ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMME

Bachelor of Science in

Chemistry

Three Years /

Bachelor of Science (Honours) in

Chemistry

Four Years

Learning Outcomes Based Curriculum Framework (LOCF)

Choice Based Flexible Credit System

Academic Year
2023-2024

SRM
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

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Content

1. Department Vision Statement	**1**
2. Department Mission Statement	**1**
3. Program Education Objectives (PEO)	**1**
4. Program Specific Outcomes (PSO)	**1**
5. Consistency Of PEO's With Mission of The Department	**1**
6. Consistency of PEO's With Program Learning Outcomes (PLO)	**1**
Curriculum B.Sc. Chemistry	
7. Programme Structure	**2**
8. Implementation Plan	**4**
9. Program Articulation Matrix	**8**
10. Structure of Course	**10**

Syllabus for B.Sc. Chemistry		
SEMESTER I		
ULT23G01J	Tamil-I	11
ULH23G01J	Hindi-I	15
ULF23G01J	French-I	17
ULE23AE1T	English	19
UCY23101T	Atomic Structure and Chemical Bonding	23
UCY23102T	Basic Organic Chemistry	26
UCY23103J	States of matter, solutions and phase equilibria	29
UCD23S01L	Quantitative Aptitude and Logical Reasoning	32
UCD23V01T	Universal Human Values	34
SEMESTER II		
ULT23G02J	Tamil-II	36
ULH23G02J	Hindi-II	40
ULF23G02J	French-II	42
UES23AE1T	Environmental Studies	44
UCY23201J	Chemistry of s and p-Block Elements	47
UCY23202T	Basic Reactions in Organic Chemistry	50
UCY23203T	Chemical Equilibria, Acids and Bases	53
UCD23S02T	Verbal Ability and Skill Development	56
UEN23V01L	Communication Skills	58
UNS23M01L	NSS	62
UNC23M01L	NCC	62
UNO23M01L	NSO	62
UYG23M01L	YOGA	62
SEMESTER III		
UCY23301T	Radioactive and Nuclear Chemistry	63
UCY23302J	Functional Groups in Organic Chemistry	66
UCY23303T	Thermodynamics and Surface Chemistry	70
UPY23G01J	Allied Physics	73
UPY23G02T	Laser Physics	75
ULT23AE1J	Applied Tamil – I	77
ULH23AE1J	Applied Hindi – I	80
ULF23AE1J	French for Specific purpose-I	82
UCY23S03L	Instrumental Methods of Analysis	84
UCD23V02T	Industry Oriented Employability Skills for Science	86
UCY23P01L	Internship-I	88
SEMSTER-IV		
UCY23401T	Coordination Chemistry	89
UCY23402T	Heterocyclic Compounds, Natural Products and Biomolecules	92
UCY23403T	Chemical Kinetics and Electrochemistry	96
UPY23G03T	Data, Statistics, and Inference	99

UMA23G11T	Allied Mathematics	101
ULT23AE2J	Applied Tamil – II	104
ULH23AE2J	Applied Hindi – II	107
ULF23AE2J	French for Specific purpose-II	109
UCY23S04L	Inorganic Qualitative Analysis	111
UCD23V05T	Career Readiness and Professional Skills	113
UMI23M01L	My India Project	114
SEMESTER-V		
UCY23501T	Chemistry of d and f-block elements	115
UCY23502J	Analytical chemistry	118
UCY23503T	Statistical Thermodynamics and Group Theory	121
UCY23D01T	Nanomaterials and Nanochemistry	124
UCY23D02T	Energy and Fuels	127
UCY23G02T	Polymer chemistry and its uses	129
UPY23G04T	Solar Technology	131
UCY23S05L	Organic Chemistry Practical-II	134
UCY23P02L	Internship-II	136
SEMESTER-VI		
UCY23601T	Pericyclic Reaction, Photochemistry and Polycyclic Aromatic Hydrocarbons (PAH)	137
UCY23602T	Quantum chemistry and Molecular spectroscopy	140
UCY23603T	Research Methodology	143
UCY23D03T	Polymer and Industrial Chemistry	146
UCY23D04T	Supramolecular Chemistry	150
UCY23G03T	Food Chemistry	153
UPY23G05T	Structure and Properties of Materials	156
UCY23P04L	Mini Project	158
SEMESTER-VII		
UCY23701T	Reagents in Organic Reactions	159
UCY23D05T	Solid State Chemistry and its applications	162
UCY23D06T	Chemical Technology and Society	165
UCY23G04T	Pharmaceutical Chemistry	168
UPY23G06T	Thin Films	171
UCY23G05T	Chemistry in everyday life	174
UPY23G07T	Group Theory	176
UCY23P03L	Internship-III	178
UCY23P05L	Project Phase-I	179
SEMESTER-VIII		
UCY23801T	Organometallic & Bioinorganic Chemistry	180
UCY23D07T	Organic Spectroscopy	182
UCY23D08T	Materials chemistry and their use in everyday life	185
UCY23D09T	Medicinal Chemistry and Drug design	188
UCY23D10T	Green Chemistry	191
UCY23G06T	Computational Modelling in Chemistry	194
UPY23G08T	Applications of Nanotechnology	197
UCY23P06L	Project Phase-II	200
Syllabus of Generic Elective courses for other department		
UCY23G01J	Basic Chemistry	201
Courses for Earning Additional Credits		
UCD23P01L	Internship Report– I	204
UCD23P02L	Project Work – I	205
UCD23P03L	Apprenticeship – I	206
UCD23P04L	Internship Report– II	207
UCD23P05L	Project Work – II	208
UCD23P06L	Apprenticeship – II	209

1.	Department Vision Statement
Stmt - 1	*To be a nationally and an internationally-acclaimed hub for high-level teaching in chemistry*
Stmt - 2	*To impart research-based education to students in the field of chemistry.*
Stmt - 3	*To Implement the global standards and nurturing the students through innovation and quality education.*

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

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 in research or industrial environments.*
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.	Program Specific Outcomes (PSO)
PSO - 1	*To provide in-depth knowledge about the terms, concepts, methodologies, principles and experimental techniques involved in the various fields of chemical sciences.*
PSO - 2	*To work in the pure, interdisciplinary and multidisciplinary areas of chemical sciences and its applications*
PSO - 3	*To prepare the students with a working knowledge of experimental techniques and instrumentation required to work independently in research or in other industrial environments.*

5.	Consistency of PEO's with Mission of the Department				
	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	H	H	H	H	H
PEO - 2	M	H	M	H	H
PEO - 3	M	H	H	H	H
PEO - 4	H	H	M	M	H
PEO - 5	M	M	M	H	L

6.	Consistency of PEO's with Program Learning Outcomes (PLO)														
	Program Learning Outcomes (PLO)														
	1.	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*	*12.*	*13.*	*14.*	*15.*
	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
PEO - 1	H	H	H	H	H	L	H	L	H	L	L	H	M	H	H
PEO - 2	H	M	M	H	H	H	H	M	M	M	M	M	H	H	H
PEO - 3	H	H	H	H	H	H	H	M	H	H	H	H	H	L	H
PEO - 4	H	H	M	H	H	H	H	H	H	H	H	H	M	M	H
PEO - 5	M	M	H	H	M	H	M	H	H	H	H	H	H	H	H

Curriculum B.Sc. Chemistry

7. Programme Structure (Total Credits:176)

1. Professional Core Courses (C)
(20 Courses)

Course Code	Course Title	Hours/ Week L	T	P	O	C
UCY23101T	Atomic Structure and Chemical Bonding	3	1	0	2	4
UCY23102T	Basic Organic Chemistry	3	1	0	2	4
UCY23103J	States of matter, solutions and phase equilibria	3	0	3	2	4
UCY23201J	Chemistry of s and p-Block Elements	3	0	3	2	4
UCY23202T	Basic Reactions in Organic Chemistry	3	1	0	2	4
UCY23203T	Chemical Equilibria, Acids and Bases	3	1	0	2	4
UCY23301T	Radioactive and Nuclear Chemistry	3	1	0	2	4
UCY23302J	Functional Groups in Organic Chemistry	3	0	3	2	4
UCY23303T	Thermodynamics and Surface Chemistry	3	1	0	2	4
UCY23401T	Coordination Chemistry	3	1	0	2	4
UCY23402T	Heterocyclic Compounds, Natural Products and Biomolecules	4	0	0	2	4
UCY23403T	Chemical Kinetics and Electrochemistry	3	1	0	2	4
UCY23501T	Chemistry of d and f-Block Elements	3	1	0	2	4
UCY23502J	Analytical chemistry	3	0	3	2	4
UCY23503T	Statistical Thermodynamics and Group Theory	3	1	0	2	4
UCY23601T	Pericyclic Reaction, Photochemistry, and Polycyclic Aromatic Hydrocarbons (PAH)	3	1	0	2	4
UCY23602T	Quantum chemistry and Molecular spectroscopy	3	1	0	2	4
UCY23603T	Research Methodology	4	0	0	2	4
UCY23701T	Reagents in Organic Reactions	3	1	0	2	4
UCY23801T	Organometallics & Bioinorganic Chemistry	3	1	0	2	4
Total Learning Credits						80

2. Discipline Specific Elective Courses (D)
(5 Courses)

Course Code	Course Title	Hours/ Week L	T	P	O	C
UCY23D01T	Nanomaterials and Nanochemistry	3	1	0	2	4
UCY23D02T	Energy and Fuels					
UCY23D03T	Polymer and Industrial Chemistry	3	1	0	2	4
UCY23D04T	Supramolecular Chemistry					
UCY23D05T	Solid State Chemistry and its Applications	3	1	0	2	4
UCY23D06T	Chemical Technology and Society					
UCY23D07T	Organic Spectroscopy	4	0	0	2	4
UCY23D08T	Materials chemistry and their use in everyday life					
UCY23D09T	Medicinal Chemistry and Drug Design	4	0	0	2	4
UCY23D10T	Green Chemistry					
Total Learning Credits						12

3. Generic Elective Courses (G)
(9 Courses)

Course Code	Course Title	Hours/ Week L	T	P	O	C
ULT23G01J	Tamil-I	3	0	0	2	3
ULH23G01J	Hindi-I	3	0	0	2	
ULF23G01J	French-I	3	0	0	2	
ULT23G02J	Tamil-II	3	0	0	2	3
ULH23G02J	Hindi-II	3	0	0	2	
ULF23G02J	French-II	3	0	0	2	
UPY23G01J	Allied Physics	3	0	3	2	4
UPY23G02T	Laser Physics	3	1	0	2	
UPY23G03T	Data, Statistics, and Inference	3	1	0	2	4
UMA23G11T	Allied Mathematics	3	1	0	2	
UPY23G04T	Solar Technology	3	1	0	2	4
UCY23G02T	Polymer chemistry and its uses	3	1	0	2	
UPY23G05T	Structure and Properties of Materials	3	1	0	2	4
UCY23G03T	Food Chemistry	3	1	0	2	
UPY23G06T	Thin Films	3	1	0	2	4
UCY23G04T	Pharmaceutical Chemistry	3	1	0	2	
UPY23G07T	Group Theory	3	1	0	2	4
UCY23G05T	Chemistry in everyday life	3	1	0	2	
UPY23G08T	Applications of Nanotechnology	3	1	0	2	4
UCY23G06T	Computational Modelling in Chemistry	3	1	0	2	
	Total Learning Credits					34

4. Skill Enhancement Courses(S)
(5 Courses)

Course Code	Course Title	Hours/ Week				
		L	T	P	O	C
UCD23S01L	Quantitative Aptitude and Logical Reasoning	0	0	2	2	1
UCD23S02T	Verbal Ability and Skill Development	2	0	0	2	2
UCY23S03L	Instrumental Methods of Analysis	0	0	3	2	1
UCY23S04L	Inorganic Qualitative Analysis	0	0	4	2	2
UCY23S05L	Organic Chemistry Practical-II	0	0	3	2	1
Total Learning Credits						**7**

5. Ability Enhancement Courses (AE)
(4 Courses)

Course Code	Course Title	Hours/ Week				
		L	T	P	O	C
ULE23AE1T	English	4	0	0	2	4
UES23AE1T	Environmental Studies	3	0	0	2	3
ULT23AE1J	Applied Tamil – I	1	0	2	2	2
ULH23AE1J	Applied Hindi – I					
ULF23AE1J	French for specific purpose-I					
ULT23AE2J	Applied Tamil – II	1	0	2	2	2
ULH23AE2J	Applied Hindi – II					
ULF23AE2J	French for specific purpose-II					
Total Learning Credits						**11**

6. Value added Courses (V)
(4 courses)

Course Code	Course Title	Hours/ Week				
		L	T	P	O	C
UCD23V01T	Universal Human Values	2	0	0	2	2
UEN23V01L	Communication Skills	0	0	4	2	2
UCD23V02T	Industry Oriented Employability Skills for Science	2	0	0	2	2
UCD23V05T	Career Readiness and Professional Skills	2	0	0	2	2
Total Learning Credits						**4**

7. Mandatory Courses(M)
(2 Course)

Course Code	Course Title	Hours/ Week				
		L	T	P	O	C
UMI23M01L	My India Project	0	0	0	0	0
UNS23M01L	NSS	0	0	0	0	0
UNC23M01L	NCC					
UNO23M01L	NSO					
UYG23M01L	YOGA					
Total Learning Credits						**0**

8. Internship/Apprenticeship / Project
(6 courses)

Course Code	Course Title	Hours/ Week				
		L	T	P	O	C
UCY23P01L	Internship-I					1
UCY23P02L	Internship-II					1
UCY23P03L	Internship-III					2
UCY23P04L	Mini Project	0	0	5	0	2
UCY23P05L	Project Phase-I	0	0	9	2	4
UCY23P06L	Project Phase-II	0	0	12	2	6
Total Learning Credits						**16**

As SRMIST strongly encourages the use of SWAYAM (Study Web of Active Learning by Learning by Young and Aspiring Minds) platform, the students are encouraged to choose at least one core/ elective course from SWAYAM on the recommendation of the faculty advisor and the credits will be transferred.

8. Implementation Plan

Semester - I						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
ULT23G01J	Tamil-I	2	0	2	2	3
ULH23G01J	Hindi-I					
ULF23G01J	French-I					
ULE23AE1T	English	4	0	0	2	4
UCY23101T	Atomic Structure and Chemical Bonding	3	1	0	2	4
UCY23102T	Basic Organic Chemistry	3	1	0	2	4
UCY23103J	States of matter, solutions and phase equilibria	3	0	3	2	4
UCD23S01L	Quantitative Aptitude and Logical Reasoning	0	0	2	2	1
UCD23V01T	Universal Human Values	2	0	0	2	2
Total Learning Credits						22
Total Number of Hours						26

Semester – II						
Code	Course Title	Hours/ Week				C
		L	T	P	O	
ULT23G02J	Tamil-II	2	0	2	2	3
ULH23G02J	Hindi-II					
ULF23G02J	French-II					
UES23AE1T	Environmental Studies	3	0	0	2	3
UCY23201J	Chemistry of s and p-Block Elements	3	0	3	2	4
UCY23202T	Basic reactions in organic chemistry	3	1	0	2	4
UCY23203T	Chemical Equilibria, Acids and Bases	3	1	0	2	4
UCD23S02T	Verbal Ability and Skill Development	2	0	0	2	2
UEN23V01L	Communication Skills	0	0	4	2	2
UNS23M01L	NSS	0	0	0	0	0
UNC23M01L	NCC					
UNO23M01L	NSO					
UYG23M01L	YOGA					
Total Learning Credits						22
Total number of hours /week						27

Semester – III						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCY23301T	Radioactive and Nuclear Chemistry	3	1	0	2	4
UCY23302J	Functional Groups in Organic Chemistry	3	0	3	2	4
UCY23303T	Thermodynamics and Surface Chemistry	3	1	0	2	4
UPY23G01J	Allied Physics	3	0	3	2	4
UPY23G02T	Laser Physics	3	1	0	2	
ULT23AE1J	Applied Tamil – I	1	0	2	2	2
ULH23AE1J	Applied Hindi – I					
ULF23AE1J	French for specific purpose-I					
UCY23S03L	Instrumental Methods of Analysis	0	0	3	2	1
UCD23V02T	Industry Oriented Employability Skills for Science	2	0	0	2	2
UCY23P01L	Internship-I	0	0	0	0	1
	Total Learning Credits					22
	Total Number of Hours					28

Semester - IV						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCY23401T	Coordination Chemistry	3	1	0	2	4
UCY23402T	Heterocyclic Compounds, Natural Products and Biomolecules	4	0	0	2	4
UCY23403T	Chemical Kinetics and Electrochemistry	3	1	0	2	4
UPY23G03T	Data, Statistics, and Inference	3	1	0	2	4
UMA23G11T	Allied Mathematics					
ULT23AE2J	Applied Tamil – II	1	0	2	2	2
ULH23AE2J	Applied Hindi – II					
ULF23AE2J	French for specific purpose-II					
UCY23S04L	Inorganic Qualitative Analysis	0	0	4	2	2
UCD23V05T	Career Readiness and Professional Skills	2	0	0	2	2
UMI23M01L	My India Project	0	0	0	0	0
	Total Learning Credits					22
	Total Number of Hours / Week					25

Semester - V						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCY23501T	Chemistry of d and f-Block Elements	3	1	0	2	4
UCY23502J	Analytical chemistry	3	0	3	2	4
UCY23503T	Statistical Thermodynamics and Group Theory	3	1	0	2	4
UCY23D01T	Nanomaterials and Nanochemistry	3	1	0	2	4
UCY23D02T	Energy and Fuels					
UCY23G02T	Polymer chemistry and its uses	3	1	0	2	4
UPY23G04T	Solar Technology					
UCY23S05L	Organic Chemistry Practical-II	0	0	3	2	1
UCY23P02L	Internship-II	0	0	0	0	1
Total Learning Credits						22
Total Number of Hours						25

Semester - VI						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCY23601T	Pericyclic Reaction, Photochemistry and Polycyclic Aromatic Hydrocarbons (PAH)	3	1	0	2	4
UCY23602T	Quantum chemistry and Molecular spectroscopy	3	1	0	2	4
UCY23603T	Research Methodology	4	0	0	2	4
UCY23D03T	Polymer and Industrial Chemistry	3	1	0	2	4
UCY23D04T	Supramolecular Chemistry					
UCY23G03T	Food Chemistry	3	1	0	2	4
UPY23G05T	Structure and Properties of Materials					
UCY23P04L	Mini project	0	0	5	0	2
Total Learning Credits						22
Total Number of Hours						25

Semester – VII						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCY23701T	Reagents in Organic Reactions	3	1	0	2	4
UCY23D05T	Solid State Chemistry and its Applications	3	1	0	2	4
UCY23D06T	Chemical Technology and Society					
UCY23G04T	Pharmaceutical Chemistry	3	1	0	2	4
UPY23G06T	Thin Films	4	0			
UCY23G05T	Chemistry in everyday life	3	1	0	2	4
UPY23G07T	Group Theory					
UCY23P03L	Internship-III	0	0	0	0	2
UCY23P05L	Project Phase-I	0	0	9	2	4
	Total Learning Credits					22
	Total Number of Hours					25

