview	Group Discussion Practice	Stress and Stress Management - Meaning Stress Management Techniques	Visual elements in Presentation	Brainstorming
SLO-8	Rules and Elements of an Interview	Email Drafting – formal and informal	Social and Cultural Etiquette	Oral Skills and Public Speaking Skills	Logic and Rationality of Critical Thinking
SLO-9	Preparation and Practice	Writing Email – Practice	Characteristics and Enhancing Social Skills	Speaking Skills – Practice	Habits and Traits of the Mind

Resources

1	*Scott Bennett, The Elements of Resume Style: Essential Rules for Writing Resumes and Cover Letters That Work, AMACOM, 2014*	4	*Paul Newton, How to deliver a presentation e-book*
2	*David John, Tricks and Techniques of Group Discussions, Arihant, 2012*	5	*Eric Garner, A-Z of Presentation, Eric Garner and Ventus Publishing ApS, 2012, bookboon.com*
3	*Singh O.P., Art of Effective Communication in Group Discussion and Interview, S Chand &*		

	Company, 2014		

Assessment									
Level of Thinking		Continuous Learning Assessment (CLA) (100% weightage)							
		CLA – 1 (20 %)		CLA – 2 (20 %)		CLA – 3 (30 %)		CLA – 4 (30%)	
		Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)	Theory (%)	Practice (%)
1	Remember	5	5	5	5	15	15	10	10
2	Understand	5	5	5	5	15	15	10	10
3	Apply	25	25	25	25	20	20	20	20
4	Analyze	25	25	25	25	20	20	20	20
5	Evaluate	20	20	20	20	15	15	20	20
6	Create	20	20	20	20	15	15	20	20
	Total (%)	100	100	100	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Mr. P. Chockalingam, Senior Lead Software Engineer, Virtusa Consulting Services Private Ltd, DLF IT Park SEZ, Chennai – 600089 p.chockalingam1986@gmail.com -	1	Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeetham, Coimbatore - 641112 g_saravanaprabu@cb.amrita.edu -	1	Mrs.Deepalakshmi S, HOD, Department of Career Guidance, FSH, SRMIST hod.dcgc.ktr@srmist.edu.in
				2	Dr. Muthu Deepa, Assistant Professor, Department of Career Guidance, FSH, SRMIST, muthudem@srmist.edu.in

Course Code	UCY24I02L	Course Title	Internship – II	Category	P	Project Work / Internship (P)	L	T	P	C
							-	-	-	1

Course Offering Department	English	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

CLR	The purpose of learning this course is to:
CLR-1	Gain practical experience within the business environment.
CLR-2	Acquire knowledge of the industry in which the internship is done.
CLR-3	Apply knowledge and skills learned in the classroom in a work setting
CLR-4	Develop a greater understanding about career options while more clearly defining personal career goals
CLR-5	Experience the activities and functions of business professionals.

CLO	At the end of this course, learners will be able to:	Depth				Attainment			Programme Learning Outcomes									
		1 Conceive	2 Design	3 Implement	4 Operate	1 Bloom's Level of Thinking	2 Expected Proficiency	3 Expected Attainment	1 Problem Solving, Critical Thinking, Creativity Solving	2 Communication Skills, Collaborating Skills	3 Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	4 Leadership Qualities, Professionalism, Autonomy, Accountability	5 Digital Technology Skills	6 Value Inculcation, Multicultural inclusivity	7 Environmental Action, Community Engagement	8 Entrepreneurial Risk Taking	9 PSO - 1	10 PSO -2
CLO-1	Identify areas for future knowledge and skill development	✓	✓	-	-	2	75	75	-	3	-	-	-	2	2	-	-	-
CLO-2	understanding of what is expected in the job market and what their standard of performance should be	✓	✓	✓	-	2	75	75	-	3	-	-	-	-	2	3	-	-
CLO-3	Build professional, as well as academic, contacts and begin the process of networking and support for your future careers.	✓	✓	✓	✓	3	75	70	-	2	-	-	-	3	-	2	-	-
CLO-4	Acquire knowledge of the industry in which the internship is done.	✓	✓	✓	✓	3	75	75	-	3	-	-	-	3	-	2	-	-
CLO-5	practical experience within the business environment	✓	✓	✓	✓	3	75	70	-	3	-	-	-	3	-	2	-	-

PROCESS	
Stage I	Identifying area of interest
Stage II	Review I
Stage III	Review II
Stage IV	Project report preparation
Stage V	Final Submission of the Project Report

	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
	Review – 1	**Review – 2**	**Project Report**	**Viva-Voce**
Project Work / Internship	*20%*	*30 %*	*30 %*	*20 %*

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra, General Manager at EncubeEthicals Private Limited Mumbai, Maharashtra Email Id: sudarshan.m@encubeethicals.com	1	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. T. Pushpa Malini Department of Chemistry, SRMIST Email: pushpamt@srmist.edu.in
2	Dr. Ravikiran Allada Head Analytical R&D and ASAT (AVP) || Steriscience (Strides) Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Prof. M. Arthanareeswari, SRMIST Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in

Semester -VI

Course Code	UCY24D07T	Course Title	Hydrogen Energy: Production, Storage and Transportation	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	Understand the properties of hydrogen fuel and its various types of production methods	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	To acquire fundamental knowledge of the electrolysis of water and their technological advancements	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills	Leadership Qualities, Professionalism Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLR-3	Acquiring the basic knowledge of hydrogen storage in liquids																	
CLR-4	Acquiring the basic knowledge of hydrogen storage in Solid																	
CLR-5	To address the importance of hydrogen transportation for various applications																	
Outcomes (CLO)	At the end of this course, learners will be able to:																	
CLO-1	Apply the knowledge to hydrogen production technology	✓	✓	✓	-	3	85	75	3	-	3	-	-	-	-	2	-	-
CLO-2	Construct and design the electrolyzers for industrial applications	✓	✓	✓	-	4	85	75	3	-	3	-	-	-	-	-	3	-
CLO-3	Skills to demonstrate and operate the liquid hydrogen storage technology	✓	✓	✓	-	4	85	70	3	-	-	-	-	3	-	-	3	-
CLO-4	Skills to demonstrate and operate solid-state hydrogen storage technology for industrial scale	✓	✓	✓	-	4	85	70	3	-	2	-	-	-	-	-	3	-
CLO-5	Describe the significance of hydrogen transport and safety	✓	✓	✓	-	3	85	75	3	-	3	-	-	-	3	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Introduction to hydrogen fuel and its production	Electrolysis of water	Hydrogen storage – liquid state	Hydrogen storage – solid state	Hydrogen transportation

	12	12	12	12	12
SLO-1	Fundamentals and use of hydrogen as a fuel	Fundamentals for electrolysis of water	Introduction to hydrogen storage	Fundamentals of adsorption-based materials for hydrogen storage in solids	Hydrogen transportation via hydrogen pipelines
SLO-2	Hydrogen production from hydrocarbons	Electrolysis of water reaction mechanism	Underground hydrogen storage	Adsorption-based solid-state hydrogen storage materials	Hydrogen transport via road
SLO-3	Hydrogen production from coal	Factors affecting the efficiency of electrolysis	Fundamentals of hydrogen compression and expansion	Metal hydrides for solid-state hydrogen storage	Options for long-distance hydrogen transmission
SLO-4	Tutorial: Significance of hydrogen as a fuel	Tutorial: Water electrolysis	Tutorial: Importance of hydrogen storage	Tutorial: Solid-state hydrogen storage	Tutorial: Hydrogen transportation
SLO-5	Hydrogen production from nuclear energy	Electrolysis of water-cell potential and thermodynamic feasibility	Thermodynamics of hydrogen compression	Fundamentals of metal hydrides for solid-state hydrogen storage	Hydrogen refueling stations
SLO-6	Hydrogen production from wind energy	Electrolytes for water electrolysis	Linear and liquid hydrogen compressors	Different types of hydrides for hydrogen storage	Use of hydrogen in internal combustion engines – Part-1
SLO-7	Hydrogen production from biomass	Photoelectrochemical hydrogen production	Electrochemical and adsorption-based compressors	Tailoring metal hydrides for practical applications	Use of hydrogen in internal combustion engines – Part-2
SLO-8	Tutorial: Renewable energy resources	Tutorial: Photoelectrochemical hydrogen production	Tutorial: Thermodynamics of hydrogen compression	Tutorial: Metal hydride-based solid-state hydrogen storage	Tutorial: Internal combustion engines of hydrogen fuel
SLO-9	Hydrogen production from solar energy	Different types of electrolyzer technologies	Compressed hydrogen tanks	Design and experimental facilities of Metal hydride system	Use of hydrogen in fuel cells
SLO-10	Hydrogen separation and purification	Electrolytic cell components and electrolyzer stacks	Hydrogen liquefaction	Novel materials and overall storage	Hydrogen sensing – Part-1
SLO-11	Global status of hydrogen supply and demand	Techno-economic status comparison of various hydrogen production routes	Liquid-state hydrogen storage	Overview of storage methods and economy	Hydrogen sensing – Part 2
SLO-12	Tutorial: Global scenario of hydrogen supply and demand	Tutorial: Electrolyzer technologies	Tutorial: Hydrogen liquefaction	Tutorial: Overall hydrogen storage and economy	Tutorial: Fuel cells and hydrogen sensing

Resources			
1	*Ram B. Gupta, Hydrogen Fuel: Production, Transport, and Storage, CRC Press, 2008*	3	*https://archive.nptel.ac.in/courses/103/101/103101215/*
2	*Angelo Basile and Adolfo Iulianelli, Advances in hydrogen production, storage and distribution, Elsevier, 2014*	4	*Ram B. Gupta, Angelo Basile, T. Nejat Veziroglu, Compendium of Hydrogen Energy, Vol.2, Hydrogen Storage, Distribution, and Infrastructure, Woodhead Publishing, Elsevier, 2016*

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
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Course Code	UCY24D08T	Course Title	Radioactive and Nuclear Chemistry	Category	D	Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:
CLR-1	Employ applications of radioactive chemistry in nuclear power and carbon dating.
CLR-2	Exploit rate of change and half- life in the context of nuclear decay.
CLR-3	Utilize the proper isotopic notation
CLR-4	Address types of nucle Address types of nuclear processes including fission, fusion and decay reactions
CLR-5	Apply the binding energy and mass defect for a given nucleus.

Outcomes (CLO)	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical	Communication Skills,	Independent Thinking, Analytical	Leadership Qualities, Professionalism,	Digital Technology Skills	Value Inculcation, Multicultural	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
		Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLO-1	Understand the basics of radioactive chemistry applications: nuclear power and carbon dating.	✓	✓	-	-	2	75	75	3	3	-	-	-	2	-	-	-	-
CLO-2	Realize the concept of rate of change and half- life in the context of nuclear decay.	✓	✓	✓	-	2	75	70	-	3	-	-	-	3	-	-	2	-
CLO-3	Use proper isotopic notation to write down and balance a nuclear reaction.	✓	✓	✓	✓	3	75	75	-	-	3	3	2	-	-	-	-	-
CLO-4	Identify and define various types of nuclear changes or processes including fission, fusion and decay reactions	✓	✓	✓	✓	3	75	70	3	-	-	3	-	-	-	-	3	-
CLO-5	Define binding energy and mass defect and be able to calculate each for a given nucleus.	✓	✓	✓	✓	3	75	70	-	3	-	3	-	-	-	-	-	3