Semester - VIII						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
UCY23801T	Organometallics & Bioinorganic Chemistry	3	1	0	2	4
UCY23D07T	Organic Spectroscopy	4	0	0	2	4
UCY23D08T	Materials chemistry and their use in everyday life					
UCY23D09T	Medicinal Chemistry and Drug Design	4	0	0	2	4
UCY23D10T	Green Chemistry					
UCY23G06T	Computational Modelling in Chemistry	3	1	0	2	4
UPY23G08T	Applications of Nanotechnology					
UCY23P06L	Project Phase-II	0	0	12	2	6
	Total Learning Credits					22
	Total Number of Hours					28

Courses for earning Additional Credits						
Course Code	Course Title	Hours/ Week				C
		L	T	P	O	
Semester – II						
UCD23P01L	Internship Report– I	0	0	8	0	4
UCD23P02L	Project Work – I					
UCD23P03L	Apprenticeship – I					
Semester – IV						
UCD23P04L	Internship Report– II	0	0	8	0	4
UCD23P05L	Project Work – II					
UCD23P06L	Apprenticeship – II					
	Total Learning Credits	**0**	**0**	**8**	**0**	**4**

9. Program Articulation Matrix

Course Code	Course Name	Programme Learning Outcomes														
		Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines
UCY23101T	Atomic Structure and Chemical Bonding	H	H	H	H	H	M	L	-	M	-	-	-	H	-	-
UCY23102T	Basic Organic Chemistry	H	H	H	M	H	M	H	H	H	L	-	-	-	-	-
UCY23103J	States of matter, solutions and phase equilibria	H	-	H	-	H	-	H	-	-	L	-	H	-	-	H
UCY23201J	Chemistry of s and p-Block Elements	H	H	H	H	M	L	-	-	-	-	-	-	H	H	-
UCY23202T	Basic Reactions in Organic Chemistry	H	H	H	-	H	M	H	-	M	-	-	-	-	-	-
UCY23203T	Chemical Equilibria, Acids and Bases	H	H	H	-	H	H	L	-	-	M	H	H	-	-	-
UCY23301T	Radioactive and Nuclear Chemistry	H	H	-	H	H	L	M	-	-	L	-	H	-	H	-
UCY23302J	Functional Groups in Organic Chemistry	H	H	H	H	H	M	H	-	-	-	-	-	-	-	-
UCY23303T	Thermodynamics and Surface Chemistry	H	H	-	H	M	M	M	L	-	-	-	H	-	-	-
UCY23401T	Coordination Chemistry	H	H	-	H	H	L	M	-	-	-	-	-	H	H	-
UCY23402T	Heterocyclic Compounds, Natural Products and Biomolecules	H	H	H	-	H	L	M	-	L	-	-	-	-	-	-
UCY23403T	Chemical Kinetics and Electrochemistry	H	H	-	H	H	L	M	-	M	-	-	H	-	-	-
UCY23501T	Chemistry of d and f-Block Elements	H	H	-	H	H	-	M	L	M	-	-	H	H	H	-
UCY23502J	Analytical chemistry	H	H	-	H	H	M	M	-	L	-	-	H	-	-	-
UCY23503T	Statistical Thermodynamics and Group Theory	H	H	-	H	H	L	M	-	L	-	-	H	-	-	-
UCY23601T	Pericyclic Reaction, Photochemistry and Polycyclic Aromatic Hydrocarbons (PAH)	H	H	H	H	M	M	H	H	-	-	-	-	-	-	-
UCY23602T	Quantum chemistry and Molecular spectroscopy	H	H	-	H	H	M	M	-	-	-	L	H	-	-	-
UCY23603T	Research Methodology	M	-	-	H	H	H	H	H	H	-	-	H	-	-	-
UCY23701T	Reagents in Organic Reactions	H	H	-	H	H	-	M	-	H	-	-	H	-	-	-
UCY23801T	Organometallics & Bioinorganic Chemistry	H	H	H	H	H	-	M	-	M	-	-	-	H	H	-
UCY23D01T	Nanomaterials and Nanochemistry	H	H	-	H	H	M	M	-	M	-	-	H	-	-	-
UCY23D02T	Energy and Fuels	H	H	-	H	M	M	M	-	-	-	-	-	-	-	-
UCY23D03T	Polymer and Industrial Chemistry	H	H	-	H	H	-	M	-	-	-	-	H	-	-	-
UCY23D04T	Supramolecular Chemistry	H	H	-	H	H	-	M	H	-	-	-	H	-	-	-
UCY23D05T	Solid State Chemistry and its Applications	H	H	H	H	H	-	M	-	-	-	-	-	H	M	-
UCY23D06T	Chemical Technology and Society	H	H	L	M	H	H	-	-	-	H	-	-	H	H	-
UCY23D07T	Organic Spectroscopy	H	H	-	H	H	-	H	H	M	-	-	H	-	-	-
UCY23D08T	Materials chemistry and their use in everyday life	H	H	-	M	H	-	H	H	-	-	-	H	-	-	-
UCY23D09T	Medicinal Chemistry and Drug Design	H	H	H	-	-	-	H	-	L	-	H	H	-	-	-
UCY23D10T	Green Chemistry	H	H	-	H	H	-	H	-	-	-	-	H	-	-	-
ULT23G01J	Tamil-I	H	M	H	M	H	H	M	H	H	M	H	H	-	-	-
ULH23G01J	Hindi-I	H	H	H	H	M	H	M	H	M	M	H	H	-	-	-
ULF23G01J	French-I	H	H	M	H	H	H	H	H	M	M	H	M	-	-	-
ULT23G02J	Tamil-II	H	M	H	M	H	H	M	H	H	M	H	H	-	-	-
ULH23G02J	Hindi-II	H	H	H	H	M	H	H	H	H	M	H	H	-	-	-
ULF23G02J	French-II	H	H	H	H	H	H	H	H	M	H	H	H	-	-	-

UPY23G01J	Allied Physics	H	H	-	-	-	-	-	H	-	-	-	H	-	-	-
UPY23G02T	Laser Physics	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
UPY23G03T	Data, Statistics, and Inference	-	-	H	H	-	-	-	H	-	-	-	-	-	-	-
UMA23G11T	Allied Mathematics	M	H	-	H	-	-	-	-	-	-	-	H	-	-	-
UPY23G04T	Solar Technology	H	H	H	-	H	H	-	H	-	H	-	H	-	-	-
UCY23G02T	Polymer chemistry and its uses	H	M	-	H	H	-	H	H	-	-	-	H	-	-	-
UPY23G05T	Structure and Properties of Materials	H	H	-	H	M	-	-	M	-	M	-	-	-	-	-
UCY23G03T	Food Chemistry	H	H	-	-	-	-	H	-	-	-	-	H	-	-	-
UPY23G06T	Thin Films	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
UCY23G04T	Pharmaceutical Chemistry	H	H	-	H	-	-	H	-	-	L	L	H	-	-	-
UPY23G07T	Group Theory	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
UCY23G05T	Chemistry in everyday life	H	H	-	H	H	H	H	-	-	-	-	H	-	-	-
UPY23G08T	Applications of Nanotechnology	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
UCY23G06T	Computational Modelling in Chemistry	H	H	-	H	H	-	H	-	M	-	-	H	-	-	-
UCD23S01L	Quantitative Aptitude and Logical Reasoning	H	M	M	M	L	M	M	H	M	H	H	H	H	H	H
UCD23S02T	Verbal Ability and Skill Development	M	H	M	M	M	H	L	M	M	H	H	H	M	M	H
UCY23S03L	Instrumental Methods of Analysis	H	-	-	H	H	L	H	-	H	L	-	H	-	-	-
UCY23S04L	Inorganic Qualitative Analysis	H	H	-	H	H	M	H	-	H	H	-	H	H	H	-
UCY23S05L	Organic Chemistry Practical-II	H	H	L	H	H	H	-	-	-	H	-	-	-	-	-
ULE23AE1T	English	H	H	M	M	M	M	-	M	M	M	H	M	-	-	-
UES23AE1T	Environmental Studies	H	-	L	M	L	H	M	M	M	H	L	M	-	-	M
ULT23AE1J	Applied Tamil – I	M	H	H	H	H	-	H	-	-	H	H	H	H	H	H
ULH23AE1J	Applied Hindi – I	H	H	H	H	M	H	M	M	M	M	H	H	-	-	-
ULF23AE1J	French for specific purpose-I	H	H	H	H	H	H	H	H	M	M	H	M	-	-	-
ULT23AE2J	Applied Tamil – II	H	M	H	M	H	H	M	H	H	H	H	H	-	-	-
ULH23AE2J	Applied Hindi – II	H	H	H	H	M	H	H	H	H	M	H	H	-	-	-
ULF23AE2J	French for specific purpose-II	H	H	M	H	H	H	H	H	M	M	H	M	-	-	-
UCD23V01T	Universal Human Values	M	M	L	H	L	L	L	M	L	L	M	L	M	H	H
UEN23V01L	Communication Skills	H	M	H	M	H	H	M	H	H	M	H	H	-	-	-
UCD23V02T	Industry Oriented Employability Skills for Science	M	M	H	M	M	H	L	M	H	M	H	H	M	L	H
UCD23V05T	Career Readiness and Professional Skills	H	M	M	M	H	H	M	H	L	H	H	H	M	H	H
UNS23M01L	NSS	H	H	-	H	H	L	H	-	-	L	-	H	-	H	-
UNC23M01L	NCC	H	H	-	H	H	L	H	-	-	L	-	H	-	H	-
UNO23M01L	NSO	H	H	-	H	H	L	H	-	-	L	-	H	-	H	-
UYG23M01L	YOGA	H	H	-	H	H	L	H	-	-	L	-	H	-	H	-
UMI23M01L	My India Project	H	H	-	H	H	-	H	L	M	-	-	H	H	H	-
UCY23P01L	Internship-I	H	H	-	-	-	H	-	-	M	-	M	-	-	H	H
UCY23P02L	Internship-II	H	H	-	-	-	H	-	-	M	-	M	-	-	H	H
UCY23P03L	Internship-III	H	H	-	-	-	H	-	-	M	-	M	-	-	H	H
UCY23P04L	Mini Project	H	H	-	H	H	-	M	-	H	-	-	H	-	-	-
UCY23P05L	Project Phase-I	H	H	H	H	H	-	M	-	M	-	-	-	H	H	-
UCY23P06L	Project Phase-II	H	-	H	H	H	H	H	-	-	-	-	H	-	-	-

H – High Correlation, M – Medium Correlation, L – Low Correlation

10.Structure of UG Courses in B.Sc. Chemistry

Distribution of different Courses in each semester with their credits in the bracket

Semester	Discipline Specific Core Courses (C)	Discipline Electives Courses (D)	Generic Electives Courses (G)	Skill Enhancement Courses (S)	Ability Enhancement Courses (A)	Extension Activity (E)	Value addition Courses (V)	Internship/ Apprenticeship Project/ Community Outreach (P)	Total Credits
Sem I	CC–1 (4) CC-2 (4) CC-3 (4)		GE – 1(3)	SE – 1 (1)	AE-1 (4)		VA-1(2)		**22**
Sem II	CC–4 (4) CC-5 (4) CC-6 (4)		GE – 2(3)	SE – 2 (2)	AE-2 (3)	EA-1 (0)	VA-2(2)		**22**
Sem III	CC–7 (4) CC-8 (4) CC-9 (4)		GE – 3(4)	SE – 3 (1)	AE-3 (2)		VA-3(2)	P -1(1)	**22**
Sem IV	CC–10 (4) CC-11 (4) CC-12 (4)		GE – 4(4)	SE – 4 (2)	AE-4 (2)	EA-2(0)	VA-4(2)		**22**
Sem V	CC–13 (4) CC-14 (4) CC-15 (4)	DSE – 1 (4)	GE – 5(4)	SE – 5 (1)				P - 2(1)	**22**
Sem VI	CC–16 (4) CC-17 (4) CC-18 (4)	DSE – 2 (4)	GE -6(4)					P - 3(2)	**22**
Sem VII	CC-19 (4)	DSE – 3 (4)	GE – 7(4) GE – 8(4)	S – 3 (2)				P -4 (2) P - 6 (4)	**22**
Sem VIII	CC-20 (4)	DSE – 4 (4) DSE – 5 (4)	GE – 9(4)					P-7 (6)	**22**
Total Credits	**80**	**20**	**34**	**9**	**11**	**0**	**08**	**16**	**176**

Syllabus for B.Sc. Chemistry
SEMESTER I

Course Code	ULT23G01J	Course Name	Tamil-I	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-1 :	மரபிலிருந்து மாற்றம் பெற்ற புதுக்கவிதை மரபின் சிந்தனைகளை அறியச் செய்தல்																		
CLR-2 :	புதுக்கவிதையின் வழி மனித வாழ்வியல் விழுமியங்களைத் தெரியச் செய்தல்																		
CLR-3 :	சிற்றிலக்கியங்கள், காப்பியங்கள் கற்பிக்கும் தமிழ்ச் சமூகத்தின் வாழ்வியலை அறியச் செய்தல்																		
CLR-4 :	நவீன தமிழ் இலக்கிய வளர்ச்சி வரலாற்றைப் புரியச் செய்தல்																		
CLR-5 :	மொழிப் பயிற்சி வழி மொழியின் பல்வேறு நுட்பங்களைத் தெரியச் செய்தல்																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	புதுக்கவிதை உருவாக்கித் தந்த புதிய சிந்தனைக் களங்களை அறிந்துகொள்ளுதல்	*2*	*75*	*60*	*H*	*L*	*H*	*M*	*H*	*H*	*L*	*M*	*H*	*M*	*L*	*H*	-	-	-
CLO-2 :	நவீன கவிதைகள் வழி மாற்றம் பெற்று வரும் மானுட விழுமியங்களைத் தெரிந்துகொள்ளுதல்	*2*	*80*	*70*	*H*	*M*	*H*	*L*	*M*	*H*	*L*	*H*	*M*	*L*	*H*	*H*	-	-	-
CLO-3 :	தமிழ்ச்சமூகத்தின் இடைக்கால வாழ்வியல் முறைகளை உணர்ந்துகொள்ளுதல்	*2*	*70*	*65*	*H*	*L*	*H*	*M*	*H*	*H*	*M*	*H*	*L*	*H*	*M*	*H*	-	-	-
CLO-4 :	நவீன இலக்கிய வரலாறு வழி தமிழ்க் கல்வி வரலாறு, சமூக வரலாறு பெற்ற வளர்ச்சி நிலைகளைத் தெரிந்துகொள்ளுதல்	*2*	*70*	*70*	*H*	*M*	*H*	*L*	*H*	*M*	*M*	*H*	*H*	*L*	*H*	*H*	-	-	-
CLO-5 :	மொழியின் நுட்பங்களை அறிந்து மொழி ஆளுமையோடு செயல்பட அறிந்துகொள்ளுதல்	*2*	*80*	*70*	*H*	*M*	*H*	*H*	*M*	*H*	*L*	*M*	*H*	*L*	*H*	*H*	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	தமிழ் இலக்கியத்தின் வளர்ச்சிப் போக்குகள்	நவீன கவிதை தோற்றம்	தமிழரின் வீரமரபு	சிற்றிலக்கியத் தோற்றம்	தமிழ் உரைநடை மரபில் உ.வே.சா.
	SLO-2	இலக்கிய உத்திகள்	நவீன கவிதை வரலாறு	போர் விழுமியங்கள்	சிற்றிலக்கிய வகைமை	ராஜ வைத்தியம்
S-2	SLO-1	தமிழ்க் கவிதை மரபு	நவீன கவிதை செல்நெறிகள்	பரணி அறிமுகம்	சிற்றிலக்கியங்கள்	வைத்தியர்களின் சிறப்பு
	SLO-2	காலந்தோறும் கவிதையின் கரு	செல்நெறிகளில் கோட்பாடுகள்	பரணி இலக்கியங்கள்	முதன்மைச் சிற்றிலக்கியங்கள் –	கழனியூரன் – அறிமுகம்
S-3	SLO-1	காலந்தோறும் கவிதையின் கட்டமைப்பு	கவிதை மொழி	கலிங்கத்துப்பரணி 477,490	பிள்ளைத்தமிழ் - உலா - தூது	சிறுதெய்வ வழிபாடு
	SLO-2	தற்கால இலக்கியம்	நவீன கவி ஆளுமைகள்	தலைவனின் வீரம்	புதுக்கவிதையில் சமூகம்	பொன் காத்த ஐயனார்
S-4	SLO-1	புதுக்கவிதை உருவாக்கம்	பெண் கவிஞர்கள்	தமிழ் இலக்கிய மரபில் தூது	புதுக்கவிதையும் இதழ்களும்	விருந்து – கள்ளர் செயல்கள்
	SLO-2	புதுக்கவிதை வளர்ச்சிநெறிகள்	கவிதையில் நாட்டுப்புற வடிவம்	தூது இலக்கியங்கள்	மணிக்கொடி இதழ்	பிழை நீக்கி எழுதுதல்
S-5	SLO-1	பாரதியார் – புதுக்கவிதையின் அடையாளம்	இளம்பிறை – அம்மா	தமிழ் விடு தூது (184 – 186)	எழுத்து இதழ்	எழுத்துப் பிழை
	SLO-2	பாரதியார் பன்முக ஆளுமைத்திறன்	பெண்களின் கல்வி நிலை	தமிழின் பெருமை	வானம்பாடி இதழ்	தொடர்பிழை
S-6	SLO-1	பாரத தேசம்	பெண் அடக்குமுறை	செய்யுள் மரபில் கலம்பகம்	சிறுகதை தோற்றம்	உயர்திணை, அஃறிணை
	SLO-2	பாரததேசத்தின் வளம்	ப. கல்பனா – கீறல் விழுந்த மாலைக் காலங்கள்	கலம்பக இலக்கியங்கள்	சிறுகதை வளர்ச்சி	பிறமொழிச் சொற்கள் வரலாறு
S-7	SLO-1	வெள்ளிப் பனிமலையின் மீதுலவுவோம் …	ஆண் பெண் சமத்துவம்	நந்திக் கலம்பகம்- வானுறு மதியை (110)	சிறுகதை – வரலாறு	பிறமொழிச் சொற்களை நீக்கி எழுதுதல்
	SLO-2	20 ஆம் நூற்றாண்டுக் கவிதை மரபில் பாரதிதாசன்	விளிம்புநிலை வாழ்வியல்	கையறுநிலை	சிறுகதை ஆசிரியர்கள்	ஷ, ஜ, ஸ, ஹ மாற்றொலிகள்

S-8	SLO-1	பாரதிதாசன் - அழகின் சிரிப்பு	திருநங்கை குணவதி - சமூகப்பார்வை	குறவஞ்சி அறிமுகம்	இதழ்களும் சிறுகதையும்	தமிழ் இலக்கணநுட்பங்கள்
	SLO-2	ஆல் - ஆயிரம் கிளைகள் கொண்ட அடிமரம்	திருநர்களும் சாதனைகளும்	குறவஞ்சி இலக்கியங்கள்	புதினம் தோற்றம்	இலக்கணமும் பயன்பாடும்
S-9	SLO-1	இயற்கையின் அழகியல்	புலம்பெயர் வாழ்வியல்	குற்றாலக் குறவஞ்சி – ஆடுமர வீனுமணி (3)	தொடக்கக்காலப் புதினங்கள்	தமிழில் சொல் வகைகள்
	SLO-2	வானம்பாடியில் மு.மேத்தா	ஸர்மிளா ஸெய்யித் – புராதன ஊர்	மலையும் வாழ்வும்	புதினம் வளர்ச்சி	சொல்லும் பயன்பாடும்
S-10	SLO-1	மு.மேத்தா - கவிதையின் தனித்தன்மைகள்	புலம் பெயர் வாழ்வின் வலியும் நம்பிக்கையும்	காப்பிய இலக்கணம்	புதினத்தின் வகைமை	பெயர்ச்சொற்கள்
	SLO-2	மனிதனைத் தேடி – கவிதை	காலந்தோறும் கவிதை வடிவில் மாற்றங்கள்	காப்பிய வகைமைகள்	புதின ஆசிரியர்கள்	பெயர்ச்சொற்கள் அறிதல்
S-11	SLO-1	மனிதநேயம்	ஹைக்கூ, லிமரைக்கூ, சென்ரியூ – தேர்ந்தெடுத்த கவிதைகள்	சிலப்பதிகாரம் – அறிமுகம்	தமிழ் இலக்கியத்தில் உரைநடைக்கூறுகள்	வினைச்சொற்கள்
	SLO-2	தமிழ்க் கவிதையில் சுற்றுச்சூழலியல்	ஹைக்கூ – மு.முருகேஷ்	கட்டுரைக்காதை	உரைநடையின் தோற்றம்	வினைச்சொற்கள் அறிதல்
S-12	SLO-1	பழனிபாரதியின் காடு	லிமரைக்கூ – ஈரோடு தமிழன்பன்	ஊழ்வினை	தமிழில் உரைநடை	தமிழில் பெயரடை, வினையடை
	SLO-2	இயற்கையும் சமூக சமத்துவ வாழ்வியலும்	சென்ரியூ – மாமதயானை	கோவலனின் முற்பிறப்பு வரலாறு	உரைநடை வளர்த்த அறிஞர்கள்	பெயரடை, வினையடை அறிதல்

Learning Resources	1. முல்லைக்காடு, தொகுப்பும் பதிப்பும் - தமிழ்த்துறை ஆசிரியர்கள், எஸ்.ஆர்.எம். அறிவியல் மற்றும் தொழில்நுட்பக் கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2023 2. வல்லிக்கண்ணன், புதுக்கவிதை தோற்றமும் வளர்ச்சியும், ஆழி பதிப்பகம், சென்னை, 2018 3. கா. சிவத்தம்பி, தமிழில் சிறுகதை தோற்றமும் வளர்ச்சியும், என்.சி.பி.எச்., சென்னை, 2013

	4. தமிழ் இணையக் கல்விக்கழகம் - http://www.tamilvu.org/ 5. மதுரை தமிழ் இலக்கிய மின் தொகுப்புத் திட்டம் - https://www.projectmadurai.org/

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**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 & Head, Dept. of Tamil, FSH, SRMIST, KTR.*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

Course Code	ULH23G01T	Course Name	HINDI-I	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
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*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*To Understand the Philosophy of life and living through Stories*	*2*	*75*	*80*	*H*	*H*	*H*	*M*	*L*	*H*	*L*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-2 :	*To Examine Travelogue writing and Sketch*	*2*	*80*	*90*	*H*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-3 :	*To Identify Irony and essay based writing*	*2*	*75*	*95*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*H*	*M*	*M*	*H*	*H*	-	-	-
CLO-4 :	*Evaluate the various social issues depicted in the prose*	*2*	*80*	*90*	*H*	*H*	*L*	*H*	*M*	*H*	*L*	*H*	*H*	*M*	*H*	*H*	-	-	-
CLO-5 :	*To Understand the basic and fundamental principal of Translation*	*2*	*85*	*90*	*M*	*H*	*M*	*H*	*L*	*H*	*H*	*L*	*H*	*M*	*H*	*H*	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*KAHANI*	*REKHACHITRA & YATRAVITRANT*	*NIBANDH*	*NATAK*	*ANUVAD& PARIBHASHIK SHABDAVALI*
	SLO-2	*AVDHARNA*	*VDHARNA*	*IBANDH KI AVDHARNA*	*AVDHARNA*	*RTH*
S-2	SLO-1	*SWARUP*	*WAROOP*	*WARUP*	*NATAK KA SWARUP*	*ARIBHASHA*
	SLO-2	*PARIBHASHA*	*HUMIKA*	*ARIBHASHA*	*PARIBHASHA*	*WARUP*
S-3	SLO-1	*KAHANI KE TATVA*	*MAHATVA*	*MAHATVA*	*TATWA*	*RAKAR*
	SLO-2	*KAHANI KA MAHATVA*	*DDESHYA*	*DDESHYA*	*PRAKAR*	*MAHATVA*
S-4	SLO-1	*PARIKSHA-PREMCHAND*	*ISHA-EKHACHITRA*	*UTAJ- NIBANDH AJARI PRASHAD DIVEDI*	*UDDESHYA*	*DDESHYA*
	SLO-2	*KAHANI KA PARICHAY*	*EKHIKA PARICHAY*	*EKHIKA PARICHAY*	*RANGMANCH KA PARICHAY*	*NUVAD KA PRAYOJAN*
S-5	SLO-1	*VISLESHAN*	*ATH KA ISHLESHAN*	*ATH KA MAHATVA*	*NATAK KA MAHATVA*	*NUVAD KA PRAYOG*
	SLO-2	*EMANDARI KA MAHATVA*	*URU SHISHYA KA AMBANDH*	*IPRIT PARISHTHITIYON ME EEVAN KI ASH*	*PRAYOJAN*	*HROT BHASHA KA GYAN*
S-6	SLO-1	*HONHARI KA PARICHAY*	*GURU KE PRATI SMARPAN BHAVANA*	*MANAV KI AKANKSHAYEN*	*ANDHER NAGRI-(NATAK) BHARTENDU HARISHCHAND*	*LAKSHYA BHASHA KA GYAN*
	SLO-2	*UDDESHYA*	*PATH KA MAHATVA*	*SHANGHARSHIL JEEVAN*	*LEKHAK PARICHAY*	*ANUVAD KA DAYITVA*
S-7	SLO-1	*MALBE KA MALIK-MOHAN RAKESH*	*HELE PAR IMALAY (YATRAVITRANT)*	*SANGHARSH KA PARINAM*	*NATAK KA VISLESHAN*	*ANUVAD KA ABHYASH*
	SLO-2	*LEKHAK PARICHAY*	*LEKHAK PARICHAY*	*BHOLARAM KA JEEV-(VYANGYA) HARISHANKAR PARSHAI*	*NATAK ABHINAY*	*ANGREJI SE HINDI*
S-8	SLO-1	*BATWARE KA YATHARTH VARNAN*	*YATRAVITRANT KA MAHATVA*	*VYANGYA KI AVADHARNA*	*LALCH KA DUSHPARINAM*	*HINDI SE ANGREJI*
	SLO-2	*TATKALIN PARISHTHITI KA VARNAN*	*YATRA KA YATHARTH CHITRAN*	*MAHATVA*	*SHISHYA KI AGYANTA*	*ANUVAD PRIYOJNA KARYA*
S-9	SLO-1	*APNI MITTI SE LAGAV*	*PATH KA VISLESHAN*	*LEKHAK PARICHAY*	*GURU SHISHYA SAMBANDH*	*PUNRIKSHAN*

	SLO-2	*RAJNITIK VIDWESH KA PARINAM*	*HIMALAY KA VARNANA*	*PATH KA VIHLESHAN*	*HASHYA VYANGY SE AVAGAT KARANA*	*VIVIDH PRAYOG*
S-10	*SLO-1*	*PROPKAR KI BHAVANA*	*HIMALAY KA LOK JEEVAN*	*MADHYAVARGI PARIVAR KI STHITI*	*DURDRISHTIHIN*	*PARIBHASHIK SHABDAVALI*
	SLO-2	*KAHANI PATH*	*LOK SAMASYA*	*SARKARI TANTRA KA KHOKHLA RUP*	*MAHATTAKANKSHI KA DUSHPARINAM*	*ATI MAHTVAPURN SHABD*
S-11	*SLO-1*	*KAHANI KA VISHLESHAN*	*UDDESHYA*	*PAURANIK KATHA KA CHITRAN*	*GURU KI AVAGYA KA DUSHPARINAM*	*TAKANIKI SHABDAVALI KA MHATVA*
	SLO-2	*PRASHO KI CHARCHA*	*PRASHNA ABHYASH*	*SANVEDANSHIL BHAVANA*	*TATKALIN SAMAJIK VYAVASTHA KI CHARCHA*	*HINDI SE ANGREZI SHABD*
S-12	*SLO-1*	*PRASHN ABHYASH*	*PATH PRICHARCHA*	*PARICHARCHA*	*PARICHARCHA*	*ANGREZI SE HINDI SHABD*
	SLO-2	*KAHANI KA UDDESHYA*	*MAHATVAPURN BIBDUON KI CHARCHA*	*PRASHANA ABHYASH*	*PRASHNABHYASH*	*SHABDAVALI KI AVSHYAKTA*

Learning Resources	***Edited Book: ""SAMANYA HINDI", SRIJONLOK PUBLICATION, 2023, New Delhi.*** 1. KABIR – HAZARI PRASAD DWEDI 2. SURDAS – RAM CHANDRA SHUKL 3. BHAKTI ANDOLAN AUR SURDAS KA KAVYA – MANAGER PANDEY 4. BIHARI – VISHVNATH PRASAD MISHR 5. Aadhunik Vigyapan aur Jansampark – Taresh Bhatia

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Shri. Santosh Kumar Editor : Srijanlok Magazine Place: Vashishth Nagar, Ara – 802301	*1. Prof.(Dr.) S.Narayan Raju, Head, Department of Hindi,CUTN, Tamilnadu*	*1. Dr.S Preeti. Associate Professor & Head, SRMIST*
		2. Dr. Md.S. Islam Assistant Professor, SRMIST
		3.Dr. S. Razia Begum, Assistant Professor, SRM IST
		4, Dr.Nisha Murlidharan Assistant Professor, VDP,SRM IST

Course Code	ULF23G01J	Course Name	French-I	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
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																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*To acquire knowledge about French language*	*2*	*75*	*80*	*H*	*M*	*H*	*H*	*M*	*H*	*H*	*L*	*M*	*M*	*H*	*L*	-	-	-
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	*2*	*80*	*90*	*M*	*H*	*L*	*H*	*H*	*M*	*H*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-3 :	*To develop content using the features in French language*	*2*	*85*	*75*	*H*	*H*	*L*	*M*	*H*	*M*	*L*	*H*	*M*	*M*	*H*	*H*	-	-	-
CLO-4 :	*To interpret the French language into other language*	*2*	*75*	*80*	*H*	*L*	*M*	*H*	*M*	*H*	*H*	*M*	*L*	*H*	*M*	*L*	-	-	-
CLO-5 :	*To improve the communication, intercultural elements in French language*	*2*	*80*	*75*	*M*	*H*	*H*	*L*	*M*	*M*	*H*	*H*	*M*	*L*	*H*	*M*	-	-	-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	**Contacts**	Les verbes du premier groupe	**Qu'est-ce qu'ils font ?**	**Portraits**	Les verbes du deuxième groupe –
	SLO-2	**Emma la championne**	**Les exemples**	**Les exemples**	**Un casting**	Les exemples
S-2	**SLO-1**	Les nombres à partir de 31	La liaison	**Où est mon sac**	Les exemples	Les pronoms personnels toniques
	SLO-2	Les activités	Les activités	Les exemples	Les activités	Les exemples
S-3	**SLO-1**	Les pays	Entrer en contact	Quelques objets	**Le Petit Spirou**	Les verbes faire et lire
	SLO-2	les nationalités	Les activités	Les exemples	Les activités	Les exemples
S-4	**SLO-1**	Les jours de la semaine	Présenter et se présenter	Les professions	L'aspect physique	*Les Sons*
	SLO-2	Les jours	Les activités	La fiche d'identité	Les activités	Les exemples
S-5	**SLO-1**	Les mois de l'année	Demander et dire la date	La formation du féminin (2)	Le caractère	*Décrire l'aspect physique*
	SLO-2	Les activités	Les activités	La phrase interrogative partielle –	Les exemples	*Décrire le caractère*
S-6	**SLO-1**	Les animaux domestiques	une rencontre.	*Qu'est-ce que c'est ?*	les états d'âme	*Demander et dire l'heure*
	SLO-2	Les activités	Les activités	*Qui est-ce ?*	Les activités	Les exemples
S-7	**SLO-1**	La famille (1)	Contacts	*C'est / Il est (1)*	Les prépositions de lieu (1)	*Elle est comment ?*
	SLO-2	Les activités	Les activités	**Les exemples**	Les exemples	Les exemples
S-8	**SLO-1**	La formation du féminin (1)	Emma la Championne	La phrase négative (1)	La famille (2)	*Portraits*
	SLO-2	Les activités	Les activités	Les exemples	Les activités	Les exemples
S-9	**SLO-1**	Les adjectifs possessifs	Mots et expressions	Les verbes aller et venir	La formation du féminin	*Mots et Expressions*
	SLO-2	Les exemples	Les activités	L'élision	Les activités	Les activités
S-10	**SLO-1**	La phrase interrogative	Grammaire -	Les formules de politesse	La formation du pluriel (2)	*Grammaire.*
	SLO-2	Les exemples	**Les** exemples	Demander des informations personnelles	Les activités	Les exemples

S-11	**SLO-1**	Les activités	Communication	C'est qui ?	*Il y a*	Les activités
	SLO-2	Les nombres	Les activités	Qu'est-ce qu'ils font ?	Les activités	*Communication*
S-12	**SLO-1**	intonation et *est-ce que*	*Les verbes du ER –groupe*	Mots et Expressions	Les articles contractés	Les activités
	SLO-2	Les exemples	Les exemples	Grammaire – Communication	Les exemples	Les exemples

Learning Resources	***Theory:*** ***1.*** **'' Nouvelle Génération-A1''** Méthode de français, Marie-Noëlle COCTON, P.DAUDA, L.GIACHINO, C.BARACCO, Les éditions Didier, Paris, 2018. ***2.*** ***Cahier d'activités avec deux discs compacts.*** ***3.*** *https://www.fluentu.com/blog/french/french-grammar* ***4.*** *https://www.elearningfrench.com/learn-french-grammar-online-free.html* ***5.*** *https://www.lawlessfrench.com/grammar* ***6.*** *https://blog.gymglish.com/2022/12/15/basic-french-grammar*

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
1. Mr. Kavaskar Danasegarane Process Expert Maersk Global Service Center Pvt. Ltd	*1. Dr. C.Thirumurugan Professor, Department of French, Pondicherry University*	*1. Mr. Kumaravel K. Assistant Professor & Head, SRMIST, KTR*
2.Mr. Sharath Raam Prasad Character Designer, Animaker Company Pvt.		*2. Mrs. Abigail, Assistant Professor, SRMIST, VDP*

Course Code	ULE23AE1T	Course Name	English	Course Category	AE	Ability Enhancement course	L	T	P	0	C
							4	0	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Develop an understanding and sensibility of human consciousness through gender inclusive curriculum	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
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.																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Analyze different literary texts to identify the representation of issues related to gender, and class	2	75	60	H	M	M	L	-	M	-	M	H	L	H	L	-	-	-
CLO-2 :	Apply critical thinking skills to analyze and respond to academic texts.	2	80	70	M	H	L	-	-	-	-	M	M	H	H	M	-	-	-
CLO-3 :	Critically evaluate and discuss contemporary issues through online articles.	2	70	65	M	M	M	-	L	L	-	H	M	H	H	L	-	-	-
CLO-4 :	Refine their general writing skills	2	70	70	H	M	L	-	M	H	-	-	-	-	H	L	-	-	-
CLO-5 :	Improve their language application skills	2	80	70	H	H	-	M	-	M	-	L	L	M	H	M	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to the poetry and the poet- Sukirtharani	Introduction to Short stories. Introducing the short story writer Katherine Mansfield.	Introduction to Creative Writing. Explaining the elements of creative writing.	Building the discourse- The significance of conversation and the key elements of discourse are the points of discussion in this class hour.	Reflecting the learning. -Review writing
	SLO- 2	Reading and recitation of the poem - Debt	Reading the story- The Doll's House	Stand-up comedy show - translate the audio content in English. (any regional language)	Art of conversation in digital and verbal discourse- Lee Mockobe's A Powerful Poem of what it means to be a Transgender. TEDX TALK- POEM RECITATION	Choosing the subject for reviewing.
S-2	SLO-1	Analysis and Critical interpretation of the poem.	Explaining the story through depiction of characters and representation of injustices.	Students- groups -Students belonging to States other than Tamilnadu	Reflecting on the style and the tone of the poem.	Planning to choose.