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Radioactivity	Transmutation	Isotopes	Nuclear stability	Nuclear fusion
	12	12	12	12	12
SLO-1	Radioactivity: Introduction. types and units of radioactivity	Transmutation or disintegration of elements.	Isotope effects, Study of individual isotopes: ordinary and heavy hydrogen	Relation between nucleus stability and its packing fraction value, variation of packing fraction with mass number	Nuclear fusion: Introduction, discovery with examples
SLO-2	Detection and measurement of radioactivity: Electroscope method Wilson's cloud chamber method, Geiger-Muller counter method	Discovery of artificial transmutation, artificial transmutation reactions induced by alpha, proton, gamma, deuterons, neutron and triton	Preparation of deuterium, chemical properties and uses of deuterium, preparation of Tritium, chemical properties and uses of Tritium	Mass defect: binding energy of a nucleus and its calculation	Conditions necessary for nuclear fusion, energy released in nuclear fusion reactions
SLO-3	Types of radioactive rays, nature, mass, charge and representation of alpha, beta and gamma rays	Applications of artificial transmutation reactions	Preparation of deuterium, chemical properties and uses of deuterium, preparation of Tritium, chemical properties and uses of Tritium	Variation of nuclear binding energy with mass number and its relation with nuclear stability, binding energy per nucleon	Amount of energy released in the form of one 42He nucleus by the fusion of four 11H nuclei
SLO-4	Tutorial: Problem solving related to natural radioactivity	Tutorial: Construct the equations for transmutation reactions	Tutorial: Construct the equations related to deuterium	Tutorial: Calculation of mass defect	Tutorial: Problem solving related to nuclear fusion reactions
SLO-5	Comparison between a beta particle and electron, Soddy-Fajans and Russel group displacement law, emission of an alpha, beta and positron particles, addition of an electron: electron capture process	Important particles: alpha, beta, deuteron, triton, neutrino, neutron, proton and positron, discovery of new fundamental particles and their uses	Uses of radioactive isotopes as tracers: medical, industry, agriculture, biological field and analytical chemistry, Radio-carbon dating and roc-dating method	Nuclear shell model: Magic numbers	Origin of the energy of the sun and stars
SLO-6	Comparison between a beta particle and electron, Soddy-Fajans and Russel group displacement law, emission of	Preparations of isotopes of various elements, discovery and types of isotopes, Isotopes: representation and	Isotones-definition and composition, Isobars: characteristics production of isobars. Isobaric isotopes	Nuclear reactions: Introduction	Proton-proton cycle, carbon-nitrogen cycle,

	an alpha, beta and positron particles, addition of an electron: electron capture process	Characteristics			
SLO-7	Half-life of a radioactive substance, amount of a radioactive substance left undisintegrated or disintegrated in n half-life	Natural radioactive series: 4n, 4n+2, 4n+3 series, artificial radioactive series: 4n+1 series	Nucleus: discovery and properties, atomic number, mass number, atomic weight and fractional atomic mass	Difference between chemical and nuclear reaction, classifications of nuclear reaction	Hydrogen bomb, comparison between hydrogen bomb and atomic bomb
SLO-8	Tutorial: Calculation of half life, number of alpha and beta particles emitted	Tutorial: Probel solving related to radioactive series	Tutorial: Calculate age of wood	Tutorial: Calculation of binding energy	Tutorial: Different detectors
SLO-9	Disintegration constant, relation between half-life period and disintegration constant, relation between t and t0.5 average life period	Separation of isotopes: gaseous and thermal diffusion method, fractional evaporation, distillation process gravity and electromagnetic method	Calculation of atomic mass of an element having isotopes of different mass numbers	Bohr's theory of nuclear reactions. Q-value of a nuclear reaction, Bohr yield curve and amount of energy released	Detectors: scintillation counter and gas ionization chamber, proportional counter and Cerenkov counter
SLO-10	Radioactive equilibrium: law of successive disintegration	Identification of isotopes: Aston's mass spectrograph, Dempster's mass spectrograph	Atomic forces operate inside the nucleus of an atom, Meson exchange theory of the origin of nuclear forces	Liquid drop model, types of fission reactions chain reaction, Atom bomb: principle and explosion	Accelerators, cyclotron, synchrocyclotron, betatron, applications of radioactivity
SLO-11	Comparison between radioactive and chemical equilibrium, Activity of a radioactive substance	Production of an isotope by the emission of one alpha and two beta particles, Isotopes of hydrogen: structure and properties	Nuclear stability. Factor affecting the nuclear stability, Even and odd number of proton and neutron, Neutron to proton ratio and packing fraction	Components of nuclear reactor: Moderators, controlling rods, fuel element, heat transfer agent, and protective chamber, uses of nuclear reactor, nuclear power plant: constitution and working	Activation analysis, isotopic dilution technique, Radiometric titration
SLO-12	Tutorial: Calculation of N	Tutorial: Calculation of atomic weight	Tutorial: Calculate the percentage of isotopes	Tutorial: Problem solving related to nuclear fission reactions	Tutorial: Activation analysis

Resources			
1	*R. P. Sarkar, General and Inorganic Chemistry: Volume II, New Central Book Agency (P) Limited, 2009*	*4*	*R. D. Madan, Modern Inorganic Chemistry, S. Chand and Company Limited, 2017.*

2	*W. D. Loveland, D. J. Morrissey, G. T. Seaborg, Modern Nuclear Chemistry, John Wiley & Sons, 2006*	*5*	*L. G. Miessler, J. P. Fischer, D. A. Tarr, Inorganic Chemistry, Fifth edition, Pearson, 2014.*
3	*P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, F.A. Armstrong and M. Hagerman, Shriver and Atkins' Inorganic Chemistry, W. H. Freeman and Company, 5th Edition, 2010.*	*6*	*D. L. Walter, J. M. David, T. S. Glenn, Modern Nuclear Chemistry, John Wiley & Sons, 2005*

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
Total (%)		100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra* *General Manager at Encube Ethicals Private Limited* *Mumbai, Maharashtra* *Email Id: sudarshan.m@encubeethicals.com*	*1*	*Prof. G. Sekar* *Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1*	*Dr. Tarak Nath Mandal,* *Department of Chemistry, SRMIST* *Email: taraknam@srmist.edu.in*
2	*Dr. Ravikiran Allada* *Head Analytical R&D and ASAT (AVP) || Steriscience (Strides)* *Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	*2*	*Prof. Sukhendu Mandal* *Department of Chemistry* *IISER Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	*2*	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D09T	Course Title	Heterocyclic Compounds, Natural Products and Biomolecules	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	The introduction and chemical reactions of heterocyclic compounds.	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Heterocyclic compound for the development of therapeutic drugs.																	
CLR-3	Isolation, purification and structural elucidation of natural products.																	
CLR-4	Biomolecules for biological systems.																	
CLR-5	The introduction to enzymes, enzymatic reactions and inhibition.																	
Outcomes (CLO)	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community z	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Familiar with their particular properties, chemical reactions, criterion of aromaticity with reference to heterocyclic compounds.	✓	✓	✓	-	2	85	75	3	-	3	-	3	-	-	-	-	-
CLO-2	Know general methods of synthesis of heterocyclic compounds.	✓	✓	✓	-	2	85	75	-	3	-	-	-	2	-	-	2	-
CLO-3	Learn a practical approach to the structure elucidation of organic compounds with specific examples of alkaloids and terpenes.	✓	✓	✓	-	3	85	75	-	-	3	-	3	-	-	-	-	-
CLO-4	Demsonstrate and imply the synthetic chemistry knowledge of carbohydrates.	✓	✓	✓	-	3	85	75	3	3	-	-	-	-	-	-	3	-
CLO-5	Understand the synthetic importance of amino acids, peptides, enzymes, nuclei acids and lipids.	✓	✓	✓	-	3	85	75	3	3	-	-	2	-	-	-	-	3

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	The introduction and chemical reactions of heterocyclic compounds	*Heterocyclic compound for the development of therapeutic drugs*	*Isolation, purification and structural elucidation of natural products*	*Biomolecules for biological systems*	*The introduction to enzymes, enzymatic reactions and inhibition*
	12	12	12	12	12
SLO-1	Heterocyclic compounds: Introduction, importance, classification	General discussion on Structure, aromaticity 6-membered rings containing one heteroatom, Basicity and relative reactivity towards electrophilic substitution reactions (amongst six membered rings)	Alkaloids: Introduction, Natural occurrence	Carbohydrates: Occurrence, classification and their biological importance, Monosaccharides: Constitution and absolute configuration of glucose, Monosaccharides: Constitution and absolute configuration of fructose	α-Amino Acids – Reactions, Zwitterions, pKa values and Isoelectric point, Electrophoresis, Peptides and its classification, Determination of their primary structures-end group analysis
SLO-2	Nomenclature of heterocyclic compounds (containing only one hetero atom)	General methods of synthesis for pyridine (Hantzsch synthesis), General methods of synthesis for Indole (Fischer indole synthesis)	Classification and uses	Monosaccharides - stereoisomerism, Mutarotation Epimers and Anomers, Osazone formation.	Synthesis of peptides using N-protecting, C-protecting and C-activating groups
SLO-3	General discussion on Structure, aromaticity in 5-membered rings containing one heteroatom	Indole: Madelung synthesis, reduction of o-nitro benzaldehyde)	General structural features	Determination of ring size of glucose and fructose	Solid-phase synthesis, Proteins and its classification
SLO-4	Tutorial on Heterocyclic compounds	Tutorial on Hantzsch synthesis, Indole: Madelung synthesis, Basicity amongst six membered rings	Tutorial on Alkaloids classification and uses, General structural features	Tutorial on Carbohydrates: Monosaccharides, Determination of ring size of glucose and fructose	Tutorial on α-Amino Acids – Reactions, Proteins synthesis and its classification
SLO-5	Basicity and relative reactivity towards electrophilic substitution reactions	Quinoline Synthesis: Skraup synthesis, Friedlander‟s synthesis, Knorr quinoline	General methods for structure elucidation: Hoffmann‟s exhaustive methylation and	Haworth projections and conformational structures	Primary, secondary and tertiary structures of proteins

	(amongst five membered rings)	synthesis, DoebnerMiller synthesis	Emde‟s method		
SLO-6	General methods of synthesis for Furan (Paal-Knorr synthesis, Feist-Benary synthesis and its variation), Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis)	Bischler-Napieralski reaction, Pictet Spengler reaction, Pomeranz-Fritsch reaction), Discuss the reaction mechanism for Pyridine and Indole, Electrophilic substitution Sulphonation	Structure elucidation of Nicotine, Synthesis and physiological action of Nicotine	Interconversions of aldoses and Ketoses, Killiani- Fischer synthesis, Ruff degradation	Denaturation, Enzymes: Introduction, Classification and characteristics of Enzymes, Mechanism of enzyme action (taking chymotrypsin as an example)
SLO-7	General methods of synthesis for Thiophene (Paal-Knorr synthesis), Hinsberg synthesis	Discuss the reaction mechanism for Quinoline and Isoquinoline: Electrophilic substitution Sulphonation	Terpenes: Introduction, Occurrence and Uses	Disaccharides – reducing and non reducing sugars, Disaccharides – Structure elucidation of maltose	Factors affecting enzyme action, Coenzymes and cofactors (NAD, FAD)
SLO-8	Tutorial on practicing reaction mechanisms for Pyrrole Paal-Knorr and Feist-Benary synthesis	Tutorial on practicing reaction mechanisms on Bischler-Napieralski reaction and Doebner Miller synthesis	Tutorial on problem solving examples on Hoffmann‟s exhaustive methylation	Tutorial on practicing reaction mechanisms on Killiani- Fischer synthesis, and Ruff degradation	Tutorial on Primary, secondary and tertiary structures and classification of proteins
SLO-9	Properties: Physical properties, Chemical reactions of Furan	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Electrophilic substitution: Halogenation, Formylation	Classification, isoprene and special isoprene rule	Disaccharides – Structure elucidation of lactose	Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance
SLO-10	Chemical reactions of Pyrrole	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Electrophilic substitution: Mercuration, Carboxylation	General methods of structure elucidation including distinction between isopropylidene and isopropenyl group	Disaccharides – Structure elucidation of sucrose	Nucleic Acids : Structure of components of nucleic acids: Bases (Nucleosides and nucleotides) and sugars, Nomenclature of nucleosides and nucleotides
SLO-11	, Chemical reactions of thiophene	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Oxidation,	Citral: Elucidation of structure, Synthesis of Citral, its industrial application.	Amino acids and its classification, α-Amino Acids: Synthesis and Ionic properties	Structure and Biological roles of DNA and RNA, Concept of heredity: Genetic Code, Transcription

		Reduction, Reactions showing acidic /basic character			and Translation, Lipids : Introduction to oils and fats
SLO-12	Tutorial on practicing reaction for Pyrrole and Furan synthesis	Tutorial on practicing the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline synthesis	Tutorial on practicing reactions for Citral synthesis	Tutorial on practicing Disaccharides – Structure elucidation of lactose and Sucrose	Tutorial on practicing classification and characteristics of enzymes, mechanism of enzyme action

Resources			
1	*G. L. Thomas Heterocyclic chemistry, Pearson Education, 3. ed. 1997 (ISBN 0-582-27843-0).*	5	*R. M. Acheson, Introduction to the Chemistry of Heterocyclic compounds, John Welly&Sons ,1976.*
2	*A. J. John, K. Mills, Heterocyclic chemistry. – 5th ed 1995.*	6	*R. K. Bansal, Heterocyclic Chemistry, Synthesis, Reactions and Mechanisms, Wiley Eastern Ltd., 1990*
3	*I. L. Finar, Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) 2002.*	7	*J. M. Berg, J. L. Tymoczko, L. Stryer, Biochemistry. VIth Edition. W.H. Freeman and Co., 2006.*
4	*D. L. Nelson, M. M. Cox, A. L. Lehninger, Principles of Biochemistry. IV Edition. W.H. Freeman and Co., 2009*	8	R. K. Murray, D. K. Granner, P. A. Mayes, V. W. Rodwell, Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/McGraw-Hill, 2009

Assessment							Strategies					
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)	Technology		Pedagogy / Andragogy		Sustainable Development	
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *		Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
		(10 %)	(10 %)	(20 %)	(10%)		Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
1	Remember	15	15	10	10	15			Debate	✓		
2	Understand	15	15	10	10	15			Interactive Lecture	✓		
3	Apply	20	25	25	25	25			Brainstorming	✓		
4	Analyze	20	25	25	25	25						
5	Evaluate	15	10	15	15	10						
6	Create	15	10	15	15	10						
	Total (%)	100	100	100	100	100						

Designers					
Professional Experts: Expert from Industry		Higher Institution Experts		Internal Experts	
1	*Dr. Ravikiran Allada*, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka *Email:* Ravikiran.Allada@Steri-science.com	1	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	1	Dr. *Naveen Malik,* *Department of Chemistry, SRMIST* *Email*: naveenm1@srmist.edu.in
2	Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, sudarshan.m@encubeethicals.com	2	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D10T	Course Title	Thin Film Technology	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	*The purpose of learning this course is to:*	*Depth*				*Attainment*			*Program Learning Outcomes (PLO)*									
CLR-1	*Acquire knowledge of the fundamentals of thin film technology*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
CLR-2	*Acquire knowledge of vacuum components and system functioning*																	
CLR-3	*Gain comprehensive knowledge and sound understanding of thin film deposition*																	
CLR-4	*Acquire knowledge regarding thin film growth and characterization*																	
CLR-5	*Emphasize the significance of thin film technology and its applications*																	

Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	*Conceive*	*Design*	*Implement*	*Operate*	*Level of Thinking*	*Expected Proficiency (%)*	*Expected Attainment (%)*	*Problem Solving, Critical Thinking, Creativity*	*Communication Skills, Collaborating Skills*	*Independent Thinking, Analytical Reasoning, Learning to Learn, Research Skills*	*Leadership Qualities, Professionalism, Autonomy, Accountability*	*Digital Technology Skills value Incalcation, Multicultural inclusivity*		*Environmental Action, Community Engagement*	*Entrepreneurial Risk Taking*	*PSO-1*	*PSO-2*
CLO-1	*To understand the fundamentals of thin film technology*	✓	✓	✓	-	*3*	*85*	*75*	*3*	-	*3*	-	-	*3*	-	-	-	-
CLO-2	*To understand and evaluate the vacuum components and system functioning*	✓	✓	✓	-	*3*	*85*	*70*	*3*	-	-	*3*	-	-	-	-	*2*	-
CLO-3	*To understand the various physical and chemical deposition methods*	✓	✓	✓	✓	*4*	*85*	*70*	*3*	-	*3*	-	-	-	-	-	-	*3*
CLO-4	*To understand different types of growth mechanisms and characterization of thin films*	✓	✓	✓	✓	*4*	*85*	*70*	*3*	-	-	-	*2*	-	-	-	*3*	-
CLO-5	*Apply thin film technology knowledge in semiconductor manufacturing, and emerging thin film applications.*	✓	✓	✓	✓	*4*	*85*	*60*	*3*	*3*	-	-	-	-	-	-	-	*3*

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Vacuum components and systems	Thin film deposition techniques	Growth of thin films and thickness measurements	Properties and characterization of thin films	Applications of thin films
	12	12	12	12	12
SLO-1	Introduction of thin film technology: Fundamentals of vacuum: basic definition and pressure regions of vacuum	Thin film deposition techniques: Physical and chemical vapor deposition technique's introduction, Physical vapor deposition (PVD): Thermal evaporation, resistive heating, flash evaporation, laser evaporation, rf-heating, co-evaporation.	Introduction: nucleation and early stages of film growth, thermodynamic aspects of nucleation.	Thin film properties: Mechanical properties: Elastic and Plastic behavior, Optical properties: Reflectance and transmittance spectra.	Introduction to organic semiconductor devices; Electronic Transitions, Excitons, and Energy transfer; Charge generation and recombination mechanisms; Polaron and Disorder models for charge transport
SLO-2	Need for vacuum, ways to achieve vacuum, and determination of vacuum	Electron bombardment heating, sputtering plasma, discharges, sputtering variants, and sputtering yield low-pressure sputtering.	General Features of nucleation theories, Effect of electron bombardment on film structure.	Absorbing films, Optical constants of film material, Multilayer films, Anisotropic and isotropic films	OLEDs: The working principle of OLEDs, space charge and Trap limited currents.
SLO-3	The kinetic theory of gases means free path.	rf-sputtering, reactive sputtering, magnetron sputtering, magnetron configurations, bias sputtering, evaporation versus sputtering.	Post-nucleation growth, Epitaxial film growth, Structural defects	Electrical properties: Conductivity in metal, Semiconductor, and Insulating films,	Charge injection at metal/organic interface; Organic light emitting diodes (OLEDs).
SLO-4	Tutorial: Fundamental discussion on thin film technology.	Tutorial: Discussion about the various evaporation techniques.	Tutorial: Evaluation and use of models for understanding nucleation and growth of thin films.	Tutorial: Discussion about the multiple properties of thin film.	Tutorial: Fundamental discussion on semiconductor technology.
SLO-5	Types of flow, types of flow, and conductance	Chemical vapor deposition (CVD): homogenous and heterogeneous processes, CVD reactions, pyrolysis, hydrogen reduction, Halide disproportionation, transfer reactions,	General Features of Capillary theory, thin film growth modes Volmert, Weber (VW) growth.	Discontinuous films, and Superconducting films.	OPV: The working principle of OPV, Bilayer, Bulk-heterojunction.
SLO-6	Vacuum pumps and systems:	CVD processes and systems,	Frank-van der Merwe (FM)	Characterization of thin films: Different methods	Inverted, and Tandem organic

	Rotary mechanical pump, roots pump	low-pressure CVD, laser-enhanced CVD, molecular beam epitaxy, laser ablation, and hot wire	growth, Stranski-Krastanov growth	of thickness measurements, electrical, optical, chemical, and structural property determination.	photovoltaic (OPV) devices
SLO-7	Diffusion pump, turbo molecular pump, sputter ion pump, measurement of vacuum.	Microwave CVD techniques, metalorganic CVD (MOCVD).	Thickness measurement: electrical methods.	Thin film study: X-ray diffraction (XRD) and X-ray photoelectron spectroscopy.	Carrier loss mechanisms in OPVs; Nanomorphology; Hybrid Perovskite solar cells and LEDs.
SLO-8	Tutorial: Examples of different vacuum pumps and measurement of vacuum.	Tutorial: Discussion on different CVD technique methods.	Tutorial: Thin film growth and calculation of thickness.	Tutorial: Explain thickness measurement techniques and the study of thin films.	Tutorial: Fundamental discussion about OPV and LEDs
SLO-9	Pressure measurement gauges: The concept of different gauges, capacitance gauges,	Film contamination, cosine law of deposition, conformal coverage, and line of sight deposition.	Microbalance monitors, quartz crystal monitor	Self-assembly studies through scanning electron microscopy, atomic force microscopy, transmission electron microscopy, and energy dispersive analysis.	Top and bottom contact organic thin film transistors (OTFTs).
SLO -10	Pirani gauges, ionization gauges, and penning gauge	Electrodeposition, electrolytic deposition, electroless deposition, anodic oxidation,	Mechanical method (stylus), optical interference methods.	Analytical techniques of characterization: High and low energy electron diffraction, Auger emission spectroscopy.	Organic thin film deposition techniques and Overview of various printing technologies.
SLO -11	Vacuum system components and operation and other system design and consideration	spray pyrolysis, spin, and dip coating.	Ellipsometry, and interference fringes.	Rutherford backscattering spectroscopy, and secondary ion mass spectrometry.	Device degradation mechanisms and Stability testing methods
SLO -12	Tutorial: Discussion about the manual operation and design concept of pressure measurement.	Tutorial: Explanation of film contamination and electrochemical deposition of thin films	Tutorial: Discussion of various instruments and methods for measuring thickness.	Tutorial: Explanation of various morphology studies and spectroscopy analyses	Tutorial: Discussion on thin film applications and problem-solving

Resources			
1	K.L. Chopra, “Thin Film Phenomena”, First Edition, McGraw-Hill, 1969.	5	S. Dushman and J.M. Lafferty, Scientific Foundations of Vacuum Technology
2	L. I. Maissel and Glang, “Handbook of Thin Film Technology”, McGraw Hill Higher Education, 1970.	6	Glow discharge processes, B. Chapman, Wiley, New York

3	M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press, 2002.	7	S. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd Ed., OUP, 1996. 3. Kaufmann, Characterization of Materials, 2 nd Ed., Wiley, 2003.
4	Sam-Shajing Sun and Larry R. Dalton, Introduction to Organic Electronic and Optoelectronic Materials and Devices, 2nd Ed., CRC Press, 2015.	8	Franky So, Organic Electronics: Materials, Processing, Devices, and Applications, CRC Press, 2010.

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email: sudarshan.m@encubeethicals.com	1	Prof. G. Sekar Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1	Dr. E. Ravindran, Department of Chemistry SRMIST Email: ravindre@srmist.edu.in
2	Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP), Steriscience (Strides), Bengaluru, Karnataka, Email:Ravikiran.Allada@Steri-science.com	2	Prof. Sukhendu Mandal Department of Chemistry IISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	2	Dr. D. Kartthick Department of Chemistry, SRMIST Email: karthikd4@srmist.edu.in

Course Code	UCY24P01L	Course Name	Project Work	Course Category	P	Project Work	L	T	P	C
							0	0	4	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Guidance Cell*	Data Book / Codes/Standards	As required for the project work		

Rationale (CLR)	The purpose of learning this course is to:
CLR-1	Demonstrate skills learnt in the real time environment.
CLR-2	Explore the different industries based on chemistry and related areas
CLR-3	Enhance the skills in the system aspects
CLR-4	Understanding the professional connections with the knowledge learnt
CLR-5	Applying the skills in problem solving

Outcomes (CLO)	At the end of this course, learners will be able to:		Depth				Attainment			Program Learning Outcomes (PLO)									
			1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
			Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving,	Communication Skills,	Independent Thinking, Analytical	Leadership Qualities, Professionalism,	Digital Technology	Value Inculcation,	Environmental Action, Community	Entrepreneurial Risk	PSO-1	PSO-2
CLO-1	Apply the studied concepts in provoking an innovative idea	✓		✓	-	-	3	80	70	3	3	-	-	-	2	-	-	-	-
CLO-2	Gain valuable skills and knowledge in research	✓		✓	✓	-	3	85	75	-	3	-	-	-	3	-	-	2	-
CLO-3	Make professional connections and enhance networking	✓		✓	✓	✓	3	75	70	-	-	3	3	2	-	-	-	-	-
CLO-4	Get experience in a field to allow the student to make a career transition	✓		✓	✓	✓	3	85	80	3	-	-	3	-	-	-	-	3	-
CLO-5	Get an inside view of an industry and organization/company	✓		✓	✓	✓	3	85	75	-	3	-	3	-	-	-	-	-	3

Assessment Component	Expected outcome	Type	Evaluators	Criteria or basis	Marks
Review – 0 Internship	Internship letter Submission Proposed Project title to be described. Abstract of the project.	Internal	Supervisor / Guide & Project Coordinator	Feasibility Studyof the project	5

Review – I Project Proposal	A short presentation about the Problem statement Literature Survey System architecture Design Specifications	Internal	Supervisor/Guide	Clarity of the idea, Preliminarywork done.	10
Review – II	Presentation on Techniques, Model/ Algorithm, Modules, coding Prototype of the project	Internal	Supervisor/Guide	Clarity of idea, Presentation	10
Review – III	Final presentation, Demonstration of Project.	Internal	Supervisor/Guide	Technical demonstration, Presentation	10
Report Submission	Submission of final project report	Internal	Project Coordinator	Regularity, Originality, Systematic progress	15
Project Report	Evaluation of Project Report	External	Examiner(s)/ Reviewer(s)	Presentation, Handling Q&A	20
Viva – Voce	Final Presentation	External			30

The assessment method for the project work consists of in-semester and end semester evaluations as detailed below:

	Continuous Learning Assessment (50% weightage)					Final Evaluation (50% weightage)	
	Review - 0	Review – 1	Review – 2	Review – 3	Report Submission	Project Report	Viva-Voce*
Project Work / Internship	5%	10%	10%	10%	15%	20 %	30 %

*Student has to be present for the viva voce for assessment. Otherwise, it will be treated as non-appearance for the examination with final grade as ‘Ab’