	SLO- 2	*Introduction to the poet Kalki Subramaniyam.*	*Analysis and critical interpretation of the short story Doll's House.*	*Practice the writing activity - creative ways of engaging in translation.*	*Practicing conversation*	*Understand the review process how effectively a review of any work can be done.*
S-3 – S-4	**SLO-1**	*Reading and recitation of the poem Phallus I cut.*	*Introduction to the writer Haruki Murakami.*	*Correction of errors- attempting to translate.*	*Introducing Content writing in Social Media- the importance of content writing.*	*Introducing the students to the review of the various works.*
	SLO- 2	*Analysis and Critical interpretation of the poem.*	*Reading the Confessions of a Shinawaga monkey.*	*Identifying equivalent terms to certain regional words - learn the art of translation.*	*.BLOG WRITING - Subtleties Of Workplace Inclusion: Mental Health And Queer Community- Salik Ansari.* .	*Reviewing -recorded -posted in the social media pages of SRMIST*
S-5	**SLO-1**	*Introduction to the poet Imtiaz Dharker*	*Discussion and analysis of the Confessions of a Shinawaga monkey.*	*Introducing famous art works and the contexts of creation.* *Salvador Dali- The Face of War* *Pablo Picasso- Guernica* *Edward Munch- The Scream* *Pieter Bruegel- The Tower of Babel*	*writer's conversation with the readers - the blog in other blog articles..*	*Thoughtful conversation with your team member post the same in the official social media page of SRMIST.*
	SLO- 2	*Reading and reciting the poem Purdah 1*	*Introduction to Crystal Wilkinson*	*creative and/ or thoughtful writing - contemporary themes of modern day relevance*	*Practice blog writing*	*Choosing the team based on the abilities that are comfortable to match the peer members*
S-6	**SLO-1**	*Analysis and Critical interpretation of the poem- Purdah 1*	*Reading Endangered Species: Case 47401.*	*Students -writing abilities- building stories- a visual treat of variety of pictures.*	*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*
	SLO- 2	*Reading and reciting the poem Purdah 2*	*Discussion and analysis of Endangered Species: Case 47401.*	*Elements of writing*	*Discussion- essay by the author - subjective depiction of life.* *Understand -subjective opinions - perspectives -*	*Planning and preparation for the script of conversation with a team member*
S-7 – S-8	**SLO-1**	*Analysis and Critical interpretation of the poem- Purdah 2*	*Introduction to C.S Lakshmi also known as Ambai.*	*Incorporate the elements of story in story writing.*	*Class discussion*	*Drafting , editing and revising the script of conversation and enacting the conversation with the team members*
	SLO- 2	*Introduction to the poet Arundathi Subramanian*	*Reading the short story- In a Forest, A Deer.*	*Practice -write stories - pictures given or shown .*	*Practising the task multiple times with all the students in the classroom.*	*Enactment -proper rehearsal -final performance - conversation- whole performance should be recorded.*
S-9	**SLO-1**	*Reading and reciting the poem- Home*	*Discussion and Analysis of In a Forest, A Deer.*	*A writing task to write a script is introduced in the classroom.*	*Interposing opinions in famous interviews-*	*The recording should be posted in the official media page and social handles of SRMIST.*

	SLO- 2	*Analysis and Critical interpretation of the poem- Home*	*Retrospecting the writing styles of the authors- Katherine Mansfield, Haruki Murakami, Crystal Wilkinson and Ambai.*	*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.*	*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*	*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	***SLO-1***	*Recollection of study of the writing styles and intentions of the poets prescribed in the syllabus.*	*Revision- The Doll's House*	*Creative writing -writing news reports. recreated with new characters, places, scenes, incidents.*	*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- 2	*Revision of the poems Debt and Phallus I cut*	*Revision- Confessions of a Shinawaga Monkey*	*Watch debate shows - summarising the arguments Enhance -descriptive writing skill.*	*Certain role plays like celebrity personalities, political personalities - conduct the interview and be the interviewer and interviewee.*	*Discussion of ideas and generation of creative ideas*
S 11 - S 12	***SLO-1***	*Revision of the poems Purdah 1 and 2*	*Revison- Endangered Species: Case 47401*	*Practice the* improvement *of writing skill.*	*The art of conversation and the ability to build a discourse*	*1. Assignment on any piece of creative writing (OR) 2. Presentation- Mastering the art of Public Speaking. (OR) 3. Project on compiling the real life influential events on gender inclusive issues and a presentation of the same. Interview Scripting /Blog writing.*
	SLO- 2	*Revision of the poem Hiome.*	*Revision- In a Forest, A Deer.*	*Repetitive practice and continuous assessment - writing skillls-master the writing skill.*	*The evaluation and assesment of the conversation -constructive feedbacks to the students.*	*Students can opt any of the project from the given choice.*

Learning Resources	Horizon- English Text Book – Compiled and Edited by the faculty of English Departement, FSH, SRMIST, 2020 English Grammar in Use by Raymond Murphy Raymond Murphy, Intermediate English Grammar, Cambridge University Press, 2007 R.P. Bhatnagar, English for Competitive Examinations, Trinity Press, 3rd Edition,2016 http://www.aptitudetests.org/verbal-reasoning-test https://www.assessmentday.co.uk/aptitudetests_verbal.htm

Level	Blooms Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (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 Understand	30%	-	30%	-	30%	-	30%	-	30%	-
2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
3	Evaluate Create	30 %	-	30%	-	30%	-	30 %	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Ann Mariya Thomson ***RA2232105010015*** ***II M.A English Literature*** ***CSH, SRM IST*** ***az1160@srmist.edu.in***	***Dr. K S Antonysamy*** ***Associate Professor and Head, Dept. of English Loyola College*** ***Chennai*** *antonysamyks@loyolacollege.edu*	***Dr. Dr. Shanthichitra, Associate Professor, & Head, Department of English, FSH,SRMIST*** ***Dr Anchal Sharma, Prof & Hod EFL SRMIST NCR Campus*** ***Dr T Sridevi, Assistant Professor English, FSH Ramapuram SRM*** ***Dr Shanmuga Priya, Assistant Professor SRMIST Trichirapalli Campus***

Code	UCY23101T	Course Name	Atomic Structure and Chemical Bonding	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
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:	Employ 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	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1:	Utilize the knowledge of quantum mechanics to understand the atomic structure	4	H	-	H	-	-	M	-	-	-	-	-	-	-	-	-
CLO-2:	Correlate the periodic properties of elements with their chemical properties	4	-	H	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3:	Understand the concept of lattice energy using Born-Landé and Kapustinskii expression and Born-Haber cycle	4	H	-	-		-	-	L	-	-	-	-	-	H	-	-
CLO-4:	Perceive the importance of structures and geometries of molecules using VSEPR and MO theory	4	H	-	-	-	H	-	-	-	M	-	-	-	-	-	-
CLO-5:	Rationalize the properties of semiconductor using metallic bonding and gaseous behavior using weak chemical forces	4	-	H	-	H	-	M	-	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to Atomic Structure	Introduction to periodic properties	Introduction to chemical bonding:	Introduction to Covalent Bonding .	Introduction to metallic bond
	SLO-2	Bohr's atomic model and limitations	Groups and Periods in the Periodic Table	Types of chemical bonds	Lewis theory-Octet rule	Electron sea theory
S-2	SLO-1	Line spectrum of hydrogen atom	Slater rules	Definition and General characteristics of Ionic bond	Valence Bond theory - Postulates and limitations	Conductor and Insulator
	SLO-2	Wave mechanics – duality of matter	Effective nuclear charge	Ionic crystal formation: Closed packing	Modified VB theory: Types of hybridization	Semiconductor
S-3	SLO-1	de Broglie equation	shielding constant	Radius ratio rule and its applications	VSEPR theory	Band Theory
	SLO-2	Heisenberg's Uncertainty Principle	Trend of the periodic table properties	Derivation for AX3 type compound	VSEPR theory to predict the type of hybridization	Multiple bonding (s and π bond approach) and Example for π-back bonding
S-4	SLO-1	Tutorial: Solving problems in de Broglie equation	Tutorial: Solving problems in Effective nuclear charge	Tutorial: Solving problems in AX3 type	Tutorial: Solving problems related to hybridization in VSEPER	Tutorial: Solving problems in Insulator
	SLO-2					
S-5	SLO-1	Failure of Bohr's atomic model	factors affecting periodic proiperties:	Lattice energy	and geometry of molecule	Van der Waals forces: Definition and types
	SLO-2	Quantum mecahanical concept of atom	a) atomic radii	Born-Lande equation	Molecular Orbital Theory	ion-dipole force

Duration (hour)		12	12	12	12	12
S-6	SLO-1	Schrödinger's wave equation (time-independent)	b) ionic radii	Kapustinskii Equation	LCAO method	dipole-dipole forces
	SLO-2	Significance of ψ and $\psi^{2.}$	c) ionization energy	Madelung constant	formation of bonding, anti-bonding and nonbonding molecular orbitals	dipole-induced dipole forces
S-7	SLO-1	Probability distribution curves,	Successive ionization energy	Born-Haber cycle and its applications.	Types of overlapping - S-S ,S-px,	Instant dipole-Induced dipole forces
	SLO-2	Radial wave functions and nods. Angular wave functions and nods	d) electronaffinity e) electronegativity	Relationship between lattice energy and solubility of ionic compounds	Types of overlapping Px-Px, Py-Py and Pz-Pz	London forces
S-8	SLO-1	Tutorial: Solving problems in Schrödinger's wave equation	Tutorial: Solving problems in periodic proiperties	Tutorial: Solving problems in Lattice energy	Tutorial: Solving problems in MO theory	Tutorial: Solving problems related to different forces
	SLO-2					
S-9	SLO-1	Shapes of orbitals	Variation of electronegativity with bond order	Relationship between lattice energy and solubility of ionic compounds	MO diagram for homonuclear and heteronuclear diatomic molecule	hydrogen bonding
	SLO-2	Significance of quantum numbers	Electronegativity scales: Pauling,	Covalent character in ionic compounds	Calculation of bond order. H_2^+,H_2, He_2^+, He_2 molecules	Types of hydrogen bonding
S-10	SLO-1	Pauli's Exclusion Principle	Allred Rochow	Fajan's Rule and applications.	Calculation of bond order. H_2+,H_2, He_2+, He_2 molecules	VB approach of hydrogen bonding
	SLO-2	Hund's rule of maximum multiplicity	Mulliken's scales of electronegativity	Polarization	Li_2, B_2, C_2 molecules	Effects of hydrogen bonding in density
S-11	SLO-1	Aufbau principle	metallic and non-metallic character	and Polarizing power	N_2, O_2, O_2-, O_2^{2-} molecules	solubility
	SLO-2	Electronic configuration of elements	Variation of oxidation state in periodic table	dipolemoment	CO, HCl molecules	melting point and boiling point.
S-12	SLO-1	Tutorial: Solving problems in quantum numbers	Tutorial: Solving problems in Electronegativity	Tutorial: Solving problems related to Covalent character	Tutorial: Solving problems in MO theory	Tutorial: Solving problems related to hydrogen bonding
	SLO-2					

Learning Resources	
	1. J.D. Lee, Concise Inorganic Chemistry, Fifth Edn., Wiley India 2008. 2. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education 2009. 3. B.E. Douglas, D. H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., John Wiley & Sons, Inc. 1993. 4. P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, and F.A. Armstrong, Shriver and Atkins' Inorganic Chemistry, 5th Edn, W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010 www.whfreeman.com. 2010. 5. L. G. Miessler, J. P. Fischer, D. A. Tarr, Inorganic Chemistry, Fifth edition, Pearson, 2014. 6. P.L. Soni, Textbook of Inorganic Chemistry, Mohan Katyal, Sultan Chand & Sons Publishers 2006. 7. S. Prakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I Sultan Chand & Sons Publishers 2000.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice

Level 1	Remember	30%	-	30%	-	20%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
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Course Code	UCY23102T	Course Name	Basic Organic Chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Understand the structure of organic molecules	
CLR-2 :	Visualize stereochemistry of molecules	
CLR-3 :	Determine the stereochemistry of molecules	
CLR-4 :	Recognize aromatic molecules	
CLR-5 :	Understand reaction rates and determine the mechanism of reactions	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Know the name and structure of molecules	4	H	-	H	-	-	M	-	-	-	-	-	-	-	-	-
CLO-2 :	Understand the 3D arrangement of substituents in a molecule	4	H	-	-	-	M	-	-	H	-	-	-	-	-	-	-
CLO-3 :	Know how to determine the stereochemistry of molecules	4	H	-	-	L	-	-	-	-	H	-	-	-	-	-	-
CLO-4 :	Predict the acidity and basicity of molecules	4	-	M	-	H	-	-	H	-	-	-	-	-	-	-	-
CLO-5 :	Understand the rate of a reaction based on kinetics and thermodynamics	4	-	H	-	-	H	-	-	-	-	L	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Concept of bonds (σ& π)	Projection formulae: Interconversion	Connect of sterogenic atom or center	S_N1, S_N2 and SN^i reactions with examples	Introduction to heterocyclic compounds: and classifications
	SLO-2	Explain with MOT	Isomerism in Organic Compounds: Structural isomerism	Topicity of ligands and faces	S_N1, S_N2 and SN^i reactions with examples	Introduction to heterocyclic compounds: and classifications
S-2	SLO-1	Hybridization	Geometrical isomerism; Confirmational isomerism and configurational isomerism	Re/Si faces	Elimination reactions: E1, E2 and E1CB	Basic synthesis of heterocyclic compounds
	SLO-2	Hybridization	Stereoisomerism: Asymmetry, Chirality	Optical isomerism and optical activity	Elimination reactions: E1, E2 and E1CB	Reactivity of heterocycles
S-3	SLO-1	Sigma π and σ bond calculations	Chirality in molecules with one or more stereocenters	Brief introduction of symmetry elements	Addition reactions (Markownikoff/Anti-markowikoff)	Directing effect of groups in electrophilic substitution: Activating groups
	SLO-2	Different types of functional groups	Chirality in molecules with one or more stereocenters	Brief introduction of symmetry elements	Addition reactions (Markownikoff/Anti-markowikoff)	Directing effect of groups in electrophilic substitution: Activating groups
S-4	SLO-1	Tutorial - Problem discussion on MOT, hybridization	Tutorial – Discussion on structural isomers and stereoisomers	Tutorial – Discussion on symmetry elements	Tutorial – Discussion on addition, elimination and substitution reactions with examples	Tutorial -Discussion on reactivity of heterocyclic compounds
	SLO-2					
S-5	SLO-1	IUPAC Nomenclature	Chirality in molecules with no stereocenter (Allenes and biphenyls)	Confirmation analysis of alkanes (Conformations, Relative stability and	Oxidation reactions	Concept of aromaticity, Huckel's rule of aromaticity; aromatic, anti-aromatic, non-

Duration (hour)		12	12	12	12	12
				energy diagrams, ethane)		aromatic and homoaromatic
	SLO-2	IUPAC Nomenclature	Chirality in molecules with no stereocenter (Allenes and biphenyls)	Confirmation analysis of alkanes (Conformations. Relative stability and energy diagrams, propane)	Reduction reactions	Concept of aromaticity, Huckel's rule of aromaticity; aromatic, anti-aromatic, non-aromatic and homoaromatic
S-6	SLO-1	IUPAC Nomenclature	Relative configurations: D/L designations	Confirmation analysis of alkanes (Conformations. Relative stability and energy diagrams, butane)	Basic named reactions: Aldol condensation Cannizzaro reaction	Concept of aromaticity, Huckel's rule of aromaticity; aromatic, anti-aromatic, non-aromatic and homoaromatic
	SLO-2	IUPAC Nomenclature	Relative configurations: D/L designations	Confirmation analysis of alkanes (Conformations. Relative stability and energy diagrams, butane)	Clemmenson reduction, Friedel-Craft Reactions, Grignard reaction, Reimer-Tieman Reaction, Sand Mayer Reaction	Concept of aromaticity, Huckel's rule of aromaticity; aromatic, anti-aromatic, non-aromatic and homoaromatic
S-7	SLO-1	IUPAC Nomenclature	Relative configurations: D/L designations	Confirmation analysis of cycloalkanes: cyclohexane	Wittig reaction, Wolf-Kirshner reduction, Wurtz reaction, Ullman reaction	Reaction rates with examples
	SLO-2	Oxidation state oc carbon in molecules	Geometrical isomerism: Cis/Trans Isomerism	Cyclohexane confirmation with energy diagram	Sand-Mayer reaction, Gattermann reaction, Étard reaction, Suzuki reaction	Activation energy, transition state and intermediates
S-8	SLO-1	Tutorial - Discussion with example of IUPAC nomenclature	Tutorial - Discussion with example D/L designations	Tutorial – Discussion on Confirmations of cyclohexane, butane	Tutorial – Discussion on oxidation, reduction and named reactions	Tutorial - Huckel's rule of aromaticity with examples
	SLO-2					
S-9	SLO-1	Strain in the molecules, dihedral angle, torsion angle, Dipole moment	Geometrical isomerism: Cis/Trans Isomerism	Axial and equatorial positions	Electronic displacements and their applications: Inductive effect	Thermodynamic and kinetic requirements
	SLO-2	Strain in the molecules, Dihedral angle, torsion angle, dipole moment	Geometrical isomerism: Syn/Anti	Stability of conformation with two or more substituents	Mesomeric effect	Hammond postulate,
S-10	SLO-1	Projection formulas: Fischer	Geometrical isomerism: Syn/Anti	Stability of conformation with two or more substituents	Resonance effect	Curtin-Hammett Principle
	SLO-2	Sawhorse, Newman,	E/Z nomenclature	Effects on stability of confirmations of cyclohexane	Hyperconjugation effect	Hammett equation
S-11	SLO-1	Flying-Wedge, Zigzag	E/Z nomenclature	Introduction to the organic reactions: discussion on electrophile, nucleophile and free radical	Electrophilic aromatic substitution: Halogenation with mechanism	Concept of pH and P*K*a)
	SLO-2	Flying-Wedge, Zigzag	CIP rule	Brief account on Nucleophilic, Electrophilic, Free radical substitution reactions	Electrophilic aromatic substitution: Halogenation with mechanism	Concept of acids and bases (Lewis and Bronsted)
S-12	SLO-1	Tutorial - on projection formulas and discuss their stabilities	Tutorial -on Cis/Trans and E/Z nomenclature	Tutorial -Discussion on factors effecting on the stability of confirmation	Tutorial - Discussion on inductive, mesomeric, resonance effects	Tutorial - Understanding the reaction mechanism
	SLO-2					

Learning Resources	**Theory:** 1. S. Sengupta, Basic Stereochemistry of Organic Molecules, third edition, 2003 2. Paula Y. Bruice, Organic Chemistry. Global Edition, 1995 3. M. B. Smith and J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc, 2007 4. J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd edition, 2001 **5.** D. N. Nasipuri, Stereochemistry of Organic Compounds: Principles & Applications South Asia Books, 1994

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	*2. Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23103J	Course Name	States of matter, solutions and phase equilibria	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Gain knowledge about the laws of distribution and their applications	
CLR-2 :	Acquire knowledge about the miscibility of liquids and CST of a system	
CLR-3 :	Infer the various phase equilibrium existing in a system	
CLR-4 :	Understand the colligative properties of a system	
CLR-5 :	Understand the solution-making and dilution	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	state laws of distribution and determine the distribution and partition coefficient	4	H	-	-	-	M	-	-	-	-	-	-	-	-	-	H
CLO-2 :	differentiate types of solutions and determine the CST of a system	4	H	-	-	-	-	-	H	-	-	L	-	-	-	-	-
CLO-3 :	Illustrates the existence of phase equilibria and constructs & interpret the phase diagram	4	H	-	H	-	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Determine the molecular weight of a compound using colligative properties	4	H	-	H	-	M	-	-	-	-	-	-	-	-	-	H
CLO-5 :	Make concentration of different solutions, express the concentration of solutions in various suitable units	4	H	-	-	-	H	-	-	-	-	-	-	H	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Gaseous state: General Characteristics of gases	Liquid state: The origin of intermolecular forces	Solid state: Types of solids	Solutions: Concentration terms	Phase equilibria; Phase, component
	SLO-2	Parameters of gases	Ion-dipole forces	Symmetry of crystals	Molality, Molarity, Normality	Degrees of freedom
S-2	SLO-1	The gas laws	dipole-dipole forces	Miller indices	Solutions of gases in gases	Derivation of the Phase rule
	SLO-2	Boyle's law	London forces	Determination of Miller indices	Henry's law	Activity – terms of phase equilibria
S-3	SLO-1	Charle's law	Hydrogen bonding	Crystal lattice	Solutions of liquids in liquids- Phenol water system	One component system
	SLO-2	Gay Lussac's law, Avagadro law	Effect of hydrogen bonding on boiling point	Unit cells		
S-4 to S-6	SLO-1	Introduction to the lab, discussion of all the experiments	Determination of transition temperature of a hydrated salt	Determination of molecular formula of copper-ammonia complex by distribution method. $Cu2+ (aq) + nNH3 \rightleftharpoons [Cu (NH3) n]^{2+}$	Determination of critical solution temperature and composition at CST of the phenol water system	Construction of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems
	SLO-2	Discussion on lab protocols and evaluation				
S-7	SLO-1	The ideal gas equation	Vapour pressure	X-Ray Crystallography	Vapour pressures of liquid-liquid solutions	Two component – Simple eutectic system
	SLO-2	Derivation	Determination of vapour pressure – Static method	Bragg's equation, derivation	Types of mixtures of miscible liquids	Silver – Lead system

Duration (hour)		18	18	18	18	18
S-8	SLO-1	Dalton's law of partial pressure	Dynamic method	Classification of crystals - Ionic liquids (ILs)	Theory of fractional distillation	Zn-Cd system
	SLO-2	Graham's law of diffusion	Effect of vapour pressure on boiling point	Molecular crystals	Vapour pressure of mixture of non-miscible liquids	Interpretation with diagram
S-9	SLO-1	Kinetic molecular theory of gases	Surface Tension	Metallic crystals	Colligative properties	Two component system with a solid compound
	SLO-2	Kinetic molecular theory of gases - Derivation	Determination of surface tension	Structure of metal crystals	Raoult's law	Congruent melting point
S-10-12	SLO-1	Distribution of acetic acid/benzoic acid between water and benzene or chloroform or cyclohexane	Determination of the composition of a given binary mixture (ethanol-water) from the study of the viscosity-composition curve	Construction of the phase diagram using cooling curves or ignition tube method: a. simple eutectic and b. congruently melting systems	Study of the effect of impurities NaCl / succinic acid on CST of the phenol water system	Construction of phase diagram of simple eutectic system
	SLO-2					
S-13	SLO-1	Distribution of Molecular velocities	Viscosity	Crystal defects	Determination of molecular mass from vapour pressure lowering	Mg-Zn system
	SLO-2	Collision properties	Measurement – The Ostwald method	Metal alloys	Measurement of lowering of vapour pressure	Incongruent melting point
S-14	SLO-1	Deviation from ideality	Effect of temperature on viscosity of a liquid	Semiconductors	Elevation of boiling point	Ferric chloride – water system
	SLO-2	Vander Waals equation	Refractive index	P type semiconductor	Determination of molar mass from elevation of boiling point.	Interpretation with diagram
S-15	SLO-1	Liquefaction of gases	Specific refraction	N type semiconductor	Freezing point depression	Ternary phase diagram
	SLO-2	Law of corresponding state	Molar refraction	Liquid crystals	Activity and activity coefficient	Three component mixtures
S-16-18	SLO-1	The partition coefficient of Iodine between benzene and water	Determination of molecular weight of a compound using Viscosity average method	Making solutions of different ppm, ppb, and serial dilution of the prepared solutions	Determination of critical solution temperature and composition at CST of the Aniline - water system	Repetition lab
	SLO-2					

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

Learning Resources	**Theory:** 1. P.W. Atkins, L.L. Jones, Chemical Principles: The quest for insight. H. Freeman and Company, New York, 2010 2. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, Shobulal Nagin Chand and Co, 2001. 3. P. L. Soni, A Textbook of Inorganic Chemistry, Sultan Chand and Co., 1977. 4. R. Gopalan, Text Book of Inorganic Chemistry, 2nd edition, Hyderabad, Universities Press, (India), 2012. 5. R.T. Morrison and R.N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th edition, Pearson India, 2011. 6. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLal Nagin Chand and Co, 2013.