Course Code	UCD24V02T	Course Name	Universal Human Values	Course Category	V	Value Added Course	L	T	P	C
							2	0	0	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Guidance Cell*	Data Book / Codes/Standards	-		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*Help the students to understand need of value education, appreciate the essential complimentarily between 'values' and 'skills' and to ensure sustained happiness and prosperity which are the core aspirations of all human beings,*	
CLR-2 :	*Help students initiate a process of dialog within themselves to know what they really want to be' in their life and profession.*	
CLR-3 :	*Help students to understand the meaning of happiness and prosperity for a human being. understanding holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.*	
CLR-4 :	*Help students on right understanding of the Human reality and the rest of existence, harmony at all the levels of human living, and live accordingly.*	
CLR-5 :	*Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn ,Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PLO-9	PLO-10
		1	2	3	1	2	3	4	5	6	7	8	9	10
CLO-1 :	*Evaluate the significance of value inputs in formal education and start applying them in their life and profession*	*3*	*80*	*70*	-	*1*	*1*	*2*	-	*3*	*2*	-	-	-
CLO-2 :	*Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.*	*3*	*80*	*75*	-	-	*1*	*2*	-	*3*	*2*	-	-	-
CLO-3 :	*Analyze the value of harmonious relationship based on trust and respect in their life and profession*	*3*	*85*	*70*	-	*1*	*1*	*2*	-	*3*	*2*	-	-	-
CLO-4 :	*Examine the role of a human being in ensuring harmony in society and nature.*	*3*	*85*	*80*	-	-	*1*	*2*	-	*3*	*2*	-	-	-
CLO-5 :	*Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.*	*3*	*85*	*75*	-	-	*1*	*2*	-	*3*	*2*	-	-	-

Duration (hour)		6	6	6	6	6
S-1	*SLO*	*Right Understanding, Relationship and Physical Facility*	*Understanding Human being as the Co-existence of the Self and the Body*	*Harmony in the Family – the Basic Unit of Human Interaction*	*Understanding Harmony in the Nature*	*Natural Acceptance of Human Values*
S-2	*SLO*	*Understanding Value Education*	*Distinguishing between the Needs of the Self and the Body*	*Trust – the Foundational Value in Relationship*	*Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature*	*Definitiveness of (Ethical) Human Conduct*
S-3	*SLO*	*Self-exploration as the Process for Value Education*	*The Body as an Instrument of the Self*	*Respect – as the Right Evaluation*	*Exploring the Four Orders of Nature*	*A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order*
S-4	*SLO*	*Continuous Happiness and Prosperity – the Basic Human Aspirations*	*Understanding Harmony in the Self*	*Other Feelings, Justice in Human-to-Human Relationship*	*Realizing Existence as Co-existence at All Levels*	*Competence in Professional Ethics*
S-5	*SLO*	*Happiness and Prosperity – Current Scenario*	*Harmony of the Self with the Body*	*Understanding Harmony in the Society*	*The Holistic Perception of Harmony in Existence*	*Holistic Technologies, Production Systems and Management Models-Typical Case Studies*
S-6	*SLO*	*Method to Fulfill the Basic Human Aspirations*	*Programme to ensure self-regulation and Health*	*Vision for the Universal Human Order*	*Exploring Co-existence in Existence*	*Strategies for Transition towards Value-based Life and Profession*

Learning Resources	1. *Gaur R.R., Sangal R., Bagaria G.P., 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi.* 2. *E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.*	3. *A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.* 4. *A N Tripathy, 2003, Human Values, New Age International Publishers.*

Learning Assessment					
Level	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)			
		CLA – 1 (20%)	CLA – 2 (20%)	CLA – 3 (30%)	CLA – 4 (30%)
		Theory	Theory	Theory	Theory
Level 1	Remember	30%	30%	30%	30%
	Understand				
Level 2	Apply	40%	40%	40%	40%
	Analyze				
Level 3	Evaluate	30%	30%	30%	30%
	Create				
	Total	100 %	100%	100%	100%

CLA-1, CLA-2 and CLA-3 can be from any combination of these: MCQ Tests, Classroom Activities, Case Studies, Poster Presentations, Power-point Presentations, Mini Talks, Group Discussions, Extempore, etc.
CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Prof. Rajiv Kumar, Member Secretary, NCC-IP as member at AICTE	*Mrs. V Sumathi, Associate Professor, Sri Sairam Engineering College, Chennai, Tamil Nadu*	*Dr. Supraja P, UHV University Coordinator, SRMIST*
		Dr. Deepalakshmi S, HoD, Department of Career Guidance Cell, FSH, SRMIST
		Dr. Sweety Bakyarani E, Department of Computer Science, FSH, SRMIST

SEMESTER -VII

Course Code	UCY24D11T	Course Title	Research Methodology	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment		
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)
CLR-1	Get overall picture of research methodology.	*1*	*2*	*3*	*4*	*1*	*2*	*3*
CLR-2	Search and find research problems and design it.							
CLR-3	Get an aoverall picture about the different methods of data collection.							
CLR-4	Get expertise in processing and analyzing data							
CLR-5	Get espertise in academic writing and presentation skills.							

Outcomes (CLO)	*At the end of this course, learners will be able to:*								*1* Problem Solving, Critical Thinking, Creativity	*2* Communication Skills, Collaborating Skills	*3* Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	*4* Leadership Qualities, Professionalism, Autonomy, Accountability	*5* Digital Technology Skills	*6* Value Inculcation, Multicultural inclusivity	*7* Environmental Action, Community Engagement	*8* Entrepreneurial Risk Taking	*9* PSO-1	*10* PSO-2
CLO-1	*Demonstrate ability to identify the significance and importance of research and research methodology.*	✓	✓	✓	-	*2*	*85*	*75*	*3*	*3*	-	-	*3*		-	-	-	-
CLO-2	*Carry out literature survey / review in research domains and write research proposal.*	✓	✓	✓	-	*2*	*85*	*75*	*3*	*3*	-	-		*3*	-	-	*3*	-
CLO-3	*Apply statistical principles in data collection, analysis, inference and prediction.*	✓	✓	✓	-	*3*	*85*	*75*	-	*3*	-	-	*3*	*3*	-	-	*2*	-
CLO-4	*Apply different processing operations for analyzing the data.*	✓	✓	✓	-	*3*	*85*	*75*	*3*	-	-	-	*3*	*3*	-	-	-	-
CLO-5	*To interpret the data and write a research report.*	✓	✓	✓	-	*3*	*85*	*75*	*3*	-	-	-	*3*	*3*	-	-	-	*3*

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	An introduction to research methodology	Defining a research problem and research design	Methods of data collection	Processing and analysis of data	Interpretation and report writing

	12	12	12	12	12
SLO-1	Meaning and objective of research	Definition of research problem – components of research problem.	Data – collection of data	Processing operations – some problems in processing.	Meaning of interpretation- techniques of interpretation – precaution in interpretation
SLO-2	Types of research – Research approaches- significance of research	Features of research problem – criteria for selecting the research problem.	Mathods of data collection	Elements/types of analysis	Significance of report writing – different steps in writing report – layout of the research report
SLO-3	Research methods verse methodology	Sources of problems for research – hypothesis – sources of hypothesis	Processing and analysis of data	Statistics in research	Types of report – oral presentation – mechanism of writing a research report – precautions for writing research report.
SLO-4	Tutorial – design a research problem after doing a detailed literature survey	Tutorial – group discussion about a particular research probelm	Tutorial – practice for analyzing a scientific data.	Tutorial – Oral presentation on a selected peer reviewed publication.	Tutorial – Write a summary on a selected peer reviewed publication.
SLO-5	Resaecrh and scientific method	Research design – meaning of research design	Types of data analysis	Simple regression analysis – multiple correlation and regression – partial correlation	Preparation of manuscript for publication of research paper, presenting a paper in scientific seminar, thesis writing.
SLO-6	Important steps in research process	Definitions of research designs – features of research design.	Questionnaire – types of questionnaires – design of questionnaire.	Multivariate analysis technique	Structure and components of research report, types of report - research papers, thesis,
SLO-7	Problems encountered by researchers in India	Characteristics of research design – nature of research design.	Difference between questionnaires and schedules.	Multivariate analysis technique - classification	Research project reports, pictures and graphs, citation styles, writing a review of paper, bibliography
SLO-8	Tutorial – Group discussion on problems encountered by the researchers in India.	Tutorial – Oral presentation about different types of research design	Tutorial – Practical session on data analysis.	Tutorial –practical session multivariant analysis techniques.	Tutorial - practice on writing a review paper.
SLO-9	Research resources – meaning – examples	Concepts of research design – types of research design.	Testing of hypothesis – parametric and non-parametric tests.	Characteristics and applications – factor analysis	Databases – types – indexing data bases – citation databases
SLO-10	Literature survey – keyword search – different tools.	Components of research design	T – test, Z -test	R and Q type factor analysis. Path analysis	Research metrics – an introduction

SLO-11	Literature gap, refining research question and objectives – case studies	Sampling – sampling techniques – sampling design	Chi-square test	Use of word processing, spread sheet and database software. Plotting of graphs. Internet and its application.	Metrics: impact factor , h-index, g index, i10 Index, altmetrics
SLO-12	Tutorial – Do a literature survey in a selected topic and define a research problem.	Tutorial – Practical session on writing research proposals.	Tutorial – Practice on T test and Z test.	Tutorial – Practical session on R and Q type factor analysis	Tutorial – calculation of hindex, i10index and g index

Resources			
1	*C. R. Kothari, Research Methodology, 5th edition, 2023*	*3*	*Donald R. Cooper, Pamela S. Schindler, Business research methods, 9th edition, 2006*
2	*Dr P M Bulakh, Dr P. S. Patki and Dr A S Chodhary, Research Methodology, 2010*	*4*	*Garg.B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology, 2002.*

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra,* *Email: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. Rahul Narayanan, Research assistant professor, SRM IST,* *E mail: rahuln@srmist.edu.in*
2	*Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka.* *Email Id: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D12T	Course Title	Medicinal Chemistry and Drug Design	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			1	2	3	4	5	6	7	8	9	10
		1	2	3	4	1	2	3	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entreprenuerial Risk Taking	PSO-1	PSO-2
CLR-1	*Learn and understand the structure and function of biomolecules*																	
CLR-2	*Know the important factors to be considered for a drug design*																	
CLR-3	*Know about the general methods of drug synthesis*																	
CLR-4	*Gain knowledge about the late stages of drug discovery and drug resistance*																	
CLR-5	*Know about the modern advancement in computer-based drug design*																	
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)										
Outcomes (CLO)	*At the end of this course, learners will be able to:*																	
CLO-1	*Gain exposure to the field of medicinal chemistry*	✓	✓	✓	-	*2*	*85*	*70*	*3*	-	*3*	-	-	*2*	-	-	-	-
CLO-2	*Gain insight about the drug molecules, their action, how to design a drug molecule*	✓	✓	✓	-	*2*	*85*	*70*	-	*3*	-	-	-	*3*	-	-	*2*	-
CLO-3	*Gain knowledge about the structural importance in activity and how to improve their water solubility*	✓	✓	✓	-	*3*	*85*	*75*	*2*	-	*3*	*3*	-		-	-	-	-
CLO-4	*Know how drug molecules pass through the membrane, their metabolism, production, and formulation*	✓	✓	✓	-	*3*	*85*	*75*	*3*	-	-	-	*3*	-	-	-	-	*3*
CLO-5	*Learn about the use of computational simulation for drug design*	✓	✓	✓	-	*3*	*85*	*75*	-	-	*3*	*3*	*3*	-	-	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Introduction to medicinal chemistry	Details about drug discovery	Methods of drug discovery	Working principles of drugs	Drug design and modelling
	12	12	12	12	12
SLO-1	Introduction and definition of medicinal chemistry, general terminologies	Drug discovery: History, general stages in drug discovery, identification, and validation of targets for drug discovery	Theories for drug–receptor interactions, occupancy, rate, induced-fit theory	Pharmacological testing, toxicological testing (IC50)	Macromolecular drug carrier systems
SLO-2	Structure and functions of proteins	Desirable properties of a drug, stereochemistry, and drug design	Potency, selectivity, structure–activity relationship of drugs	Formulation development, production, quality control	Bioprecursor prodrugs
SLO-3	Structure and functions of nucleic acid	Importance of water solubility, and structure of the solute	Drug synthesis: The design of combinatorial syntheses	Drug resistance, mechanisms of drug resistance	Production and quality control
SLO-4	Tutorial: Problem solving on protein and nucleic acid functions	Tutorial: Applying concept on drug discovery	Tutorial: Applying concept on drug discovery methods	Tutorial: Problem solving on drug mechanism	Tutorial: Applying concept on drug production
SLO-5	Enzyme structure, binding pocket, catalytic active site	Methods of improving water solubility, salt formation, formulation, effect of pH, surfactants, amphiphiles	Solid support method, encoding methods, combinatorial synthesis in solution	Altered target enzyme or receptor	Proton activation, hydrolytic activation, elimination activation
SLO-6	Amino acid residues involve in catalysis, examples of biologically important reactions	Methods and routes of administration, drug metabolism, secondary pharmacological implications of metabolism	Library generation and analysis, high-throughput screening	Increased drug-destroying mechanisms	Oxidative activation, reductive activation
SLO-7	Reversible inhibitors, irreversible inhibitors, transition-state inhibitors, case studies	Phase I & phase II metabolic reactions with examples, drug action	Random screening, targeted (or focused) screening, introduction, and bioassay	Activation of new pathways circumventing the drug effect, reversal of drug action, drug synergism (Drug combination)	Nucleotide activation, phosphorylation activation
SLO-8	Tutorial: Applying concept on inhibitors	Tutorial: Problem solving on drug solubility	Tutorial: Problem solving on drug screening	Tutorial: Problem solving on drug actions	Tutorial: Applying concept on activation
SLO-9	Structure of DNA, binding sites (major and minor groves), DNA interactive agents and	Pharmacodynamics and pharmacokinetics, drug targets: action sites	Lead discovery, lead modification, Identification of the active part, functional	Mechanisms of drug synergism, inhibition of a drug-destroying enzyme,	Sulfation activation, decarboxylation activation

	chemotherapy		group modification, structure modifications	sequential blocking	
SLO-10	DNA binding agents	Receptors proteins, carrier proteins	Homologation, chain branching, conformational constraints and ring-chain transformations	Inhibition of targets in different pathways, use of multiple drugs for the same target	Computer-based drug design, benefits over the traditional method, molecular modeling methods, molecular mechanics, molecular dynamics, docking: de novo design
SLO-11	Intercalation and alkylation, DNA strand breakers	Drug–receptor interactions	Lipophilicity effects, balancing potency, quantitative structure–activity relationship (QSAR), scaffold hopping, molecular graphics-based lead modification	Enzyme activation of drugs, utility of prodrugs, mechanisms of drug inactivation	Comparing 3D structures and use, pharmacophores, three-dimensional QSAR, other uses of computers in drug discovery
SLO-12	Tutorial: Problem solving on DNA srtuctures	Tutorial: Problem solving on pharmacodynamics	Tutorial: Problem solving on drug modifications	Tutorial: Problem solving on drug mechanism	Tutorial: Applying concept on computer on drug discovery

Resources	
1	*G. Thomas, Medicinal Chemistry: An Introduction, 2nd Ed., John Wiley and Sons, Ltd. 2007.*
2	*G. L. Patrick An introduction to medicinal chemistry, 5th Ed, Oxford university press, 2012.*
3	*T. Nogrady, D. F. Weaver, Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd Ed., Oxford University Press, Inc 2005.*

Assessment						
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra,* *General Manager at Encube Ethicals Private Limited,* *Mumbai, Maharashtra,* *Email Id: sudarshan.m@encubeethicals.com*	*1*	*Prof. G. Sekar,* *Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1*	*Dr. Anjan Das, SRMIST,* *anjand@srmist.edu.in* *Dr. Susnata Pramanik, SRMIST* *susmatap@srmist.edu.in*
2	*Dr. Ravikiran Allada,* *Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	*2*	*Prof. Sukhendu Mandal,* *Department of Chemistry, IIISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	*2*	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D13T	Course Title	Green Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment		
CLR-1	*Know the basics of Green Chemistry and its developments.*	1	2	3	4	1	2	3
CLR-2	*Understand the microwave mediated organic synthesis*							
CLR-3	*Acquire knowledge on green solvents and green catalysts*							
CLR-4	*Employ nonconventional reaction techniques for the synthesis of molecules*							
CLR-5	*Learn about future advancement in Green chemistry*							

Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	1	2	3	4	5	6	7	8	9	10
									Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	*Gain knowledge about the principles of green chemistry*	✓	✓	✓	-	*2*	*85*	*60*	*3*	-	*3*	-	-	*2*	-	-	-	-
CLO-2	*Employ a green chemistry approach to the existing synthetic reactions*	✓	✓	✓	-	*2*	*85*	*65*	-	*3*	-	-	-	*3*	-	-	*2*	-
CLO-3	*Employ nonconventional reaction methods to existing conventional synthetic methods*	✓	✓	✓	-	*4*	*85*	*70*	*2*	-	*3*	*3*	-	-	-	-	-	-
CLO-4	*Utilize the knowledge gained in the course for experimenting with solvent less reactions*	✓	✓	✓	-	*3*	*85*	*75*	*3*	-	-	*3*	-	-	-	-	*3*	-
CLO-5	*Identify reactions wherein sustainable synthetic methods can be employed*	✓	✓	✓	-	*4*	*85*	*75*	-	-	*3*	*3*	*3*	-	-	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Introduction, need of green chemistry, microwave assisted organic reaction	Sonochemical and biocatalyzed organic reactions	Ionic liquids and its application	Solid supported, phase transfer and magnetically recoverable catalysts	Mechanochemical and photo induced reaction
	12	12	12	12	12
SLO-1	Introduction: Green chemistry	Organic reactions by sonication method, examples - Cannizaro reaction, Strecker synthesis	Ionic liquids: Introduction & classification	Super critical CO2 – preparation, properties, and applications	Photo reduction of benzophenone to benzopinacol using sunlight.

SLO-2	Need for green chemistry	Untrasonic Reformatsky reaction, Wittig reaction, halogen addition to C=C bond (bromination of trans-stilbene)	Synthesis, properties, and application ionic liquids	Super critical CO2 – preparation, properties, and applications	Photochemical alternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylating agent.
SLO-3	Need for green chemistry	Untrasonic Diels-Alder reactions, acetylation of primary amine, rearrangement reaction (benzyl-benzilic acid rearrangement),	Synthesis, properties and application ionic liquids	Supported metal catalysts: Introduction	Photochemical alternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylating agent.
SLO-4	Tutorial: Introducing general idea about Microwave assisted organic synthesis	Tutorial: Introducing general idea about electrocatalysis	Tutorial: Problem solving on Ionic liquids	Tutorial: Problem solving on super critical CO2	Tutorial: Applying concept on photoinduced reactions
SLO-5	Anastas' twelve principles of green chemistry	Electrocatalysis: synthesis of 3-bromothiophene	Ionic liquids in organic reactions (Heck reaction)	Supported metal catalysts – mesoporous silica.	Reaction in water - furan Reaction in water -maleic acid.
SLO-6	Atom economy-principle, definition with example (ibuprofen synthesis	Electrocatalytic synthesis of adiponitrile	Ionic liquids in organic reactions (Suzuki reactions)	Phase transfer catalyst - applications	Reaction in water - furan Reaction in water -maleic acid.
SLO-7	Microwave assisted organic synthesis (MAOS)	Biocatalysts in organic synthesis	Ionic liquids in organic reactions (epoxidation)	Phase transfer catalyst - applications	Extraction of dlimonene from orange peel.
SLO-8	Tutorial: Applying general concept on green chemistry	Tutorial: Problem solving on ultrasonic reactions	Tutorial: Problem solving organic reactions in Ionic liquids	Tutorial: Problem solving on PTC	Tutorial: Applying concept on reaction in water medium
SLO-9	Examples of MAOS (synthesis of fused anthroquinones,	Biochemical reductions, biochemical oxidation	Ionic liquids in analytical chemistry (gas chromatography stationary phases)	Magnetically recoverable catalysts.	Mechanochemistry principles in green chemistry
SLO-10	Microwave assisted oxidation of toluene in water	Coenzyme catalyzed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin), electrophilic aromatic substitution reactions (nitration of phenol)	Ionic liquids in analytical chemistry (matrices for MALDITOF-MS)	Magnetically recoverable catalysts.	Mechanochemistry principles in green chemistry
SLO-11	Microwave assisted esterification of carboxylic acid	Green oxidation reactions (synthesis of adipic acid)	Advantages and disadvantages	Magnetically recoverable catalysts.	Green chemistry in sustainable development.

	and alcohol, advantages and disadvantages of MAOS.				
SLO-12	Tutorial: Problem soving on MAOS	Tutorial: Problem solving on enzyme catalyzed reactions	Tutorial: Applying concept on analytical use of Ionic liquids	Tutorial: Applying concept on magnetically recoverable catalysts	Tutorial: Applying concept on mechanochemistry

Resources			
1	*V. K. Ahluwalia, M. R. Kidwai, New Trends in Green Chemistry, Anamalaya Publishers 2nd ed. 2007*	5	*M. C. Cann, M. E. Connely, Real-World cases in Green Chemistry, ACS ,1st ed.2000*
2	*M. Lancaster, Green Chemistry: An Introductory Text RSC Publishing, 2nd ed, 2010.*	6	*M. A. Ryan, M. Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, 1st, ed. 2002*
3	*P. T. Anastas, J. K. Warner, Green Chemistry- Theory and Practical, Oxford University Press, 2nd ed., 1998*	7	*S. P. Dey, N. Sepay, A Text book on Green Chemistry, Techno World, 1st, ed., 2021*
4	*A. S. Matlack, Introduction to Green Chemistry, Marcel Dekker, 2nd ed..2010.*		

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra,* *General Manager at Encube Ethicals Private Limited,* *Mumbai, Maharashtra,* *Email Id: sudarshan.m@encubeethicals.com*	*1*	*Prof. G. Sekar,* *Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1*	*Dr. Anjan Das, SRMIST,* *anjand@srmist.edu.in* *Dr. Samarendra Maji, SRMIST* *samarenr@srmist.edu.in*
2	*Dr. Ravikiran Allada,* *Head Analytical R&D and ASAT (AVP) ||* *Steriscience (Strides), Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	*2*	*Prof. Sukhendu Mandal,* *Department of Chemistry,* *IIISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	*2*	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D14T	Course Title	Solid State Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	*The purpose of learning this course is to:*	Depth				Attainment			Program Learning Outcomes (PLO)									
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-1	Gain knowledge of the basic concepts of solid-state chemistry.																	
CLR-2	Address concepts related to crystal defects and non-Stoichiometry.																	
CLR-3	Get knowledge on different types of synthesis with mechanisms.																	
CLR-4	Employ various fabrication methods towards designing of materials.																	
CLR-5	Learn the different properties of crystalline materials.																	

Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural Inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	*Understand basic concepts of solid-state chemistry and its applications*	✓	✓	✓	-	*2*	*75*	*75*	*3*	*3*	-	-	-	*2*	-	-	-	-
CLO-2	*Gain knowledge about crystal defects and non-Stoichiometry*	✓	✓	✓	-	*2*	*75*	*70*	-	*3*	-	-	-	*3*	-	-	*2*	-
CLO-3	*Understand the mechanism of different types of synthesis*	✓	✓	✓	-	*3*	*75*	*75*	-	-	*3*	*3*	*2*	-	-	-	-	-
CLO-4	*Familiar with different properties and their technological relevance*	✓	✓	✓	-	*3*	*75*	*60*	*3*	-	-	*3*	-	-	-	-	*3*	-
CLO-5	*Gain deep knowledge about fabrication methods towards technological relevance*	✓	✓	✓	-	*3*	*75*	*70*	-	*3*	-	*3*	-	-	-	-	-	*3*

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Crystal systems	Crystal defects	Synthesis, processing and fabrication	Thermal properties and conduction	Magnetic properties
	12	12	12	12	12
SLO-1	Crystal structures and crystal chemistry; introduction, classification of solids, differences between crystalline	Crystal defects: types of defects, point, line and plane defects, intrinsic and extrinsic defects-	Synthesis, processing and fabrication methods, solid state reaction	Thermal properties: Introduction, lattice vibrations	Magnetic properties: Introduction, classification of magnetic materials

	and amorphous solids, point group	vacancies, Schottky and Frenkel defects			
SLO-2	Crystallography-law of constancy of interfacial angles, law of rational indices and Miller indices, d-spacing formulae	The Kroger–Vink notation for crystal defects, thermodynamics of Schottky and Frenkel defect formation.	Shake ’n Bake Methods, nucleation and growth, epitaxy and topotaxy	phonon spectrum lattice heat capacity thermal expansion thermal conductivity	Langevin diamagnetism quantum theory of paramagnetism super paramagnetism
SLO-3	Seven crystal systems, Bravais and non-Bravais lattices. Close packed structures of solids in 1D, 2D and 3D; cubic closed packing, hexagonal closed packing,	Defect clusters or aggregates	Examples of solid-state reactions, combustion synthesis mechanosynthesis	Electrical properties: introduction, electrical conductivity and Ohm's law Hall effect and band theory	cooperative phenomena ferromagnetism, cooperative phenomena antiferro magnetism, cooperative phenomena ferrimagnetism magnetic domains and hysteresis
SLO-4	Tutorial: Miller indices related problem, seven crystal systems, CCP, HCP and FCC	Tutorial: crystal defects point, line and plane defects: notations for crystal defects	Tutorial: Solid state reaction, synthesis methods	Tutorial: Heat capacity related problem	Tutorial: magnetism
SLO-5	Law of symmetry and types of crystal symmetry, space lattice and unit cell-primitive and non-primitive unit cells	Interchanged atoms, order–disorder phenomena	Low temperature methods Chimie Douce methods-alkoxide	Intrinsic and extrinsic semiconductors hopping semiconductors.	Optical properties: introduction. optical reflectance, plasmon frequency Raman scattering in crystals
SLO-6	Face-centered cubic and body-centered cubic structure. Total number of atoms per unit cell. Relationship between the edge length of a cubic unit cell and the radius of atom	Colour centers	Sol–Gel method using oxyhydroxides and colloid chemistry	p-n junctions, superconductors Meissner effect	Type-I and type-II superconductors, basic concepts of BCS theory.
SLO-7	The relative density of packing -simple cubic, face-centered cubic (FCC) and body-centered cubic (BCC) system	Vacancies and interstitials in non-stoichiometric crystals	Citrate gel and Pechini processes	Semiconductor/metal transition	Manifestations of the energy gap, Josephson devices.
SLO-8	Tutorial: Total number of atoms per unit cell related problems	Tutorial: Extrinsic defects intrinsic defects, disorder phenomena	Tutorial: All the methods and processes and their importance	Tutorial: band theory, intrinsic semiconductors, extrinsic semiconductors	Tutorial: BCS theory, type I superconductors, Josephson devices