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Srinivasarao Kancharla,* SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. D*r. T. Pushpa Malini*, SRMIST*

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Course Code	UCD23S01L	Course Name	Quantitative Aptitude and Logical Reasoning	Course Category	S	Skill Enhancement Course	L	T	P	0	C
							0	0	2	2	1

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:
CLR-1 :	Demonstrate various principles involved in solving mathematical concepts
CLR-2 :	Critically evaluate basic mathematical concepts related to profit, loss, interest calculations, average and interpret data
CLR-3 :	Enable students to understand reasoning skills
CLR-4 :	Use the basic mechanics of Grammar
CLR-5 :	Acquire time management skills and expose students to the requirements of the job market

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behaviour	Life Long Learning
CLO-1 :	Understand the concepts of LCM, HCF, ratio and proportions, percentages and approach questions in a simpler and innovative method	3	80	70	H	M	-	M	-	M	-	H	M	H	-	M	-	-	-
CLO-2 :	Develop, solve, analyze, and use simple mathematical models that are relevant to daily life.	3	80	75	H	M	-	M	L	M	-	H	M	H	-	M	-	-	-
CLO-3 :	Solve problems on reasoning	3	85	70	-	M	-	-	-	M	M	H	-	H	-	H	-	-	-
CLO-4 :	Understand the different parts of speech and use them in sentences appropriately	3	85	80	H	-	-	-	-	-	M	M	-	-	-	H	H	-	M
CLO-5 :	Instill confidence in students and develop skills necessary to face the audience	3	85	75	-	-	M	-	-	M	-	-	M	-	H	M	-	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Speed Maths and Simplification	Profit and Loss-Introduction	Number Series	Most Logical Choice	Self-Introduction - Introduction
	SLO-2	Simplification Techniques and Tricks	Profit and Loss- Basic Problems	Number Series – Solving Problems	Most Logical Choice – solving problems	Self-Introduction - Session 1
S-2	SLO-1	Divisibility	Simple Interest-Introduction, Formulas &Problems	Word Series	Logical Order	Self-Introduction - Session 2
	SLO-2	Power cycle, Reminder cycle	Compound Interest-Introduction, Formulas &Problems	Word Series – Solving Problems	Logical Order – tips and tricks	Self-Introduction - Session 3
S-3	SLO-1	Problems On H.C.F and L.C.M	Averages-Introduction& Basics	Odd man out	Synonyms	Self-Introduction - Session 4
	SLO-2	Problems On H.C.F and L.C.M Solving problems	Averages-Tricky Problems	Missing number and wrong number	Antonyms	Self-Introduction - Session 5
S-4	SLO-1	Linear and Simultaneous Equation	Algebra –Introduction	Image Based Problems-Introduction	Essential Part	Self-Introduction - Session 6
	SLO-2	Linear and Simultaneous Equation –solving problems	Algebraic Expressions Concepts	Image Based Solving Problems	Parts of Speech - Worksheets	Self-Introduction - Session 7
S-5	SLO-1	Ratio and Proportions-Introduction	Data Interpretation – Bar chart, Pie Chart	Inequalities	Spotting Error	Basics of Written Communication

	SLO-2	*Ratio and Proportions- Basics Problems*	*Data Interpretation – Table, Line Graph*	*Inequalities - methods*	*Spotting Error –Concord, Prepositional usage, Usage of Articles*	*Basics of Written Communication Methods*
S-6	**SLO-1**	*Percentage - Introduction*	*Quadratic Equations*	*Coding – Decoding- Introduction*	*Sentence Correction – Vocabulary based*	*Time Management Skills*
	SLO-2	*Percentage- Basic problems*	*Quadratic Equations – Formulas and Methods*	*Coding – Decoding- Different types*	*Sentence Correction – Grammar Based*	*Time Management Skills - Activity*

Learning Resources	*1.* Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition 2020. *2. Dr. Agarwal.R.S, Quantitative Aptitude for Competitive Examinations, S. Chand and Company Limited, 2018 Edition* *3. Archana Ram, PlaceMentor: Tests of Aptitude for Placement Readiness, Oxford University Press, Oxford, 2018*	*4. Edgar Thrope, Test of Reasoning for Competitive Examinations, Tata McGraw Hill, 6th Edition 2020.* *5. Singh O.P., Art of Effective Communication in Group Discussion and Interview, S Chand & Company, 2014* *6. Bhatnagar R P, English for Competitive Examinations, Trinity Press, 2016*

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%)#**
		Practice	**Practice**	**Practice**	**Practice**
Level 1	Remember	30%	30%	30%	10%
	Understand				
Level 2	Apply	30%	30%	30%	50%
	Analyze				
Level 3	Evaluate	40%	40%	40%	40%
	Create				
	Total	100 %	**100%**	**100%**	**100%**

CLA-1, CLA-2 and CLA-3 can be from any combination of these: Online Aptitude 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, Conf. Paper etc.,

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. M. Ponmurugan , Executive PMOSS, Cognizant Technology Solutions India Pvt. Limited, Chennai	*Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeedam, Coimbatore*	*Dr. Sathish K, HOD, Department of Career Guidance, FSH, SRMIST*
		Ms. Deepalakshmi S, Assistant Professor, Department of Career Guidance, FSH, SRMIST

Course Code	UCD23V01T	Course Name	Universal Human Values	Course Category	V	Value Addition Course	L	T	P	0	C
							2	0	0	2	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		
		1	2	3
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 (%)
CLO-1 :	Evaluate the significance of value inputs in formal education and start applying them in their life and profession	3	80	70
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
CLO-3 :	Analyze the value of harmonious relationship based on trust and respect in their life and profession	3	85	70
CLO-4 :	Examine the role of a human being in ensuring harmony in society and nature.	3	85	80
CLO-5 :	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.	3	85	75

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	M	-	-	H	-	-	-	-	-	-	M	-	-	H	H
CLO-2 :	-	M	-	H	-	L	-	-	-	-	-	-	-	H	H
CLO-3 :	-	-	-	H	-	-	-	M	L	-	-	-	-	H	H
CLO-4 :	-	-	-	H	-	-	L	-	L	L	-	L	M	H	H
CLO-5 :			L	H	L	-	-	-	-	-	-	-	M	H	H

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
-	-	*Dr. Supraja P, UHV University Coordinator, SRMIST*
		Dr. Sathish K, HOD, Department of Career Guidance, FSH, SRMIST
		Dr. Sweety Bakyarani E, Department of Computer Science, FSH, SRMIST

Semester – 2

Course Code	ULT23G02J	Course Name	Tamil-II	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	சங்க இலக்கியங்கள் வழி தொன்மை அக, புற வாழ்வியலை அறியச் செய்தல்																		
CLR-2 :	தமிழ்ச்சமூகத்தின் அறவியல் குறித்து தெரியச் செய்தல்																		
CLR-3 :	பக்தி இலக்கியங்கள் போதித்த மனித மாண்புகளை உணரச் செய்தல்																		
CLR-4 :	பண்டைத் தமிழ்ச்சமூகத்தின் தொல் இலக்கியங்கள் வளர்ச்சி பெற்ற வரலாற்றைப் புரியச் செய்தல்																		
CLR-5 :	சிறுகதைகள் சொல்லும் வாழ்வியல் நெறி, மொழியின் நுட்பங்கள் ஆகியவற்றைத் தெரியச் செய்தல்																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	பண்டைத் தமிழ்ச் சமூகத்தின் அக, புற வாழ்வியல் இன்றைய சமூக மேம்பாட்டிற்கு வழிகாட்டி நிற்பதை அறிந்துகொள்ளுதல்	2	75	60	H	L	H	M	H	H	L	M	H	M	L	H	-	-	-
CLO-2 :	தமிழ்ச் சமூகம் அறத்தை வலியுறுத்திய சமூகம் என்பதன் வழி மானுட அறத்தைத் தெரிந்துகொள்ளுதல்	2	80	70	H	M	H	L	M	H	L	H	M	L	H	H	-	-	-
CLO-3 :	பக்தி இலக்கியம் மூலம் இறைத் தந்துவங்களை அறிந்து மானுட ஒற்றுமை மேம்பாட்டை அறிந்துகொள்ளுதல்	2	70	65	H	L	H	M	H	H	M	H	L	H	M	H	-	-	-
CLO-4 :	தொல் தமிழ்ச்சமூகம் இலக்கியம், அரசியல், அறம், பக்தி ஆகியவற்றில் தழைத்தோங்கியதைத் தெரிந்துகொள்ளுதல்	2	70	70	H	M	H	L	H	M	M	H	H	L	H	H	-	-	-
CLO-5 :	வாழ்வியலின் நெறிகளைச் சொல்லும் கதைகளைப் படைக்கும் திறனோடு மொழி ஆளுமையையும் அறிந்துகொள்ளுதல்	2	80	70	H	M	H	H	M	H	L	M	H	L	H	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	காலந்தோறும் தமிழ் அகத்திணை மரபு	சங்க மருவிய காலம்	பல்லவர் காலம்	பண்டைக்காலத் தமிழகம்	தமிழ்ச் சிறுகதைப் போக்குகள்
	SLO-2	அக இலக்கியத்தின் கட்டமைப்பு/ உள்ளடக்கம்	அறமும் வாழ்வியலும்	பல்லவர் கால இலக்கியங்கள்	சங்ககால மக்களின் வாழ்வியல்	தமிழ்ச் சிறுகதையும் தமிழ்ச் சமூக வாழ்வியலும்
S-2	SLO-1	எட்டுத்தொகை நூல்களும் பகுப்புமுறையும்	உலகப்பொதுமறை - திருக்குறள்	பக்தியும் தமிழும்	முச்சங்கம் – அறிமுகம்	புதுமைப்பித்தன் - சங்குத்தேவனின் தர்மம்
	SLO-2	ஐங்குறுநூறு (375)	திருக்குறளின் கட்டமைப்பு	பக்தி இலக்கியத் தோற்ற நிலை	முச்சங்க வரலாறு	கள்வனின் தர்மம்
S-3	SLO-1	உடன்போக்கும் நற்றாய் புலம்பலும்	திருக்குறள் வான்சிறப்பு (2)	சைவ சமய இலக்கியங்கள்	பத்துப்பாட்டும் எட்டுத் தொகையும்	ந.பிச்சமூர்த்தி – வேப்பமரம்
	SLO-2	ஐங்குறுநூறு (391)	மழையும் வாழ்வும்	சைவக்குரவர் நால்வர்	சங்க கால மக்களின் வாழ்வியல்	மரபும் நம்பிக்கைகளும்
S-4	SLO-1	உடன் போக்கும் தமிழர் பறவையியல் அறிவும்	திருக்குறள் – புலவி நுணுக்கம்	தேவாரம் – திருஞான சம்பந்தர் - பாடல் – 2834	எட்டுத்தொகை நூல்களின் வரலாறு	தமிழருவி மணியன் – ஒற்றைச் சிறகு
	SLO-2	குறுந்தொகை (02)	ஊடலின் அழகியல்	தேவாரம் – திருநாவுக்கரசர் –பாடல் - 4262	எட்டுத்தொகை நூல்களின் கட்டமைப்பு	உறவின் மேன்மை
S-5	SLO-1	இயற்கைப் புணர்ச்சியும் தலைவி நலம் பாராட்டலும்	நீதி இலக்கியங்கள்	திருவாசகம் அறிமுகம்	பத்துப்பாட்டு நூல்களின் வரலாறு	ஆர். சூடாமணி – மூடநம்பிக்கை
	SLO-2	குறுந்தொகை (03)	நாலடியார்	மாணிக்கவாசகர் பாடல் - ஆனந்த பரவசம் – பாடல் 10	பத்துப்பாட்டும் தமிழர் வாழ்வியலும்	சமூகத்தில் மூடநம்பிக்கைகள்
S-6	SLO-1	தலைவனின் மேன்மைத் தன்மையும் இயற்கையும்	வைகலும் - பாடல் (39)	வைணவ சமயம்	பதினெண் கீழ்க்கணக்கு நூல்கள்	மூடநம்பிக்கைகளின் சிக்கல்கள்
	SLO-2	அகநானூறு (238)	நிலையாமையும் அறமும்	வைணவ சமய வளர்ச்சிப்போக்கு	பதினெண் கீழ்க்கணக்கும் தமிழர் அற மரபும்	கிருஷ்ணா டாவின்ஸி – காலா அருகே வாடா

S-7	**SLO-1**	இயற்கையும் அகவாழ்வுச் சித்திரிப்பும்	தமிழர் மருத்துவம்	நாலாயிரத் திவ்யப் பிரபந்தம்	நீதி இலக்கியங்கள்	மனித வாழ்வில் மருத்துவம்
	SLO-2	நள்ளியின் கொடைத்திறம்	நீதி இலக்கியத்தில் மருந்து நூல்கள்	குலசேகராழ்வார் பாடல் - 678	நீதி இலக்கியங்களின் பன்முகத் தன்மைகள்	பாரம்பரிய மருத்துவம்
S-8	**SLO-1**	கலித்தொகைப் பாடல் –(11)	சிறுபஞ்சமூலம் (64)	ஆண்டாள் பாடல் – 574.	காப்பிய இலக்கணம்	மொழிப்பயிற்சி
	SLO-2	அறம் பொருள் இன்பம் சிறப்பு	ஈகையின் சிறப்பு	திருமழிசை ஆழ்வார் பாடல் – கணிகண்ணன்	காப்பியத்தின் போக்குகள்	சொற்களை உருவாக்குதல்
S-9	**SLO-1**	சூழலியலும் மனித வாழ்வும்	பழமொழி நானூறு அறிமுகம்	தமிழில் இஸ்லாமிய இலக்கியங்கள்	காப்பியங்களின் வகைமை	எழுத்துகளில் இருந்து சொற்களைக் கண்டுபிடித்தல்
	SLO-2	தமிழர் புறமரபு	பழமொழி நானூறு – தனித்தன்மைகள்	இஸ்லாமிய இலக்கியங்களின் கொடை	ஐம்பெருங்காப்பியங் களின் தனித்தன்மைகள்	படம் பார்த்துக் கதை எழுதுதல்
S-10	**SLO-1**	புறநானூறு (107) பாரியும் மாரியும்	பழமொழி நானூறு (184)	சீறாப்புராணத்தின் அமைப்பு	தமிழ்ச் சமூகமும் சமயத் தத்துவங்களும்	படம் பார்த்துக் கவிதை எழுதுதல்
	SLO-2	புறநானூறு (110) பாரியின் வள்ளல் தன்மை	பழமொழியும் அறிவுரையும்	விடமீட்டப் படலம் (10 பாடல்கள்)	சமயத் தத்துவங்களும் வாழ்வியல் விழுமியங்களும்	கற்பனைத்திறன் – வளர்த்தல்
S-11	**SLO-1**	புறநானூறு (112) கையறுநிலை	பண்டைக்காலப் போரும் வாழ்வும்	கிறித்தவ சமய இலக்கியங்கள்	சைவத் திருமுறை – அறிமுகம்	கற்பனையும் படைப்பும்
	SLO-2	சிறுபாணாற்றுப்படை (84-115)	புற இலக்கியங்கள்	கிறித்தவ இலக்கியங்களின் தமிழ்க் கொடை	பன்னிரு திருமுறை – வரலாறு	தமிழில் வாசகம்
S-12	**SLO-1**	கடையெழு வள்ளல்களின் சிறப்புகள்	களவழி நாற்பது (40)	கிறித்துவின் அருள்வேட்டல் – திரு.வி.க	நாலாயிரத் திவ்வியப் பிரபந்தம் – அறிமுகம்	விளம்பரத்திற்கு வாசகம் எழுதுதல்
	SLO-2	பட்டினப்பாலை (40-50) அட்டில் சாலைகளின் நிலை	போர்க்களமும் யானைப்படையும்	அலகிலொளி – 5 பாடல்கள்	வைணவ ஆழ்வார்கள் வரலாறு	வாசகம் எழுது முறைகள்

earning Resources	1. கொன்றை, தொகுப்பும் பதிப்பும் - தமிழ்த்துறை ஆசிரியர்கள், தமிழ்த்துறை, எஸ்.ஆர்.எம். அறிவியல் மற்றும் தொழில்நுட்பக் கல்விநிறுவனம், காட்டாங்குளத்தூர், 603203, 2023

	2. தமிழண்ணல், புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை, 2017 3. மு. அருணாசலம், தமிழ் இலக்கிய வரலாறு, நூற்றாண்டு முறை (9ஆம் நூ. முதல் 16 வரை), தி பார்க்கர், சென்னை, 2005 4. தமிழ் இணையக் கல்விக்கழகம் - http://www.tamilvu.org/ 5. மதுரை தமிழ் இலக்கிய மின் தொகுப்புத் திட்டம் - https://www.projectmadurai.org/