SLO-9	Types of crystals-ionic crystals. Structures of NaCl, CsCl and zinc blende	X-Ray diffraction, Bragg's law.	Use of homogeneous, single-source precursors	Intercalation and deintercalation graphite intercalation compounds	Photoconduction, photoluminescence
SLO-10	Structures of Wurtzite Structures of Rutile Structures of Perovskite	Diffraction methods-Laue method diffraction methods- the rotating crystal method.	Hydrothermal and solvothermal synthesis	Pillared clays and layered double hydroxides	Electroluminescence
SLO-11	Covalent crystals: structure of diamond structure of graphite, metallic crystals and molecular crystals	Diffraction methods-the powder method.	Microwave synthesis	Synthesis of graphene	Photovoltaic photoelectrochemical effects.
SLO-12	Tutorial: Structures of Wurtzite, Rutile perovskite, structures of NaCl and Zinc blende structure of CsCl	Tutorial: problem solving related to Bragg's law diffraction methods	Tutorial: Hydrothermal synthesis methods, solvothermal synthesis methods, microwave synthesis methods	Tutorial: Intercalation, deintercalation, graphene	Tutorial: Photoluminescence, electroluminescence, photoelectrochemical reactions

Resources

1	*A. S. Negi, S. C. Anand, A Textbook of Physical Chemistry, 2nd Ed., New Age International Publishers, 2008.*	5	*Kröger, F. A.; Vink, H. J. Seitz, F.; Turnbull, D. (eds.). Solid State Physics. Vol. 3, 1956, pp. 307–435.*
2	*P. W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, F.A. Armstrong and M. Hagerman, Shriver and Atkins' Inorganic Chemistry, W. H. Freeman and Company, 5th Ed, 2010.*	6	*A. R. West, Solid State Chemistry and Its Application, 2nd Ed, Wiley, 2014.*
3	*D. M. Adam, Inorganic Solids: An introduction to concepts in solid-state structural chemistry, John Wiley and Sons, London, New York, Sydney, Toronto, 1974.*	7	*C. N. R. Rao and J. Gopalakrishnan, New Directions in Solid State Chemistry, 2 Ed, Cambridge University Press, 2010.*
4	*P. A. Cox, The Electronic Structure and Chemistry of Solids, Oxford Science Publications, 1987.*		

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra,* *Email Id: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar,* *Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. Rajorshi Das,* *Department of Chemistry, SRMIST* *Email: rajorshd@srmist.edu.in*
2	*Dr. Ravikiran Allada, Director,* *Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka* *Email: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal,* *Department of Chemistry, IISER Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D15T	Course Title	Organic Semi-conductors: Materials and Devices	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	Learn and understand the basic knowledge of organic semiconductor materials and devices	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Know the synthetic methods and types of semiconductor materials																	
CLR-3	Inculcate the structure-property relation of materials																	
CLR-4	Inculcate the knowledge about the photovoltaic devices																	
CLR-5	Inculcate the knowledge about the organic light-emitting diode and sensor devices																	

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Discuss about organic semiconductor materials and devices	✓	✓	✓	-	2	85	75	3	-	2	-	-	3	-	-	-	-
CLO-2	Prepare the synthetic methods for organic semiconductor materials	✓	✓	✓	-	2	85	75	3	-	3	-		3	-	-	-	-
CLO-3	Interpret structure – property relation of materials	✓	✓	✓	-	3	85	70	3	-	3	-	-	-	-	-	-	2
CLO-4	Differentiate the types of working principle and photovoltaic device	✓	✓	✓	-	3	85	70	3	-	-	-	-	3	-	-	3	-
CLO-5	Differentiate the types of working principle and organic light-emitting diodes and sensors	✓	✓	✓	-	3	85	60	3	-	-	-	2	-	-	-	3	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Introduction to organic semiconductors	Semiconducting materials: Synthesis	Functional properties of materials	Optoelectronics: Photovoltaics	Optoelectronics: Organic light emitting diodes
	12	12	12	12	12
SLO-1	Organic semiconductors: Introduction	Synthetic methods of semiconductor materials	Electronic structure of organic semiconductor materials, Structure-property relation: An electronic view	Introduction to semiconducting devices, optoelectronics	Fluorescent materials, types of luminescent devices
SLO-2	Organic semiconducting	Useful methods of C-C	Structure-property relation:	Types of devices, requirement	Introduction to organic light-

	materials: small molecules, oligomers, dendrimers, polymers and conjugated polymers	coupling reactions, small molecule C-C bond formation	Solution- state properties	of material properties for various devices	emitting diode, device structure and working principle
SLO-3	Organic semiconducting materials: polymers and conjugated polymers	Small molecule C-C bond formation	Structure-property relation: Solid-state properties, physical properties of materials	Photovoltaics devices: Introduction, types of devices	The evaluation and generation of OLEDs
SLO-4	Tutorial: Organic semiconducting materials-small molecules, dendrimers, polymers	Tutorial: Small molecule C-C bond formation	Tutorial: Structure-property relation: Solution and solid-state properties	Tutorial: Requirement of material properties for various devices	Tutorial: Device structure and working principle
SLO-5	Carbon rich compounds: Aromatic compounds	Small molecule C-N bond formation	Electronic energy levels, Redox potentials	Device structure and working principle, history and latest development	Important parameters and efficiency calculation
SLO-6	Cross conjugated compounds: Dendralene, radialene, fullerene	Synthesis of polycyclic aromatic compounds	Energy level calculation, controlling the energy levels	Important parameters and efficiency calculation	Factors affecting the performance of device
SLO-7	Structure-property relation of small molecules	Synthesis of large PAH	Importance of frontiers orbitals	Factors affecting the performance of device	Host materials
SLO-8	Tutorial: Carbon rich compounds, structure-property relation of small molecule	Tutorial: Synthesis of PAH	Tutorial: Energy level calculation, controlling the energy levels	Tutorial: Device structure and working principle, important parameters and efficiency calculation	Tutorial: Important parameters and efficiency calculation
SLO-9	Structure-property relation of dendrimers	Synthesis of heterocyclic PAH	UV-Vis absorption and structure relation	Photovoltaics devices: Dye sensitized solar cell	Charge transporting materials
SLO-10	Structure-property relation of polymers	Synthesis of dendrimers	Photoluminescence and structure relation	Photovoltaics devices: Bulk heterojunction solar cell	Device stability
SLO-11	Types of applications: display, energy applications.	Synthesis of polymers	Excited state properties	Perovskite solar cells	Fluorescent chemical sensor
SLO-12	Tutorial: Structure-property relation of dendrimers, polymers, applications	Tutorial: Synthesis of dendrimers and polymers	Tutorial: UV-Visible and photoluminescence properties	Tutorial: Types of photovoltaic devices	Tutorial: Charge transporting materials

Resources			
1	*M. M. Haley and R. R. Tykwinski, Carbon-Rich Compounds: From Molecules to Materials, Wiley, 2006*	*5*	*J. Singh, Smart electronic Materials: Fundamentals and Applications, Cambridge University Press, 2004*
2	*C. Brabec, V. Dyakonov, J. Parisi and N. S. Sariciftci (Ed), Organic Photovoltaics, Springer, 2003*	*6*	*M. Norio, Cross-Coupling Reactions: A Practical Guide, Springer, 2002*
3	*N. T. Kalyani, H. Swart, S. J. Dhoble, PRINCIPLES AND APPLICATIONS OF ORGANIC LIGHT EMITTING DIODES (OLEDs), Woodhead Publishing, 2017*	*7*	*S. Ogawa, Organic electronics materials and devices, 2nd edition, Spinger Nature, 2023*
4	*J. R. Lakowicz, Principles of Fluorescence Spectroscopy, 3rd edition, Springer, 2007*	8	*S. R. Forrest, Organic Electronics: Foundations to Applications, Oxford University Press, 2020*

Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra,* *Email Id: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. Karthik D, Department of Chemistry, SRMIST* *Email id: karthikd4@srmist.edu.in*
2	*Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

SEMESTER-VIII

Course Code	UCY24D16T	Course Title	Energy Conversion and Storage	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes(PLO)									
CLR-1	Introduction to various forms of energy resources	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Explore various types of energy conversion systems																	
CLR-3	Understand the fundamental knowledge of energy storage devices																	
CLR-4	Acquiring the basic knowledge of all types of batteries and their working principles																	
CLR-5	To acquire knowledge about various types of supercapacitors and their applications																	

Outcomes (CLO)	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Recognize the knowledge about the available energy resources	✓	✓	✓	-	3	85	70	3	-	2	-	-	-	-	-	3	-
CLO-2	Illustrate the various energy conversion systems for industrial applications	✓	✓	✓	-	4	85	75	3	-	3	-	-	-	-	2	-	-
CLO-3	Describe the various types of energy storage systems for industrial and commercial applications	✓	✓	✓	-	3	85	70	3	-	3	2	-	-	-	-	-	-
CLO-4	Prepare and demonstrate various types of battery cell assemblies and testing	✓	✓	✓	-	4	85	75	3	-	3	-	-	-	-	-	3	-
CLO-5	Prepare and validate various types of supercapacitor cell fabrication and testing	✓	✓	✓	-	4	85	75	3	-	3	-	-	-	3	-	3	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Energy resources	Energy conversion systems	Fundamentals of energy storage devices	Batteries	Supercapacitors
	12	12	12	12	12
SLO-1	Introduction to global energy systems and its current status	Steam power plant	Fundamentals of electrochemistry	Primary aqueous and non-aqueous batteries	Supercapacitors
SLO-2	Role of energy conversion and storage technology	Solar thermal energy conversion	Primary and secondary batteries	Aqueous and non-aqueous metal-air batteries	Classification of supercapacitors
SLO-3	Energy resources	Wind energy conversion	Thermodynamic concepts in electrochemical systems	Reserve battery – Seawater-activated battery	Electrical double-layer capacitance (EDLC)
SLO-4	Tutorial: Energy resources	Tutorial: Energy conversion systems	Tutorial: Fundamentals of electrochemical reactions	Tutorial: Aqueous and non-aqueous batteries	Tutorial: Concepts of EDLC behaviour
SLO-5	Fossil fuels	Biomass energy conversion	Kinetics of electrochemical energy storage processes	Secondary aqueous and non-aqueous batteries	Electrolytes, electrode materials, and electrochemical performance of EDLC
SLO-6	Biomass energy properties and resources	Geothermal power generation	The terminologies used in batteries: Half cell, full cell, redox couple, positive and negative electrodes	Gel-polymer electrolyte-based secondary batteries	Pseudocapacitance and its significance in the supercapacitors
SLO-7	Nuclear resources	Ocean energy technology	Electrolytes, separators, current collectors, and battery components	Solid-state electrolyte-based secondary battery	Hybrid supercapacitors and their electrochemical performances
SLO-8	Tutorial: Natural energy resources	Tutorial: Energy conversion technologies	Tutorial: Kinetics of electrochemical energy storage processes	Tutorial: Gel-polymer and solid-state electrolytes	Tutorial: Pseudocapacitance
SLO-9	Solar energy resources	Direct energy conversion	Current-potential measurements	Rechargeable metal-air battery beyond lithium-ion	Symmetric and asymmetric supercapacitors
SLO-10	Wind energy resources	Electrochemical energy conversion	Charge-discharge measurements	High-temperature system: Na-S battery	Testing of supercapacitors
SLO-11	Geothermal energy	Photocatalytic energy conversion	Nominal voltage, capacity, rate performance	Flow battery: Zinc-Bromine system	Applications of supercapacitors

SLO-12	Tutorial: Solar, wind, and geothermal energy resources	Tutorial: Electro and photocatalytic energy conversion systems	Tutorial: Electrochemical characterizations of energy storage devices	Tutorial: Next-generation metal-ion batteries beyond lithium-ion	Tutorial: Asymmetric supercapacitors

Resources			
1	*Yuping Wu, Rudolf Holze, Electrocheical Energy Conversion and Storage Wiley, 2020*	3	*D. Yogi Goswami, Frank Kreith, Energy Conversion, CRC Press, 2007*
2	*D. Yogi Goswami, Frank Kreith, Energy Conversion, CRC Press, Second Edition, 2007*	4	*Robert A. Huggins, Energy Storage: Fundamentals, Materials, and Applications, Second Edition, Springer, 2016*