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Expert from Higher Technical Institutions	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 & Head, Dept. of Tamil, FSH, SRMIST*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

Course Code	ULH23G02T	Course Name	HINDI-II	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
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*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*To provide a brief Introduction of Hindi poetry(Bhaktikal,Reetikal and Aadhunikkal)*	*2*	*75*	*80*	*H*	*H*	*H*	*M*	*L*	*H*	*L*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-2 :	*To Discuss the origin and development of various forms of poetry in Hindi*	*2*	*80*	*90*	*H*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-3 :	*Focus on Evaluating the social changes through poetry*	*2*	*75*	*95*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*H*	*M*	*M*	*H*	*H*	-	-	-
CLO-4 :	*To Examine Transcreation in advertisement*	*2*	*80*	*90*	*H*	*H*	*L*	*H*	*M*	*H*	*L*	*H*	*H*	*M*	*H*	*H*	-	-	-
CLO-5 :	*To guide the students in the learning of the technical aspect of the Hindi Languge,this would help them in the field administration*	*2*	*85*	*90*	*M*	*H*	*M*	*H*	*L*	*H*	*H*	*L*	*H*	*M*	*H*	*H*	-	-	-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	*BHAKTI* KALIN KAVITA	RITI *KALIN* KAVITA	*ADHUNIK KAVITA*	*VIGYAPAN*	PATRA *LEKHAN* & *PARIBHASHIK* SHABDAVALI
	SLO-2	*BHAKTIU KALIN KAITA KI AVADHARNA*	*AVADHARNA*	*AVADHARNA*	*AWADHARNA*	*VADHARNA*
S-2	SLO-1	*SWARUP*	*SWARUP*	*SWARUP*	*ARTH*	*RTH*
	SLO-2	*MAHATVA*	*RITI KAL VIBHAJAN*	*MAHATVA*	*PARIBHASHA*	*WARUP*
S-3	SLO-1	*UDDESHYA*	*MAHATVA*	*DDESHYA*	*SWARUP*	*ARIBHASHA*
	SLO-2	*BHAKTIKAL KI PRASANGIKTA*	*UDDESHYA*	*MATHLI SHARAN GUPT- NAR HO NA NIRASH KARO MAN KO*	*VIGYAPAN KE PRAKAR*	*RAYOJAN*
S-4	SLO-1	*DOHE- KABIRDAS*	*DOHE- BIHARI*	*KAVI PARICHAYA*	*VIGYAPAN KI VISHESHTAYEN*	*RAYOG*
	SLO-2	*SANT PARICHAY*	*KAVI PARICHAYA*	*KAVITA KA VISLESHAN*	*VIGYAPAN MANG*	*AHATVA*
S-5	SLO-1	*DOHE KA VISLESHAN*	*DOHE KA VISLESHAN*	*ASHAVADI DRISHTIKON*	*VIGYAPAN KA PRABHAV*	*ATRALEKHAN KALA*
	SLO-2	*GURU KA MAHATVA*	*KANAK KA MAHATVA*	*SANGHARSH KI AOR PRERNA*	*VIGYAPAN MAHATVA*	*RAKAR*
S-6	SLO-1	*GURUTVA SE ISHVARATVA KI AOR*	*VIPRIT SWABHAV KI CHARCHA*	*SURYAKANT TRIPATHI NIRALA- VAR DE*	*VIGYAPAN KI BHASHA*	*VYAKTIGAT PATRA*
	SLO-2	*GURUTVA SE ISHVARATVA KI AOR*	*PRAKRITI KA ATAL RUP*	*KAVI PARICHAYA*	*VIGYAPAN AUR BAZAR*	*AUPCHARIK PATRA*
S-7	SLO-1	*BAHYA ADAMBAR KA VIRODH*	*YAMAK ALANKAR KA PRAYOG*	*KAVITA KA VISLESHAN*	*VIGYAPAN AUR ROZGAR*	*SARKARI PATRA*
	SLO-2	*MURTI POOJA KA VIRODH*	*SNEH KE MAHATVA KI CHARCHA*	*SARSHWATI KE PATRI SAMARPAN*	*PRINT VIGYAPAN*	*ARDHA SARKARI PATRA*
S-8	SLO-1	*GHARELU VASHTUON KI UPYOGITA*	*BIHARI KI KAVYA SHAILI KA MAHATVA*	*BHAKTI KI BHAVANA*	*ELECTRONIC VIGYAPAN*	*PARIBHASHIK SHABDAVALI*
	SLO-2	*AHNKAR KA PARITYAG*	*DOHE- GHANANAND*	*NAGARJUN-- AKAL AUR USKE BAD*	*VIGYAPAN PARIYOJANA*	*AVADHARNA*
S-9	SLO-1	*DOHE- TULSHIDAS*	*KAVI PARICHAYA*	*AKAL KA VASHTAVIK CHITRAN*	*VIGYAPAN AUR SAMAJ*	*SHABDAVALI KI AVSHYAKTA*

	SLO-2	*PAROPKAR KI BHAVANA*	*DOHE KA VISLESHAN*	*AKAL KE PURVA KA CHITRAN*	*VIGYAPAN KI VYAPAKTA*	*KARYALYIN SHABDAVALI*
S-10	SLO-1	*DAYA KA MAHATVA*	*SNEH KI SARLTA KA VARNAN*	*AKAL KE BAD KA CHITRAN*	*VIGYAPANLEKHAN KALA*	*EK DIN EK SHABD*
	SLO-2	*ISHVAR KI MHATTA*	*PREM KA MAHATVA*	*KATTIS-BADRINARAYAN*	*VIGYAPAN AUR JAGRUPTA*	*HINDI SE ANGREJI SHABD*
S-11	SLO-1	*MADHUR VAHAN KI UPYOGITA*	*NAYIKA KE PRATI SMARPAN*	*SAMBAND VICCHED KI PARICHARCHA*	*UDDESHYA*	*ANGREJ SE HINDI SHABD*
	SLO-2	*RAM KI MAHIMA*	*GHANANAND KI KAVYA SHAILI KA MAHATVA*	*SWARTH NIHIT BHAVANA*	*VIGYAPAN KI SPASTTA*	*ABHYASH KARYA*
S-12	SLO-1	*DHOHA PARICHARCHA*	*DHOHA PARICHARCHA*	*KAVYA PARICHARCHA*	*VIGYAPANPARICHARCHA*	*PARICHARCHA*
	SLO-2	*PRASHNAABHYASH*	*PRASHNAABHYASH*	*PRASHNAABHYASH*	*PRASHNAABHYASH*	*PRASHNAABHYASH*

Learning Resources	***Edited Book: ""SAMANYA HINDI", SRIJONLOK PUBLICATION, 2023, New Delhi.*** 1. KABIR – HAZARI PRASAD DWEDI 2. SURDAS – RAM CHANDRA SHUKL 3. BHAKTI ANDOLAN AUR SURDAS KA KAVYA – MANAGER PANDEY 4. BIHARI – VISHVNATH PRASAD MISHR 5. Aadhunik Vigyapan aur Jansampark – Taresh Bhatia

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Shri. Santosh Kumar Editor : Srijanlok Magazine Place: Vashishth Nagar, Ara – 802301	*1. Prof.(Dr.) S.Narayan Raju, Head, Department of Hindi,CUTN, Tamilnadu*	*1. Dr.S Preeti. Associate Professor & Head, SRMIST*
		2. Dr. Md.S. Islam Assistant Professor, SRMIST
		3.Dr. S. Razia Begum, Assistant Professor, SRM IST
		4, Dr.Nisha Murlidharan Assistant Professor, VDP,SRM IST

Course Code	ULF23G02J	Course Name	French-II	Course Category	G	Generic Elective Course	L	T	P	O	C
							2	0	2	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

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

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*To acquire knowledge about French language*	2	75	80	H	M	H	H	M	H	H	L	M	M	H	L	-	-	-
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	2	80	90	M	H	L	H	H	M	H	M	L	L	H	M	-	-	-
CLO-3 :	*To develop content using the features in French language*	2	75	80	H	H	L	M	H	M	L	H	M	M	H	H	-	-	-
CLO-4 :	*To interpret the French language into other language*	2	75	90	H	L	M	H	M	H	H	M	L	H	M	L	-	-	-
CLO-5 :	*To improve the communication, intercultural elements in French language*	2	80	75	M	H	H	L	M	M	H	H	M	L	H	M	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	**Temps libre**	Le pronom indéfini *on*	**Vendre**	Il faut	Les gallicismes
	SLO-2	Les activités quotidiennes	Les activités	Les exemples	C'est / Il est	Les activités
S-2	SLO-1	Les exemples	Les adjectifs interrogatifs	**Acheter**	Le verbe devoir	Les pronoms personnels COI
	SLO-2	Les activités	Les activités	Les exemples	Les activités	Les exemples
S-3	SLO-1	Les moments de la journée	Les prépositions avec les noms géographiques	Les aliments	Le verbe pouvoir	Le pronom *y*
	SLO-2	Les exemples	Les activités	Les exemples	Le verbe savoir	Les exemples
S-4	SLO-1	Les matières scolaires	Les verbes prendre et sortir	Les emballages	Le verbe vouloir	Des pronoms compléments
	SLO-2	Les exemples	Les activités	Les exemples	Les sons	Les activités
S-5	SLO-1	Les activités	Les sons	Les quantités	Demander et dire le prix	Les nombres ordinaux
	SLO-2	Les loisirs	Les activités	Les exemples	Les activités	Les exemples
S-6	SLO-1	Les exemples	Parler de ses gouts	Les commerces	Faire des achats	Les verbes écrire et voir
	SLO-2	Les activités	Les activités	Les activités	Expliquer une recette de cuisine	Les activités
S-7	SLO-1	La fréquence	Parler de ses préférences	les commerçants	Les activités	Le E caduc ou instable
	SLO-2	Les exemples	Les activités	Les exemples	Les courses	Les exemples
S-8	SLO-1	Les activités	Parler de sa routine	L'impératif	Les activités	Présenter ses vœux
	SLO-2	Les verbes pronominaux	Les activités	Les activités	Vendre et acheter	Présenter ses souhaits
S-9	SLO-1	Les exemples	A la recherche d'un cadeau –.	Les articles partitifs	Mots et expressions	Présenter ses félicitations
	SLO-2	Les activités	Les activités	Les exemples	Grammaire	inviter à une invitation
S-10	SLO-1	Les pronoms personnels COD	Temps libre	*Très* ou *beaucoup* (de)	Communication	répondre à une invitation
	SLO-2	Les exemples	Les activités	Les exemples	**Tout le monde s'amuse**	Les exemples
S-11	SLO-1	Les activités	Mots et expressions	Le pronom en (la quantité)	Les sorties	Écrire un message amical
	SLO-2	Les adjectifs démonstratifs	Les activités	Les exemples	Les saisons	Les exemples
S-12	SLO-1	Les exemples	Grammaire –Communication	La phrase négative (2	Les fêtes	Parler au téléphone

	SLO-2	Les activités	Les activités	Les exemples	Les messages	Un coup de fil

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

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
1. Mr. Kavaskar Danasegarane Process Expert Maersk Global Service Center Pvt. Ltd	*1. Dr. C.Thirumurugan Professor, Department of French, Pondicherry University*	*1. Mr. Kumaravel K. Assistant Professor & Head, SRMIST, KTR*
2.Mr. Sharath Raam Prasad Character Designer, Animaker Company Pvt.		*2. Mrs. Abigail, Assistant Professor, SRMIST, VDP*

Course Code	UES23AE1T	Course Name	Environmental Studies	Course Category	AE	Ability Enhancement Courses	L	T	P	O	C
							3	0	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
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*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Applying knowledge on Renewable and Non-renewable resources*	*2*	*80*	*65*	*L*	*H*	*L*	*M*	*L*	*H*	*L*	*L*	*L*	*H*	*L*	*M*	*-*	*-*	*M*
CLO-2 :	*Understanding about ecosystem and Biodiversity*	*2*	*80*	*70*	*M*	*H*	*L*	*M*	*L*	*H*	*L*	*L*	*L*	*H*	*L*	*M*	*-*	*-*	*M*
CLO-3 :	*Gathering knowledge on impact of environmental pollution*	*2*	*80*	*70*	*L*	*H*	*L*	*M*	*L*	*H*	*M*	*M*	*M*	*H*	*L*	*M*	*-*	*-*	*M*
CLO-4 :	*Understanding of different environmental problems*	*2*	*80*	*70*	*M*	*H*	*L*	*M*	*L*	*H*	*M*	*M*	*M*	*H*	*L*	*M*	*-*	*-*	*M*
CLO-5 :	*Having knowledge on various Environment Protection acts and the impact of human population on*	*2*	*80*	*65*	*M*	*H*	*L*	*M*	*L*	*H*	*L*	*M*	*L*	*H*	*L*	*M*	*-*	*-*	*M*

Duration (hour)		9	9	9	9	9
S-1	**SLO-1**	*Multidisciplinary nature of environmental studies*	*Energy flow in the ecosystem*	*Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity*	*Disaster management- Nature Floods, Earthquakes*	*Environment Protection Act*
	SLO-2	*Definition, Scope and Importance of Environmental Studies*	*Energy flow in the ecosystem*	*Environmental Pollution- Definition*		*Air (Prevention and Control of Pollution) Act*
S-2	**SLO-1**	*Need for public awareness.*	*Ecological succession*	*Causes, Effects and Control Measures of Air Pollution*	*Cyclones Landslides*	*Water (Prevention and control of Pollution) Act*
	SLO-2	*Institutions in Environment*	*Food chains, Food webs and Ecological pyramids*			*Wildlife Protection Act*
S-3	**SLO-1**	*People in Environment*	*Ecosystem, Introduction, Types, Characteristic features, Structure and functions*	*Causes, Effects and Control Measures of Water Pollution*	*Social Issues and the Environment: From Unsustainable to Sustainable Development*	*Forest Conservation Act*
	SLO-2	*Introduction to natural resources- Associated Problems*	*Forest ecosystem*			*Issues involved in enforcement of environmental legislation*
S-4	**SLO-1**	*Renewable and Nonrenewable resources*	*Grassland ecosystem*	*Causes, Effects and Control Measures of Soil Pollution*	*Urban problems related to energy*	*Public awareness*
	SLO-2	*Forest resources*	*Desert ecosystem*		*Water Conservation*	

S-5	**SLO-1**	*Water Resources*	*Aquatic ecosystems (ponds, lakes, streams)*	*Causes, Effects and Control Measures of Marine pollution*	*Rain Water Harvesting, Watershed*	*Human Population and the Environment: Population growth, variation among nations*
	SLO-2	*Mineral Resources*	*Aquatic ecosystems (rivers, estuaries, oceans)*			
S-6	**SLO-1**	*Food Resources*	*Biodiversity and its conservation- genetic, species and ecosystem diversity*	*Causes, Effects and Control Measures of Noise Pollution*	*Environmental Ethics: Issues and Possible Solutions*	*Population explosion – Family Welfare Programme*
	SLO-2	*Energy Resources*	*Biogeographical classification of India*			*Environment and human health*
S-7	**SLO-1**	*Land Resources*	*Value of Biodiversity*	*Causes, Effects and Control Measures of Thermal Pollution*	*Climate change & Global warming*	*Human Rights*
	SLO-2	*Role of an individual in conservation of natural resources*	*Biodiversity at Global, National and Local Levels*			*Value Education*
S-8	**SLO-1**	*Equitable use of resoureces for sustainable lifestyles*	*India as a Mega Diversity Nation*	*Causes, Effects and Control Measures of Nuclear hazards*	*Acid rain & Ozone layer depletion*	*HIV/AIDS*
	SLO-2	*Concept of an ecosystem*	*Hot-spots of biodiversity*			
S-9	**SLO-1**	*Structure and Functions of an ecosystem*	*Threats to biodiversity: habitat loss, poaching of wildlife man-wildlife conflicts*	*Solid Waste Management Causes, Effects and Control Measures of Urban and Industrial Waste*	*Nuclear Accidents and Nuclear Holocaust*	*Women and Child Welfare*
	SLO-2	*Producers, consumers and decomposers*	*Endangered and endemic species of India*	*Role of Individuals In Pollution Prevention*	*Wasteland Reclamation*	*Role of Information Technology in Environment and human health*

Learning Resources	**Theory:** 1. Bharucha Erach, Textbook of Environmental Studies for Undergraduate Courses (Second edition). Telangana, India: Orient BlackSwan 2013. 2. Basu Mahua, Savarimuthu Xavier, SJ Fundamentals of Environmental Studies. Cambridge, United Kingdom: Cambridge University Press 2017. 3. R.Jeyalakshmi ,Text book of Environmental Studies, Devi publications, Chennai 2014. 4. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380013, India, 2002.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Academic	Internal Experts
Dr.Arumugam Perumal, Director ARMATS BIOTEK Training and Research Institute, Chennai	Dr.N.Banu, Assistant Professor Bharathi Womens College (Autonomous), Chennai	*1. Dr. P. Parthipan, Assistant Professor, Department of Biotechnology, FSH, SRMIST*
		2.Dr. D. Sankari, Professor and Head, Department of Biotechnology, FSH, SRMIST

Course Code	UCY23201J	Course Name	Chemistry of s and p-Block Elements	Course Category	C	Discipline Specific Core course	L	T	P	O	C
							3	0	3	2	4

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Exploit the general principals of s-block elements in Metallurgy
CLR-2 :	Utilize the general properties of s-block elements in Industry
CLR-3 :	Get knowledge on metals and non-metals to prepare different alloys
CLR-4 :	Address the physical and chemical properties of p-block elements
CLR-5 :	Utilize the basic nuclear chemistry principles for modern science advancement

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Level of Thinking (Bloom)	Program Learning Outcomes (PLO) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Exploit the general principles of metallurgy	4	H	-	H	-	M	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Perceive the importance of periodicity of the s-block elements	4	H	-	-	H		L	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the chemical properties of alkali and alkaline earth metals	4	-	-	-	H	M	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Gaining the knowledge about hydrides, oxides and oxoacids of p-block elements	4	H	M	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Design and develop industrially valuable p-block element compounds	4	-	H	H	-	-	-	-	-	-	-	-	-	-	H-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	General Principles of Metallurgy	Relationship between lattice energy, hydration energy and solubility	*Thermal stability of salts of alkali earth metals*	*hydrides of Group 13*	*halides of silicon*
	SLO-2	General Principles of Metallurgy	Trend of thermal stability of hydrides of alkali metal compounds	*Solubility of salts of alkali earth metal compounds*	*hydrides of Group 14*	*halides of phosphorus*
S-2	SLO-1	Chief modes of occurrence of metals based on standard electrode potentials.	Trend of thermal stability of oxides, peroxides of alkali metal compounds	Important alkaline earth metal compounds	*hydrides of Group 15 (EH_3 where E = N, P)*	Preparation of Borazine
	SLO-2	Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent	Trend of thermal stability of carbonates, nitrates, sulphates of alkali metal compounds	*Structure and uses of beryllium nitrate*	*hydrides of Group 15 (EH_3 where E = As, Sb)*	*structure of Borazine*
S-3	SLO-1	*Electrolytic Reduction*	Trend of thermal stability of hydroxides and halides of alkali metal compounds	*EDTA complexes of Ca and Mg*	*hydrides of Group 15 (EH_3 where E = Bi)*	*uses of Borazine*
	SLO-2	*Hydrometallurgy with reference to cyanide process for silver and gold.*	Trend of thermal stability of hydroxides and halides of alkali metal compounds	*Determination of hardness*	*hydrides of Group 15 (EH_3 where E = Bi)*	*Preparation and structure of Silicates*
S-4 to S-6	SLO-1	Lab Introduction	Acid-Base Titrations: Principles Estimation of sodium carbonate using standardized HCl	Estimation of carbonate and bicarbonate present together in a mixture	Oxidation-Reduction Titrimetry : Estimation of oxalic acid using standardized $KMnO_4$	Estimation of Fe(II) with $K_2Cr_2O_7$ using internal indicator (diphenylamine, N-phenylanthranilic acid)
	SLO-2	Lab Introduction				

Duration (hour)		18	18	18	18	18
S-7	SLO-1	*Methods of purification of metals*	anomalous behaviour of Li,	*Chemistry of p Block Elements: Electronic configuration, atomic and ionic size*	*hydrides of Group 16*	*Preparation and properties of silicones*
	SLO-2	*Electrolytic process*	diagonal relationship of Li with Mg	*metallic/non-metalliccharacter, melting point*	*hydrides of Group 16*	*structure and uses of silicones*
S-8	SLO-1	*van Arkel-de Boer process*	Structure and Importance of alkali metal compounds	*ionization enthalpy*	*hydrides of Group 17*	*Preparation of Phosphonitrilic halides {$(PNCl_2)_n$ where n = 3 and 4}*
	SLO-2	*Zone refining*	Coordination complexes of Li	*electron gain enthalpy*	*hydrides of Group 17*	*properties of Phosphonitrilic halides {$(PNCl_2)_n$ where n = 3 and 4}*
S-9	SLO-1	*Chemistry of s-Block Elements: General characteristics*	Crown ethers,	*electronegativity*	*oxides of phosphorus*	*Structure of Phosphonitrilic halides {$(PNCl_2)_n$ where n = 3 and 4}*
	SLO-2	*melting point and flame colour*	cryptates	*Catenation*	*oxides of phosphorus*	*Uses of Phosphonitrilic halides {$(PNCl_2)_n$ where n = 3 and 4}*
S-10 to S-12	SLO-1	Titrimetric Analysis: Calibration and use of apparatus	Estimation of carbonate and hydroxide present together in a mixture	Estimation of free alkali present in different soaps/detergents	Estimation of oxalic acid and sodium oxalate in a given mixture.	Estimation of Fe(II) with $K_2Cr_2O_7$ using external indicator .
	SLO-2					
S-13	SLO-1	Trend of atomic size, ionization energy, density	*Properties of alkali metals in liquid ammonia*	*Allotropy of C, P and S*	*oxides of sulphur*	*Preparation and properties of Interhalogen compounds*
	SLO-2	reducing power, melting and boiling points	biological importance of alkali metals	*inert pair effect*	*oxides of sulphur*	*Preparation and properties of pseudohalogen compounds*
S-14	SLO-1	*Reactions of alkali metals with oxygen and hydrogen, and nitrogen*	periodic properties of alkaline earth metals, Chemical properties	*Diagonal relationship between B and Si and anomalous behaviour of first member of each group.*	*oxides of chlorine*	*structure and uses of pseudohalogen compounds*
	SLO-2	*Reactions of alkali metals with water and liq ammonia*	periodic properties of alkaline earth metals, Chemical properties	*Structure, bonding and properties: acidic/basic nature, stability*	*oxides of chlorine*	*Preparation and properties of Clathrate compounds of noble gases*
S-15	SLO-1	*Reactions of alkali earth metals with water*	Chemical properties of alkaline earth metals,	*ionic/covalent nature, oxidation/reduction,*	*peroxoacids of sulphur*	*structure and uses of Clathrate compounds of noble gases*
	SLO-2	*Common features such as ease of formation of alkali metal compounds*	Chemical properties alkaline earth metals,	*hydrolysis, action of heat of Hydrides*	*peroxoacids of sulphur*	*Preparation and properties of xenon fluorides. Structure and uses of xenon fluorides, MO treatment of XeF_2.*
S-16 to S-18	SLO-1	Preparation of solutions of titrants of different Molarity/Normality. .	Estimation of amount of chloride content of a water sample	Estimation of Hardness of water using EDTA	Repeat experiments	Repeat of experiments
	SLO-2					

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

	7. S. Prakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I Sultan Chand & Sons Publishers 2008.	

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*Dr. M. Ganesh Pandian, SRM IST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23202T	Course Name	Basic Reactions in Organic Chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Lean how to prepare the reaction intermediate and their stability	
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	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Gain deep understanding about the reaction intermediates and their use	4	-	H	-	-	-	M	H	-	-	-	-	-	-	-	-
CLO-2 :	Learn how to use addition reaction in organic transformation	4	-	H	-	-	L	-	H	-	-	-	-	-	-	-	-
CLO-3 :	Know how to prepare unsaturated compounds	4	-	-	H	-	H	M	-	-	-	-	-	-	-	-	-
CLO-4 :	Gain understanding in converting functional group in aliphatic compounds	4	H	M	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Gain understanding in converting functional group in aromatic compounds	4	-	H	-	-	H	-	-	-	M	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduce reactive intermediates	Introduce Addition reaction	Elimination reactions and their types,	Introduce S_N2 mechanism	Mechanism of nitration,
	SLO-2	Importance of these, how affecting the rate of a reaction	Electrophilic addition to alkenes and alkynes, compare the reactivity of alkenes and alkynes	Different types of -elimination	Explain stereochemical outcomes	reagents for nitration,
S-2	SLO-1	Carbocation (classical and nonclassical), structure	dihalogens and stereoselectivity	E_1, and E_2 mechanisms	Proof of mechanism	Effect of external functional groups in product distribution
	SLO-2	Synthesis and stability	Reaction with haloacids and stereoselectivity, regeoselectivity	E_{1CB} mechanism and their comparative study	Compared oxo-and halo-nucleophiles	Sulphonation, reagents
S-3	SLO-1	Carbanion, structure	Hydration to alkene and alkynes	Stereoelectronic criteria of E_1, E_2 and E_{1CB} elimination, use examples of acyclic and cyclic halocompounds	Nucleophilicity of chalcogens	Mechanism, KCP and TCP
	SLO-2	Synthesis, stability	Oxymercuration and demercuration and their use	Explain the steric effects in product distribution using projection formula	Nucleophilicity of amines, ambient nucleophiles	Synthetic utility of sulphonic acid group
S-4	SLO-1	Tutorial: Discuss examples on reaction intermediates and their stabilities	Tutorial: Problem solving on addition reaction	Tutorial: Problem solving on elimination reaction	Tutorial: Problem solving on nucleophilic substitution reaction	Tutorial: Discuss examples to prepare substituted aromatic compounds
	SLO-2					
S-5	SLO-1	Carbene, structure	Addition of hydroborane, stereoselectivity	Explain Hoffmann and Saytzeff products	Effect of substrates, solvent, leaving groups in mechanisms	Aromatic nucleophilic substitution reaction

Duration (hour)		12	12	12	12	12
	SLO-2	Synthesis, stability, Evidence for singlet and triplet carbenes	regeoselectivity and hydrolysis	substitution vs elimination (substrate, nucleophile/base, solvents)	Transforming a bad leaving group into good leaving group	Activation of substrates, reactivity of haloarenes
S-6	SLO-1	Nitrene, structure	Addition to alkynes, synthetic utility	Pyrolytic elimination	Nucleophilic catalysts	Types: carbanion intermediate
	SLO-2	Stability and reactions	Scope of hydroboration reaction (functional group interconversion)	Stereoselctivity of products,	Phase Transfer Catalyst	Types: benzyne mechanism
S-7	SLO-1	Benzyne: structure, synthesis, stability (orbital pictures)	Ozonolysis of alkenes and alkynes	Chugaev Reaction	Introduce S_Ni mechanism	Types: diazonium salt,
	SLO-2	trapping of benzynes, Reactions using benzynes	Addition of radicals	Cope elimination	NGP	Orientation effect
S-8	SLO-1	Tutorial: Discuss examples on reaction intermediates and their stabilities	Tutorial: Problem solving on addition reaction	Tutorial: Problem solving on elimination reaction	Tutorial: Problem solving on nucleophilic substitution reaction	Tutorial: Discuss examples to prepare substituted aromatic compounds
	SLO-2					
S-9	SLO-1	Radicals, synthesis, structure	Hydrogenation reaction	Introduce Nucleophilic Substitution reactions	Aromatic electrophilic substitution reaction, reactivity of substituted arenes	Grignard Reagents, synthesis, structure
	SLO-2	Reactions	Willkinson's catalyst, Lindlar's catalyst	Nucleophiles, electrophilic centers,leaving groups, types of substitution in aliphatic compounds	□-, □-complex	Mechanism, reactivity of aliphatic and aromatic halides, halides
S-10	SLO-1	Redox reaction	Birch reduction of alkenes and alkynes	Introduce S_N1 mechanism	Friedel-Craft alkylation and acylation	Reactions with ketone, epoxide, ester
	SLO-2	Determination of Oxidation states	Benzylic halogenation	Explain stereochemical outcomes	Merits and demerits, Orientation effect,	1,2- vs 1,4 addition, dialkyl cuprate reagent
S-11	SLO-1	Oxidation of alcohols, alkenes	Addition to allenes and conjugated alkenes	Effect of substrates, nucleophiles, Ritter reaction	Halogenation reaction	Organolithium compounds, synthesis and use
	SLO-2	Reduction of ketones, alkenes	Nucleophilic adition to conjugated alkenes	Effect of solvent, leaving groups, Salt effect	Different reagents, Reactivity of halogens as electrophiles	Organozinc compounds, synthesis and use
S-12	SLO-1	Tutorial: Problem discussion on Redox reaction	Tutorial: Problem solving on addition reaction	Tutorial: Problem solving on elimination reaction	Tutorial: Problem solving on electrophilic substitution reaction	Tutorial: Use of organometallic compounds, Green organic synthesis
	SLO-2					

Learning Resources	**Theory:**

1. M. B. Smith and J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc 2006.
2. J. Clayden, N. Greeves, and S. Warren, Organic Chemistry 2nd Ed., Oxford University Press 2012.
3. J. McMurry, Organic Chemistry 5th Ed., Thomson business information 2007.
4. T. W. G. Solomons and C. B. Fryhle, Organic Chemistry 10th Ed., John Wiley and Sons, Inc 2011.
5. I. L. Finar and A. L. Finar, Organic Chemistry Vol. 2, Addison-Wesley 1988.
6. D. N. Nasipuri, Stereochemistry of Organic Compounds: Principles & Applications South Asia Books 2012.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	20%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-
	Create										

	Total	100 %	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr.Susnata Pramanik, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23203T	Course Name	Chemical Equilibria, Acids and Bases	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Understand and manipulate the progress of a reaction
CLR-2 :	Understand the acidity or basicity of various compounds
CLR-3 :	Understand the pH of solutions of weak acids and bases
CLR-4 :	Understand buffer and its design
CLR-5 :	Gain knowledge of solubility product

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Level of Thinking (Bloom)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Select and alter the parameters to drive the reaction forward or backward	4	H	H	-	-	-	M	-	-	-	-	-	-	-	-	-
CLO-2 :	Asses the acidity or basicity of various chemical compounds	4	H	-	-	-	-	-	L	-	-	-	-	H	-	-	-
CLO-3 :	Calculate the pH of mono and polyprotic acids	4	-	-	H	-	M	-	-	-	-	-	H	-	-	-	-
CLO-4 :	Make buffers of desired capacity and components	4	H	L	-	-	-	H	-	-	-	-	-	-	-	-	-
CLO-5 :	Manipulate the solubility of sparingly soluble salts	4	-	H	-	-	H	-	-	-	-	M	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Reactions at equilibrium:	The nature of acids and bases	Solutions of weak bases	Aqueous equilibria	Stoichiometry of Polyprotic Acid Titrations
	SLO-2	The reversibility of reactions	Brønsted–Lowry Acids and Bases	Examples discussion	Mixed solutions	Identifying the number of pKa values of polyprotic acids
S-2	SLO-1	Equilibrium	Lewis Acids	How to calculate pH of a solution of a weak base	Buffers	Solubility Equilibria
	SLO-2	the Laws of mass action	Lewis Bases	Steps involved in the calculation	Buffer action	The Solubility product
S-3	SLO-1	The thermodynamic origin of equilibrium constants	Acidic, Basic, Amphoteric Oxides	pH of salt solutions	Designing a buffer	Determining the solubility product
	SLO-2	Relation between equilibrium constant and free energy	Proton exchange between water molecules	Acidic character and K_a values of common cations in water; Acidic and basic character of common anions in water	Key points in buffer design	Writing the solubility product for various compounds
S-4	SLO-1	Exercises on writing equilibrium constant expression for different reactions	Writing the formulas of conjugate acids and bases	Calculating the pH and percentage protonation of a weak base	Calculating the pH of a buffer solution	Estimating the molar solubility from the solubility product
	SLO-2	Calculating Gibbs free energy of reaction from the reaction quotient	Identify (a) the Brønsted acids and bases in both reactants and products in the proton transfer equilibrium (b) Which species (not necessarily	Calculating the pH of a salt solution with an acidic cation Calculating the pH of a salt solution with a basic anion	Calculating the pH change of a buffered solution	Estimating the effect of a common ion on solubility Predicting whether a precipitate will form when two solutions are mixed

Duration (hour)		12	12	12	12	12
			shown explicitly) are Lewis acids and which are Lewis bases?			
S-5	SLO-1	The extent of the reaction progress	The pH scale	Polyprotic acids and bases:	Selecting the composition of a buffer solution with a given Ph	The common ion effect
	SLO-2	Predicting the direction of the reaction	Calculating pH from a concentration	The pH of a polyprotic acid solution	Correlating the composition and pH	Estimating the effect of a common ion on solubility
S-6	SLO-1	Equilibrium calculations: Equilibrium concentration in terms of the molar concentration of gases	Calculating hydronium ion concentration from pH	Solutions of salts of polyprotic acids	Buffer capacity	Predicting precipitation
	SLO-2	Relation between K and K_c	The pOH of solutions	Different examples of polyprotic acids	Steps to calculate buffer capacity	Examples of precipitates
+S-7	SLO-1	Alternative forms of equilibrium constants	Weak acids and bases	The concentration of solute species	Titrations: Strong acid- Strong base titration	Selective Precipitation
	SLO-2	summarize the relations between equilibrium constants for the same reaction written in different ways	Acidity and basicity constants	Method to calculate the concentrations of all species in a polyprotic acid solution	Strong Acid–Weak Base and	Predicting the order of precipitation
S-8	SLO-1	Calculating equilibrium constant	The conjugate seesaw	Estimating the pH of a solution of amphiprotic salt	Calculating points on the pH curve for a strong acid–strong base titration	Examples of determining the order of precipitation
	SLO-2	(i) Learn how to setup and use an equilibrium table (ii) calculate the equilibrium composition of a reaction mixture	Deciding which of the two species is the stronger acid or base	Calculating the concentrations of all solute species in a polyprotic acid solution	Calculating the pH before the stoichiometric point in a weak acid–strong base titration	Examples of calculating the concentration of the first ion to precipitate that remains in solution when the second ion precipitates
S-9	SLO-1	The response of equilibria to changes in conditions (Le chatelier's principle)	Molecular structure and acid strength	Composition and pH	Estimating the pH at the stoichiometric point of the titration of a weak acid with a strong base	Dissolving Precipitates
	SLO-2	adding and removing reagents	comparison	correlation	Analyzing the graph	Key points to make the precipitates to dissolve
S-10	SLO-1	Calculating the equilibrium composition after the addition of a reagent	The strengths of oxoacids and carboxylic acids	Autoprotolysis and pH	Weak Acid–Strong Base Titrations	Complex Ion Formation
	SLO-2	Compressing a reaction mixture	The strengths of carboxylic acids	Very dilute solutions of Strong acids and bases	Analyzing the graph	Calculating molar solubility in the presence of complex formation
S-11	SLO-1	Temperature and reaction equilibrium	pH solutions of weak acids and bases: Solutions of Weak Acids	Very dilute solutions of weak acids	Acid-Base indicators	Qualitative Analysis
	SLO-2	Predicting the effect of temperature on an equilibrium		Examples discussion	Molecular structures and their mode of action	Examples of various ions

Duration (hour)		12	12	12	12	12
S-12	SLO-1	Predicting the effect of compression on an equilibrium	Calculating the pH and percentage deprotonation of a weak acid	Estimating the pH of a dilute aqueous solution of a weak acid and when the autoprotolysis of water must be considered	Explain what happens to (a) the pH of a solution of phosphoric acid after the addition of solid sodium dihydrogen phosphate; (b) the percentage deprotonation of HCN in a hydrocyanic acid solution after the addition of hydrobromic acid;	Examples of calculating molar solubility in the presence of complex formation
	SLO-2	(i) Predict the value of the equilibrium constant at a different temperature (ii) Catalysts and Haber's Achievement	Calculating the K_a and pK_a of a weak acid from the pH	Calculating the pH of a very dilute aqueous solution of a strong acid	(c) the concentration of H_3O^+ ions when pyridinium chloride is added to an aqueous solution of the base pyridine.	Correlating the different examples solved

Learning Resources

Theory:

1. P.W. Atkins, L.L. Jones, Chemical Principles: The quest for insight. H. Freeman and Company, New York, 2010
2. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, Shobulal Nagin Chand and Co, 2001.
3. P. L. Soni, A Textbook of Inorganic Chemistry, Sultan Chand and Co., 1977.
4. R. Gopalan, Text Book of Inorganic Chemistry, 2nd edition, Hyderabad, Universities Press, (India), 2012.
5. R.T. Morrison and R.N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th edition, Pearson India, 2011.
6. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLal Nagin Chand and Co, 2013.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Expert from Industry	*Experts from Higher Technical Institutions*	*Internal Experts*
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Srinivasa Rao, SRMIST*
	Dr. Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru *Email: kanishka@jncasr.ac.in*	***2.*** *Prof. M. Arthanareeswari, SRMIST*

Course Code	*UCD23S02T*	Course Name	*Verbal Ability and Skill Development*	Course Category	S	*Skill Enhancement Course*	L	T	P	O	C
							2	0	0	2	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**			**Program Learning Outcomes (PLO)**														
CLR-1 :	*Critically evaluate basic mathematical concepts related to mixtures and alligations, Numbers, time and work*	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	*Use their logical thinking and analytical abilities to solve reasoning problems*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behaviour	Life Long Learning
CLR-3 :	*Develop soft skills relating to the need for job recruitment*																		
CLR-4 :	*Provide students with the necessary skills to generate and interpret data sufficiency, problems on Chain Rule, Pipes and Cisterns, Boats and streams,*																		
CLR-5 :	*Enable students to understand problems on graphs and also increase their ability in language skills*																		
CLO-1 :	*Understand the concepts of mixtures and alligations, Numbers, time and work and to approach questions in a simpler and innovative method*	3	80	70	M	H	-	L	-	M	-	M	M	H	-	H	-	-	-
CLO-2 :	*Establish a student's interest and awareness in seating arrangements, mathematical operations, logical reasoning*	3	80	75	M	H	-	L	-	M	-	M	M	H	-	H	-	-	-
CLO-3 :	*Acquire soft skills that will help for applying jobs*	3	85	70	-	-	M	H	M	-	L	-	-	-	H	-	M	M	H
CLO-4 :	*Demonstrate various principles involved in aptitude problems*	3	85	80	-	-	-	-	M	-	L	H	-	H	-	H	-	-	L
CLO-5 :	*Ability to solve problems on reasoning and to interpret English language*	3	85	75	-	H	-	L	-	H	-	M	M	-	H	--	M	-	M