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
Total (%)		100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email Id: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar, Department of Chemistry, IIT Madras, Email: gsekar@iitm.ac.in*	1	*Dr. S. Anandhakumar S, SRMIST, anandhas2@srmist.edu.in* *Dr. K. Kamala Bharathi, SRMIST, kamalabk@srmist.edu.in*
2	*Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka, Email Id: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram. Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari, Department of Chemistry, SRMIST Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D17T	Course Title	Polymer Chemistry and its Uses	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	Understanding polymers and their chemistry	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	Acquire knowledge on synthesis, properties and applications of different kinds of polymers																	
CLR-3	Learning this course will help develop skills on synthesis of conducting polymers as well as understand the significance and applications of conducting polymers																	
CLR-4	Enrich the knowledge on biopolymers and biodegradable polymers and the basic aspects of polymer nanocomposites																	
CLR-5	Knowledge on materials developed using polymers to extend their applications to meet today's on-demands																	

Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Gain knowledge on polymer science	✓	✓	✓	-	2	85	75	2	-	-	-	3	3	-	-	-	-
CLO-2	Synthesis of different types of polymers and their applications	✓	✓	✓	-	2	85	75	-	3	-	-	3	-	2	-	-	-
CLO-3	Get knowledge on ionic, conducting and biopolymers	✓	✓	✓	-	3	85	75	3	-	-	-	-	-	3	-	3	-
CLO-4	Modern use of polymers for today's on-demand applications	✓	✓	✓	-	3	85	75	-	3	-	3	-	-	-	-	-	2
CLO-5	Applications of polymers in medical science	✓	✓	✓	-	3	85	75	-	3	-	-	3	-	3	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Polymerisation and its types	Liquid crystal polymers	Ionic polymers	Aromatic conducting polymers	Stimuli responsive polymers
	12	12	12	12	12
SLO-1	Introduction to polymers, their uses	Introduction to liquid crystal polymers (LCPs), their uses	Introduction to bioionic polymers Synthesis of bionic polymers (examples 1 and 2)	Polyaromatic conducting polymers: introduction and synthesis, examples	Applications of polymers for designing drug carriers, controlled drug release
SLO-2	Step-growth polymerization mechanism, examples	Application of liquid crystal (LC) main-chain	Applications of bioionic polymers (examples 1 and 2)	Polyaniline, polypyrrole & polythiophene: Structure,	pH-responsive polymers, applications

		polymers (examples 1 and 2)		physicochemical properties and uses	
SLO-3	Radical chain polymerization: mechanism, examples	Side-chain LC polymers (examples 1 and 2)	Ionic crosslinking and ion exchange in bionic polymers, their uses	Poly(3,4- ethylenedioxythiophene) (PEDOT): Structure and physicochemical properties poly(p-phenylene sulfide), poly(vinyl carbazole): Structure and physicochemical properties	Photoresponsive polymers, applications
SLO-4	Tutorial: Problem solving	Tutorial: Numericals	Tutorial: Worked out examples	Tutorial: Problem solving	Tutorial: Worked out examples
SLO-5	Ionic chain polymerization: Mechanism examples	Properties of side chain LC polymers applications of LC polymers	Ionomers based on polyethylene and polystyrene	Applications of conducting polymers in rechargeable batteries, examples	Magnetically responsive polymers, enzyme responsive polymers
SLO-6	Chain Copolymerization: mechanism, examples	Photochromic LCPs chiral-photochromic LCPs	Polyelectrolytic complexes, applications	Applications of conducting polymers in sensors and biosensors fabrication, examples	Shape memory polymers, applications
SLO-7	Ring opening polymerization: mechanism, examples	LC block copolymers, their uses	Inorganic ionic polymers (synthesis) applications	Conducting polymers as electrochemical actuators, examples	Smart polymer hydrogels, applications
SLO-8	Tutorial: Problem solving	Tutorial: Numericals	Tutorial: Worked out examples	Tutorial: Problem solving	Tutorial: Worked out examples
SLO-9	Polymer stereo chemistry, examples	LC composites, applications	Synthesis of conducting polymers, examples	Introduction to biopolymers and biodegradable polymers, examples	Polymers in tissue engineering, examples
SLO-10	Coordination polymerization , examples	Synthesis of ionic polymers (examples 1 and 2)	Polyacetylene, poly (p-phenylene vinylene) (PPV) Examples	Characterization of biopolymers by using NMR spectroscopy	Polymers for medical devices (synthesis only), examples
SLO-11	Characterization of polymers to understand their physical properties	Applications of ionic polymers (examples 1 and 2)	Polyheterocyclic conducting polymers: synthesis	Characterization of biopolymers by using Mass spectroscopy	Polymer nanocomposites (synthesis only), examples
SLO-12	Tutorial: Problem solving	Tutorial: Numericals	Tutorial: Worked out examples	Tutorial: Problem solving	Tutorial: Worked out examples

Resources			
1	*A. R. West, Basic Solid-State Chemistry, 2nd Ed., John Wiley &Sons Ltd., 1999.*	4	*K. J. Klabunde, Nanoscale materials in Chemistry, Wiley Interscience, New York, 2001.*
2	*C. Giacovazzo, Fundamentals of Crystallography, Oxford University Press, 2002.*	5	*W. D. Callister and D. G. Rethwisch, Materials Science and Engineering: An*

			Introduction,9th Ed., Wiley, 2013.
3	*D. J. Ward, Materials Science, Lerner Classroom, 2008.*	6	*W Wagner, S Sakiyama-Elbert, G Zhang, M Yaszemski. Biomaterials Science: An Introduction to Materials in Medicine, 4th Ed., Academic Press, 2020.*

Assessment						
		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
	Bloom's Level of Thinking	Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies					
Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email Id:* *Email: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. Arun Prakash P, SRMIST* *Department of Chemistry, SRMIST* *E-mail: arunprap1@srmist.edu.in*
2	*Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D18T	Course Title	Industrial Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	*Chemistry*	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	The purpose of learning this course is to:	Depth				Attainment			Program Learning Outcomes (PLO)									
CLR-1	To familiarize the students about the topics in industrial chemistry	1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
CLR-2	To gain knowledge about various industrial fuels																	
CLR-3	To study in depth about the use of various fertilizers in agriculture																	
CLR-4	To learn the basic concepts about water treatment and water pollution control																	
CLR-5	To gain knowledge about the manufacture of cement and glass																	

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Give an overview about the industrial fuels	✓	✓	✓	-	2	85	75	3	-	-	-	-	-	3	3	-	-
CLO-2	Explain the types and the applications of fertilizers and pesticides	✓	✓	✓	-	2	85	75	3	-	-	-	-	-	2	-	3	-
CLO-3	Demonstrate the sequential steps involved in the waste water treatment	✓	✓	✓	-	3	85	75	3	-	-	-	2	-	-	-	-	2
CLO-4	Develop innovative technology for pollution control and management	✓	✓	✓	-	3	85	75	-	-	2	3	-	-	-	-	3	-
CLO-5	Demonstrate the manufacturing process of cement, glass and ceramics	✓	✓	✓	-	3	85	75	-	-	-	-	3	3	-	-	3	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Industrial fuels	Chemistry in agriculture	Water treatment	Chemical toxicology, manufacturing and hazards in handling chemicals	Cement, glass and ceramics
	12	12	12	12	12
SLO-1	Energy sources – types and classification Classification of fuels-solid, liquid and gaseous fuels. Calorific value of fuels and its determination.	Fertilizers- NPK-superphosphate- triple. Superphosphate.	Introduction-sources of water. Hardness of water- temporary and permanent hardness.	Chemical toxicology: Effect of toxic chemicals on enzymes.	Cement: Manufacturing-wet process and dry process- types.

SLO-2	Solid fuels: A brief introduction Types of solid fuels - coal, lignite, and sub-bituminous coal. Bituminous coal and anthracite.	Use of mixed fertilizers. Micronutrients and their role.	Units of hardness. Disadvantages of hard water. Effects of iron and manganese in water.	Biochemical effects of Lead and mercury.	Analysis of major constituents- setting of cement.
SLO-3	Solid fuels: Coking and non-coking coal.	Biofertilizers- plant growth harmones.	Estimation of hardness – EDTA method and alkali titration method.	Biochemical effects of cyanide pollution.	Analysis of major constituents-reinforced concrete.
SLO-4	Tutorial: Problem solving	Tutorial: Numericals	Tutorial: Worked out examples	Tutorial: Problem solving	Tutorial: Worked out examples
SLO-5	Introduction to liquid fuels. Petroleum refining and uses.	Pesticides- classification of pesticides with examples.	Water softening methods.	Carbon monoxide, sulfur dioxide- oxides of nitrogen- ozone - biochemical effects.	An overview of cement industries in India.
SLO-6	Hydrodesulphurisation and cracking (thermal and catalytic - fixed bed and fluidised bed).	Insecticides - stomach poisons- contact insecticides- fumigants.	Zeolite process.	Manufacturing and hazards in handling chemicals: Manufacture of hydrochloric acid, nitric acid, sulphuric acid.	Glass: Composition and manufacture of glass.
SLO-7	Octane number. Production and uses of tetraethyl lead, ETBE and MTBE.	Manufacture and uses of insecticides.	Ion-exchange demineralisation. Mixed – bed deionisation.	Manufacture of caustic soda and borax.	Types of glasses- optical glass.
SLO-8	Tutorial: Problem solving	Tutorial: Worked out examples	Tutorial: Problem solving.	Tutorial: Problem solving	Tutorial: Worked out examples
SLO-9	Gaseous fuels, hydrogen and hydrocarbon fuels production.	DDT- BHC (gammaxane: Conformation of gamma isomer) pyrethrin, banned pesticides.	Domestic waste water treatment.	Hazards in handling the chemicals - hydrochloric acid.	Types of glasses - optical glass- coloured glasses and lead glass
SLO-10	Natural gas and gobar gas production.	Herbicides -manufacture of 2,4-D and 2,4,5-T. Fungicides -preparation of Bordeaux mixture-lime-sulphur creosote oil (formula only).	Purification methods – chlorination- break point chlorination.	Hazards in nitric acid, sulphuric acid, caustic soda and borax.	Ceramics: Types - raw materials-white wares.
SLO-11	Compositions and uses of Gobar Electric cell.	Sugar industry - double sulphitation process. Refining and grading of sugar. Saccharin - use as a sugar substitute- aspartame.	Osmosis - Desalination.	Hazards in hydrogen peroxide and bleaching powder.	Ceramics: Manufacture and uses.

SLO-12	Tutorial: Problem solving	Tutorial: Worked out examples	Tutorial: Numericals	Tutorial: Problem solving	Tutorial: Worked out examples

Resources			
1	*R. Norris Shreve and Joseph A. Brink, Jr., Chemical process industries, 4th edition, Mc Graw – Hill, Kogakusha, Ltd, New York, 1977.*	4	*T. George Austin, Shreve's Chemical Process industries, 5th edition, Mc Graw – Hill, New York, 1984.*
2	*P. C. Jain and M.C. Jain, Engineering Chemistry, 10th edition, Dhanpat Rai and Sons, New Delhi, 1993.*	5	*A. K. De, Environmental Chemistry, 2nd edition, Wiley Eastern Ltd., Delhi, 1986.*
3	*E. S Manahan, Fundamentals of Environmental Chemistry, 2nd edition, CRC Press, Florida, 2000.*	6	*N. S. Subba Rao, Biofertilizers in Agriculture, Oxford and IBH Publishing Co Pvt Ltd, New Delhi, 1982.*

Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
	Total (%)	100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra, General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra, Email Id:* *Email: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. Arun Prakash P,* *Department of Chemistry, SRMIST* *E-mail: arunprap1@srmist.edu.in* *Dr. T. Pushpa Malini, SRMIST* *Department of Chemistry, SRMIST* *E-mail: pushpamt@srmist.edu.in*
2	*Dr. Ravikiran Allada, Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24D19T	Course Title	Pharmaceutical Chemistry	Category	D	Discipline Specific Elective	L	T	P	C
							3	1	0	4

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR)	The purpose of learning this course is to:
CLR-1	Develop basic understanding about nomenclature, classifications and side effects of drugs.
CLR-2	Comprehend the mode of action of anti-inflammatory, antibacterial, antifungal and antiviral agents
CLR-3	Understand the steps involved in synthesis of selective drugs used in treatment of inflammation, infection and disorders
CLR-4	Gain knowledge about enzyme-based reactions and factors affecting them
CLR-5	Gain an overview of fermentation process involved in the production of selective dietary supplements and commonly used antibiotics

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Depth				Attainment			Program Learning Outcomes (PLO)										
		1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency (%)	Expected Attainment (%)	Problem Solving, Critical Thinking, Creativity	Communication Skills, Collaborating Skills	Independent Thinking, Analytical Reasoning, Learning to Learn , Research Skills	Leadership Qualities, Professionalism, Autonomy, Accountability	Digital Technology Skills	Value Inculcation, Multicultural inclusivity	Environmental Action, Community Engagement	Entrepreneurial Risk Taking	PSO-1	PSO-2
CLO-1	Gather information about a commercial pharmaceutical drug, based on its nomenclature and summarize the drug's benefit and side effects	✓	✓	✓	-	3	85	75	-	3	3	-	-	-	-	-	3	-

CLO-2	Differentiate between different class of drugs based on its reported biological action	✓	✓	✓	-	3	85	70		2	3	-	-	-	-	-	-	-	3
CLO-3	Design synthetic methods for generating simple drug molecules or their intermediates	✓	✓	✓	-	4	85	70		3	2	3	-	-	-	-	-	-	-
CLO-4	Identify appropriate enzyme mediated reactions for organic molecule synthesis	✓	✓	✓	-	4	85	70		3	-	3	-	-	-	-	-	2	-
CLO-5	Discuss about the role of fermentation process in the production of ethanol, citric acids, antibiotics and some classes of vitamins	✓	✓	✓	-	4	85	60		3	3	3	-	-	-	-	-	-	-

Sessions	CLO-I	CLO-II	CLO-III	CLO-IV	CLO-V
	Drug metabolism	Pharmaceutical aids	Drug synthesis	Drug – enzyme interaction	Fermentation mediated production
	12	12	12	12	12
SLO-1	Introduction of drugs - Nature and sources of drugs, classifications of drugs: biological & chemical, nomenclature of drugs	Medicinally important inorganic compounds role of inorganic compounds therapeutic uses of inorganic compounds	Definition and actions of representative antibacterial agent - synthesis of the representative drugs (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim)	Storage of drugs: Importance, and different conditions	Fermentation - Aerobic and anaerobic fermentation
SLO-2	Drug receptor interaction	Drugs and pharmaceuticals – I: Study of pharmaceutical aids - talc, diatomite and kaolin	Definition and actions of representative antifungal agent - synthesis of the representative drugs	Shelf life of drug, encapsulation of drugs	Production of ethyl alcohol Production of citric acid
SLO-3	Mechanism of drug interaction	Study of pharmaceutical aids – bentonite and gelatin	Definition and actions of antiviral agents - synthesis of the representative drugs antiviral agents (Acyclovir)	Brief introduction to drug delivery	Production of Antibiotics – Penicillin
SLO-4	Tutorial – Classify given drug molecules based on their structure and identify their application	Tutorial – Discuss the use of bentonite and gelatin in drug manufacturing	Tutorial - List the reagents and synthetic methods used in synthesis of acyclovir	Tutorial – Discuss the role of drug shelf life and its effectiveness in treatment.	Tutorial – List out the difference between aerobic and anaerobic functions with example

SLO-5	Metabolism of drugs	Study of pharmaceutical aids - natural colours	Definition and actions of central nervous system agents - synthesis of the representative drugs central nervous system agents (Phenobarbital, Diazepam)	Introduction – Enzymes, classification of enzymes, enzyme specificity	Production of antibiotics - Cephalosporin
SLO-6	Definition of the following terms: Pharmacophore-pharmacology, pharmacopeia	Basic retro-synthetic approach for development of drug.	Definition and actions of cardiovascular drug - synthesis of the representative cardiovascular drug (Glyceryl trinitrate)	Role of enzyme cofactor in enzyme reactions	Production of antibiotics - Chloromycetin
SLO-7	Definition of the following terms: Bacteria, virus, chemotherapy and vaccine	Basic retro-synthetic approach for development of drug.	Definition and actions of anti-leprosy drug	Role of coenzyme in enzyme reactions	Production of antibiotics - Streptomycin
SLO-8	Tutorial – Find names of bacteria and virus associated with common infections and their treatment options	Tutorial – Identify different approaches to synthesizing commonly used drug molecules	Tutorial - List the reagents and synthetic methods used in synthesis of phenobarbital, diazepam	Tutorial – Practice correlation between name of the enzymes and their mode of action	Tutorial – List out the role of fermentation process on antibiotic production
SLO-9	Causes and symptoms for common disease and their treatment	Definition and actions of antipyretic drug synthesis of the representative drugs	Synthesis of the representative anti leprosy drugs (Dapsone)	Mechanism of enzyme action – enzyme inhibition	Production of - Lysine, glutamic acid
SLO-10	Causes and symptoms for common disease and their treatment	Definition and actions of anti-inflammatory drug	Definition and actions of HIV-AIDS related drugs	Role of enzyme involved in drug metabolism	Production of - Vitamin B12
SLO-11	Difference between drug and poison.	Synthesis of ani-inflammatory representative drugs - (Aspirin)	Synthesis of the representative HIV-AIDS related drugs (AZT Zidovudine)	Role of enzyme in drug activity – cytochrome p450	Production of - Vitamin C
SLO-12	Tutorial – Identify symptoms associated with diseases and discuss remedies	Tutorial – List the reagents and synthetic methods used in synthesis of aspirin	Tutorial - List the reagents and synthetic methods used in synthesis of AZT Zidovudine	Tutorial –Discuss the effect of cytochormep450 on drug action	Tutorial - List out the role of fermentation process on vitamin B12 production

Resources			
1	*G. L. Patrick, Introduction to Medicinal Chemistry, Oxford University Press, UK 2013.*	4	*H. V. K. Kapoor, Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi 2008.*
2	*W. O. Foye, L. Thomas, D. A. William, Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi 2012.*	5	*R. A. Kjonaas, P. E. Williams, D. A. Counce, L. R. Crawley, Synthesis of Ibuprofen. in the Introductory Organic Laboratory, J. Chem. Educ., 88 (6), pp 825– 828, 2011.*
3	*D. G. Marsh, D. L. Jacobs, H. Veening, Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry, J. Chem. Educ., 50 (9), p 62,1973.*		

Assessment

Bloom's Level of Thinking		Continuous Learning Assessment (CLA) (50% weightage)				Final Assessment (50 % weightage)
		CLA – 1	CLA – 2	CLA – 3	CLA – 4 *	
		(10 %)	(10 %)	(20 %)	(10%)	
		Theory (%)	Theory (%)	Theory (%)	Theory (%)	Theory (%)
1	Remember	15	15	10	10	15
2	Understand	15	15	10	10	15
3	Apply	20	25	25	25	25
4	Analyze	20	25	25	25	25
5	Evaluate	15	10	15	15	10
6	Create	15	10	15	15	10
Total (%)		100	100	100	100	100

Strategies

Technology		Pedagogy / Andragogy		Sustainable Development	
Simulations		Clarification/Pauses	✓	Good Health & Well Being	✓
Presentation Tools	✓	Group Discussion	✓	Quality Education	✓
Learning Management System	✓	Hands-on Practice	✓	Gender Equality	✓
		Debate	✓		
		Interactive Lecture	✓		
		Brainstorming	✓		

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
1	*Dr. Sudarshan Mahapatra* *General Manager at Encube Ethicals Private Limited, Mumbai, Maharashtra,* *Email Id: sudarshan.m@encubeethicals.com*	1	*Prof. G. Sekar* *Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	1	*Dr. M.R. Ganesh,* *Department of Chemistry, SRM IST* *Email id: ganeshm1@srmist.edu.in*
2	*Dr. Ravikiran Allada,* *Head Analytical R&D and ASAT (AVP) || Steriscience (Strides), Bengaluru, Karnataka,* *Email Id: Ravikiran.Allada@Steri-science.com*	2	*Prof. Sukhendu Mandal* *Department of Chemistry, IISER, Thiruvananthapuram* *Email: sukhendu@iisertvm.ac.in*	2	*Prof. M. Arthanareeswari,* *Department of Chemistry, SRMIST* *Email: hod.chy.ktr.et@srmist.edu.in*

Course Code	UCY24P02L	Course Name	Research Project and Dissertation	Course Category	P	Project Work	L	T	P	C
							0	0	24	12

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Guidance Cell*	Data Book / Codes/Standards	As required for the project work		

Rationale (CLR)	The purpose of learning this course is to:
CLR-1	Demonstrate skills learnt in the real time environment.
CLR-2	Explore the different industries based on chemistry and related areas
CLR-3	Enhance the skills in the system aspects
CLR-4	Understanding the professional connections with the knowledge learnt
CLR-5	Applying the skills in problem solving

Outcomes (CLO)	At the end of this course, learners will be able to:		Depth				Attainment			Program Learning Outcomes (PLO)									
			1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
		Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment	Problem Solving,	Communication Skills,	Independent Thinking, Analytical	Leadership Qualities, Professionalism,	Digital Technology	Value Inculcation,	Environmental Action, Community	Entrepreneurial Risk	PSO-1	PSO-2	
CLO-1	Apply the studied concepts in provoking an innovative idea	✓	✓	-	-	3	80	70	3	3	-	-	-	2	-	-	-	-	
CLO-2	Gain valuable skills and knowledge in research	✓	✓	✓	-	3	85	75	-	3	-	-	-	3	-	-	2	-	
CLO-3	Make professional connections and enhance networking	✓	✓	✓	✓	3	75	70	-	-	3	3	2	-	-	-	-	-	
CLO-4	Get experience in a field to allow the student to make a career transition	✓	✓	✓	✓	3	85	80	3	-	-	3	-	-	-	-	3	-	
CLO-5	Get an inside view of an industry and organization/company	✓	✓	✓	✓	3	85	75	-	3	-	3	-	-	-	-	-	3	

Assessment Component	Expected outcome	Type	Evaluators	Criteria or basis	Marks
Review – 0 Internship	Internship letter Submission Proposed Project title to be described. Abstract of the project.	Internal	Supervisor / Guide & Project Coordinator	Feasibility Studyof the project	5

Review – I Project Proposal	A short presentation about the Problem statement Literature Survey System architecture Design Specifications	Internal	Supervisor/Guide	Clarity of the idea, Preliminarywork done.	10
Review – II	Presentation on Techniques, Model/ Algorithm, Modules, coding Prototype of the project	Internal	Supervisor/Guide	Clarity of idea, Presentation	10
Review – III	Final presentation, Demonstration of Project.	Internal	Supervisor/Guide	Technical demonstration, Presentation	10
Report Submission	Submission of final project report	Internal	Project Coordinator	Regularity, Originality, Systematic progress	15
Project Report	Evaluation of Project Report	External	Examiner(s)/ Reviewer(s)	Presentation, Handling Q&A	20
Viva – Voce	Final Presentation	External			30

The assessment method for the project work consists of in-semester and end semester evaluations as detailed below:

	Continuous Learning Assessment (50% weightage)					Final Evaluation (50% weightage)	
	Review - 0	Review – 1	Review – 2	Review – 3	Report Submission	Project Report	Viva-Voce*
Project Work / Internship	5%	10%	10%	10%	15%	20 %	30 %

*Student has to be present for the viva voce for assessment. Otherwise it will be treated as non-appearance for the examination with final grade as 'Ab'

Course Code	UCY24P03L	Course Title	Professional Internship	Category	P	Project Work / Internship (P)	L	T	P	C
							0	0	24	12

Course Offering Department	Chemistry	Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil	Data Book / Codes/Standards	Nil

Rationale (CLR)	The purpose of learning this course is to:
CLR-1	Demonstrate skills learnt in the real time environment.
CLR-2	Explore the different industries based on chemistry and related areas
CLR-3	Enhance the skills in the system aspects
CLR-4	Understanding the professional connections with the knowledge learnt
CLR-5	Applying the skills in problem solving

Outcomes (CLO)	At the end of this course, learners will be able to:		Depth				Attainment			Program Learning Outcomes (PLO)									
			1	2	3	4	1	2	3	1	2	3	4	5	6	7	8	9	10
			Conceive	Design	Implement	Operate	Level of Thinking	Expected Proficiency	Expected Attainment	Problem Solving,	Communication Skills,	Independent Thinking, Analytical	Leadership Qualities, Professionalism,	Digital Technology	Value Inculcation,	Environmental Action, Community	Entrepreneurial Risk	PSO-1	PSO-2
CLO-1	Apply the studied concepts in provoking an innovative idea	✓		✓	-	-	3	80	70	3	3	-	-	-	2	-	-	-	-
CLO-2	Gain valuable skills and knowledge in research	✓		✓	✓	-	3	85	75	-	3	-	-	-	3	-	-	2	-
CLO-3	Make professional connections and enhance networking	✓		✓	✓	✓	3	75	70	-	-	3	3	2	-	-	-	-	-
CLO-4	Get experience in a field to allow the student to make a career transition	✓		✓	✓	✓	3	85	80	3	-	-	3	-	-	-	-	3	-
CLO-5	Get an inside view of an industry and organization/company	✓		✓	✓	✓	3	85	75	-	3	-	3	-	-	-	-	-	3

PROCESS	
Stage I	Identifying area of interest
Stage II	Review I
Stage III	Review II
Stage IV	Project report preparation
Stage V	Final Submission of the Project Report

	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
	Review – 1	**Review – 2**	**Project Report**	**Viva-Voce**
Project Work / Internship	*20%*	*30 %*	*30 %*	*20 %*

Designers					
Professional Experts		Higher Institution Experts		Internal Experts	
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