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:

Duration (hour)		**6**	**6**	**6**	**6**	**6**
S-1	**SLO-1**	Time and Distance – Introduction	Seating Arrangements (Circular and table) Introduction	Resume Building - Introduction	Chain Rule, Pipes and Cistern – Introduction	Functions and Graphs Introduction
	SLO-2	Time and Distance – Problems	Seating Arrangements (Circular and table) – Problems	Resume Building	Chain Rule, Pipes and Cistern – Problems	Functions and Graphs – Problems
S-2	**SLO-1**	Time & Work- Introduction	Mathematical Operations – Basic Problems	Group Discussions - Introduction	Data Sufficiency – Introduction	Comprehension
	SLO-2	Time & Work – Problems	Mathematical Operations – Tricky Problems	Group Discussions – Mock GD	Data Sufficiency – Problems	Comprehension – Practise session
S-3	**SLO-1**	Alligation or Mixture – Introduction	Data Arrangements - Introduction	Group Discussions - Activity 1	Logarithms – Introduction	Idioms and Idiomatic Expressions – Introduction
	SLO-2	Alligation or Mixture - Problems	Data Arrangements – Problems	Group Discussions - Activity 1	Logarithms – Problems	Idioms and Idiomatic Expressions – Practise Session
S-4	**SLO-1**	Numbers – Basic Problems	Logical Deductions – Introduction	Group Discussions - Activity 2	Boats and Streams – Basic Problems	Cause and Effect - Introduction
	SLO-2	Numbers – Tricky Problems	Logical Deductions – Problems	Group Discussions - Activity 2	Boats and Streams – Tricky Problems	Cause and Effect – Practise Session
S-5	**SLO-1**	Problems on Trains – Introduction	Letter and Symbol Series – Basic Problems	Leadership Skills Introduction	True Discount – Introduction	Theme detection – Introduction
	SLO-2	Problems on Trains – Problems	Letter and Symbol Series – Tricky Problems	Leadership Skills	True Discount – Problems	Theme detection – Activity
S-6	**SLO-1**	Races and Games – Basic Problems	Input Output Tracing Introduction	How to Handle Criticism and Feedback	Geometry and Mensuration Introduction	Ordering of words _ Introduction
	SLO-2	Races and Games – Tricky Problems	Input Output Tracing – Problems	How to Handle Criticism and Feedback	Geometry and Mensuration –	Ordering of words – Practise Session

					Problems	

Learning Resources	1. James Barrett & Tom Barrett - Ultimate aptitude tests: over 1000 practice questions for abstract visual, numerical, verbal, physical, spatial and systems tests, Kogan Page, London, 2018. Fourth edition 2. Kathy A. Zahler & Over Drive, Inc (Distributor) Conquering GRE verbal reasoning and analytical writing, McGraw-Hill Education, New York, 2020 Second Edition 3. Archana Ram, Place Mentor: Tests of Aptitude for Placement Readiness, Oxford University Press, Oxford, 2018	4. David Bartlett, The art of general practice: soft skills to survive and thrive, Scion, Banbury, 2018, eBook, 2018 5.Zsolt Nagy, Soft skills to advance your developer career: actionable steps to help maximize your potential, A press, Berkeley, CA, 2019, eBook, 2022

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%	20%	30%	30%
	Understand				
Level 2	Apply	30%	50%	30%	30%
	Analyze				
Level 3	Evaluate	40%	30%	40%	40%
	Create				
	Total	**100%**	**100%**	**100%**	**100%**

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

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. M. Ponmurugan, Executive PMOSS, Cognizant Technology Solutions India Pvt. Limited, Chennai	*Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeedam, Coimbatore*	*Dr. Sathish K, HOD, Department of Career Guidance, FSH, SRMIST* *Dr. Muthu Deepa M, Assistant Professor, Department of Career Guidance, FSH, SRMIST*

Course Code	***UEN23V01L***	**Course Name**	**COMMUNICATION SKILLS**	**Course Category**	***AE***	***Value Addition Course***	**L**	**T**	**P**	**O**	**C**
							0	**0**	**4**	**2**	**2**

Pre-requisite Courses	***Nil***	**Co-requisite Courses**	***Nil***	**Progressive Courses**	***Nil***
Course Offering Department	*Department of English, FSH, SRMIST*		**Data Book / Codes/Standards**	***Nil***	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**	**Program Learning Outcomes (PLO)**

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	*Develop fluency in spoken English by practicing and engaging in various speaking activities.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-2 :	*Improve pronunciation and intonation to enhance clarity and effectiveness in oral communication.*																		
CLR-3 :	*Expand vocabulary and idiomatic expressions to communicate more accurately and expressively.*																		
CLR-4 :	*Enhance listening skills to understand and respond appropriately to spoken English in different situations.*																		
CLR-5 :	*Employ effective communication strategies, such as active listening, summarizing, paraphrasing, and asking clarifying questions, to enhance interpersonal and intercultural communication.*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Demonstrate improved fluency in spoken English by expressing ideas and thoughts confidently and coherently.*	*2*	*75*	*60*	*H*	*M*	*M*	*L*	*-*	*M*	*-*	*M*	*H*	*L*	*H*	*L*	*-*	*-*	*-*
CLO-2 :	*Pronounce English words and phrases accurately, using appropriate intonation and stress patterns.*	*2*	*80*	*70*	*M*	*H*	*L*	*-*	*-*	*-*	*-*	*M*	*M*	*H*	*H*	*M*	*-*	*-*	*-*
CLO-3 :	*Expand and effectively use a range of vocabulary and idiomatic expressions to enhance communication.*	*2*	*70*	*65*	*M*	*M*	*M*	*-*	*L*	*L*	*-*	*H*	*M*	*H*	*H*	*L*	*-*	*-*	*-*
CLO-4 :	*Understand and comprehend spoken English in various contexts, including informal conversations, lectures, and presentations.*	*2*	*70*	*70*	*H*	*M*	*L*	*-*	*M*	*H*	*-*	*-*	*-*	*-*	*H*	*L*	*-*	*-*	*-*
CLO-5 :	*Deliver well-structured and engaging oral presentations, incorporating effective body language and visual aids.*	*2*	*80*	*70*	*H*	*H*	*-*	*M*	*-*	*M*	*-*	*L*	*L*	*M*	*H*	*M*	*-*	*-*	*-*

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	*Introduction to Listening Skills.*	*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.*
	SLO- 2	*Exploring Effective Ways of Listening. Barriers of Listening. Active and Passive Listening.*	*Identifying common reading problems in students after making them read a few passages.*	*Explaining the usage of the Oxford Learner's Dictionary to learn phonetics of the words at the fundamental level.*	*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.*
S-2	**SLO-1**	*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.*

	SLO- 2	*Equipping the listening skill of the learners*	*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.*
S-3 – S-4	**SLO-1**	*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- 2	*Task to write down the words from the audio they have listened to. This activity should be done in two steps. 1. Jotting down the words simultaneously as they listen to the speaker. 2. Writing the transcript of the audio through repetitive play and pause.*	*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* *Understanding characters by analyzing the usage of their style of language*
S-5	**SLO-1**	*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.*
	SLO- 2	*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.*
S-6	**SLO-1**	*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*
	SLO- 2	*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.*

S-7 – S-8	**SLO-1**	*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- 2	*The recognition of different accents should be practiced by speaking after listening.*	*scanning and skimming activities*	*Idioms and phrases*	*Practicing effective writing by learning to avoid common errors in tenses, direct and indirect speech and syntax structure.*	*Mathrubootham's love for food and the miscommunication about food.*
S-9	**SLO-1**	*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.*
	SLO- 2	*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*
S-10	**SLO-1**	*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.*
	SLO- 2	*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.*
S 11 - S 12	**SLO-1**	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- 2	*Group activities and games can be conducted to test the listening skills by responding to*	*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 speech given by other students				*the books they have read.*

Learning Resources	1. Horizon- English Text Book – Compiled and Edited by the faculty of English Departement, FSH, SRMIST, 2020 2. English Grammar in Use by Raymond Murphy Cambridge University Press 2012. 3. *Raymond Murphy, Intermediate English Grammar, Cambridge University Press, 2007* 4. *R.P. Bhatnagar, English for Competitive Examinations, Trinity Press, 3rd Edition,2016* 5. *http://www.aptitudetests.org/verbal-reasoning-test* *https://www.assessmentday.co.uk/aptitudetests_verbal.htm*

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%) #**
		Practice	Practice	Practice	Practice
Level 1	Remember Understand	10%	10%	30%	15%
Level 2	Apply Analyze	50%	50%	40%	50%
Level 3	Evaluate Create	40%	40%	30%	35%
	Total	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Short Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
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Course Code	*UNS23M01L* *UNC23M01L* *UNO23M01L* *UYG23M01L*	Course Name	***NSS/NCC/NSO/YOGA***	Course Category	M	Extension Activity Course	L	T	P	C
							0	0	0	0

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

Assessment is Fully Internal

Learning Assessment	
Assessment Tools	**Marks**
Continuous Learning Assessment –I (CLA-I)	20 Marks
Continuous Learning Assessment –II (CLA-II)	30 Marks
Continuous Learning Assessment –III (CLA-III)	30 Marks
Continuous Learning Assessment –IV (CLA-IV)	20 Marks
Total Marks	100 Marks

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Semester – III

Course Code	UCY23301T	Course Name	Radioactive and Nuclear chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
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 nuclear processes including fission, fusion and decay reactions	
CLR-5 :	Employ the binding energy and mass defect for a given nucleus.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the basics of Radioactive chemistry applications: nuclear power and carbon dating.	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Realize the concept of rate of change and half- life in the context of nuclear decay.	4	-	H	-	-	H	L	-	-	-	-	-	-	-	-	-
CLO-3 :	Use proper isotopic notation to write down and balance a nuclear reaction.	4	M	-	-	-	M	-	-	-	-	-	-	-	-	H	-
CLO-4 :	Identify and define various types of nuclear changes or processes including fission, fusion and decay reactions	4	H	-	-	H	-	-	L	-	-	-	-	-	-	-	-
CLO-5 :	Define binding energy and mass defect and be able to calculate each for a given nucleus.	4	-	H	-	-	-	-	H	-	-	L	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Radioactivity: introduction. Types and Units of Radioactivity	Transmutation or disintegration of elements. Discovery of artificial transmutation	Isotope effects	Relation between nucleus stability and its packing fraction value	Nuclear fusion: Discovery and Examples
	SLO-2	Detection and measurement of Radioactivity:	Important particles: alpha, beta, deuteron, triton, Neutrino, neutron, proton and positron	Study of individual isotopes: ordinary and heavy hydrogen	Variation of packing fraction with mas number and relation between the packing fraction and nuclear stability	Conditions necessary for nuclear fusion
S-2	SLO-1	Electroscope method Wilson's cloud chamber method	artificial transmutation reactions induced by alpha, proton, gamma,	Preparation of deuterium	Mass Defect: Binding energy of a nucleus and its calculation	Energy released in nuclear fusion reactions
	SLO-2	Geiger-Muller counter method	deuterons, neutron and triton	Chemical properties and uses of deuterium	Variation of nuclear binding energy with mas number and its relation with nuclear stability	Amount of energy released in the form of one $^{4}_{2}He$ nucleus by the fusion of four $^{1}_{1}H$ nuclei
S-3	SLO-1	Types of Radioactive rays	Applications of artificial transmutation reactions:	Preparation of Tritium	Binding energy per nucleon:	Origin of the energy of the sun and stars
	SLO-2	Nature, mass, charge and representation of alpha, beta and gamma rays	Discovery of new fundamental particles and their uses	Chemical properties and uses of Tritium.	Variation of binding energy per nucleon with mass number and its relation with nuclear stability	Solar energy

Duration (hour)		12	12	12	12	12
S-4	SLO-1	Tutorial: Examples showing natural Radioactivity	Tutorial: construct the equations	Tutorial: construct the equations related to deuterium	Tutorial: Calculation of Mass Defect	Tutorial: Nuclear fusion reactions
	SLO-2					
S-5	SLO-1	Comparison between a beta particle and electron	Preparations of isotopes of various elements	Uses of radioactive isotopes as tracers: Medical, industry, agriculture, biological field and analytical chemistry	Nuclear shell model: Magic numbers. Nuclear reactions: Introduction	Proton-proton cycle
	SLO-2	Soddy-Fajans and Russel group displacement law	Release of atomic energy in nuclear fission and fusion reactions	Radio-carbon dating and roc-dating method	Difference between chemical and nuclear reaction	Carbon-nitrogen cycle
S-6	SLO-1	Emission of an alpha, Beta and positron particles	Natural radioactive series: 4n, 4n+2, 4n+3 series	Isotones-definition and composition	Classifications of nuclear reaction	Hydrogen bomb
	SLO-2	Addition of an electron: Electron capture process	artificial radioactive series: 4n+1 series	Isobars: characteristics Production of isobars. Isobaric isotopes	Bohr's theory of nuclear reactions. Q-value of a nuclear reaction	Comparison between hydrogen bomb and atomic bomb
S-7	SLO-1	Half-life of a radioactive substance	Isotopes: Representation and Characteristics	Nucleus: Discovery and properties	Nuclear fission: discovery	Detectors: scintillation counter and gas ionisation chamber
	SLO-2	Amount of a radioactive substance left undisintegrated or disintegrated in n half-life	Discovery and types of isotopes	Atomic number, Mass number, atomic weight and fractional atomic mass	Bohr yield curve and Amount of energy released	proportional counter and Cerenkov counter
S-8	SLO-1	Tutorial: Calculation of number of alpha and beta particles emitted	Tutorial: U-Pb Series	Tutorial: Calculation of age of wood	Tutorial: Calculation of binding energy	Tutorial:: Different Detectors
	SLO-2					
S-9	SLO-1	Disintegration constant	Separation of isotopes: gaseous and Thermal diffusion method	Calculation of atomic mass of an element having isotopes of different mass numbers	Liquid drop model	Accelerators, cyclotron
	SLO-2	Relation between half-life period and disintegration constant	Fractional evaporation, distillation process Gravity and electromagnetic method	Atomic forces operate inside the nucleus of an atom	Types of fission reactions Chain reaction	Synchrocyclotron, betatron
S-10	SLO-1	Relation between t and $t_{0.5}$ Average life period. Relation between t_{av} and $t_{0.5}$	Identification of isotopes: Aston's mass spectrograph	Meson exchange theory of the origin of nuclear forces	Atom bomb: Principle and explosion	applications of radioactivity
	SLO-2	Radioactive equilibrium: Law of successive disintegration	Dempster's mass spectrograph	Nuclear stability. Factor affecting the nuclear stability	Components of Nuclear reactor: Moderators, controlling rods, fuel element, heat transfer agent, and protective chamber	activation analysis
S-11	SLO-1	Comparison between radioactive and chemical equilibrium	Production of an isotope by the emission of one alpha and two beta particles	Even and odd number of proton and neutron	Uses of Nuclear reactor	isotopic dilution technique
	SLO-2	Activity of a radioactive substance	Isotopes of hydrogen: structure and properties	Neutron to proton ratio and Packing fraction	Nuclear power plant: Constitution and working	Radiometric titration.
S-12	SLO-1	Tutorial: Calculation of N	Tutorial: Calculation of atomic weight	Tutorial: Calculate percentage of isotopes	Tutorial: Nuclear fission reactions	Tutorial: activation analysis
	SLO-2					

Learning Resources	1. S. Prakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I Sultan Chand & Sons Publishers. 2. P. L. Soni, A Textbook of Inorganic Chemistry, Sultan Chand and Co., 1977. 3. P.W. Atkins, T.L. Overton, J.P. Rourke, M.T. Weller, and F.A. Armstrong, Shriver and Atkins' Inorganic Chemistry, 5th Edition 2010, W. H. Freeman and Company, 41 Madison Avenue, New York, NY 10010 4. L. G. Miessler, J. P. Fischer, D. A. Tarr, Inorganic Chemistry, Fifth edition, Pearson, 2014. 5. D. L. Walter, J. M. David, T. S. Glenn, Modern Nuclear Chemistry, John Wiley & Sons, 2005 **6.** P. A C McPherson, Principles of Nuclear Chemistry, Uk 2017

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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Course Code	UCY23302J	Course Name	Functional Groups in Organic Chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Gain knowledge on the importance of functional groups	
CLR-2 :	Acquire knowledge on alcohols, ethers, thiols, phenols.	
CLR-3 :	Promote the importance of carboxylic acid and 'N' containing functional groups	
CLR-4 :	Understand the uses of functional groups and their transformations	
CLR-5 :	Acquire basic understanding of carbonyl compounds and their reactivity	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the basic concepts of functional groups	4	H	-	H	-	-	-	H	-	-	-	-	-	-	-	-
CLO-2 :	Gain knowledge about the organic reaction mechanism	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the importance of diverse chemistry of carbonyl compounds	4	H	-	H	-	-	M	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply knowledge of active methyl compounds in the synthesis of new organic molecules	4	H	-	-	H	-	-	L	-	-	-	-	-	-	-	-
CLO-5 :	Gain basic understanding of 'N' chemistry, particular properties, chemical reactions, trends in basicity of amines and applications.	4	H	H	-	-	-	-	H	-	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Alcohols: 1°, 2°, 3° alcohols; properties	Aldehyde and ketone: properties	Monocarboxylic acids preparation	Introduction: Active methylene compounds	Nitro compounds (Aliphatic and Aromatic): Nomenclature & classification
	SLO-2	Synthesis:reduction reaction, addition reaction to carbonyl compounds	Polarization of carbonyl bond and its reactivity	Properties	Introduce different substituents	General methods of preparation
S-2	SLO-1	Protection of alcohol Synthesis and reactions of diols	Synthesis using oxidation reactions, reduction and hydration reactions	Reactions of monocarboxylic acids	Acidity and synthesis	Properties and reaction with alkali and its synthetic Applications Condensation reaction with mechanism
	SLO-2	Synthesis and reactions of triols Introduction of thiols	Synthesis using oxidation reactions, reduction and hydration reactions	Reactions of monocarboxylic acids	Preparation and synthetic applications of diethyl malonate	Mannich reaction and Hydrolysis reaction
S-3	SLO-1	Thiols: acidity and reactivity.	Tautomerization Schiff base formation and their stability	Typical reactions of dicrboxylic acids.	Preparation and synthetic applications of diethyl malonate	Reaction with nitrous acid

Duration (hour)		18	18	18	18	18
	SLO-2	Phenols: acidity and reactivity	Reduction of carbonyl group to alkane and alcohol	Reactions of hydroxy acids and unsaturated acids	Preparation and synthetic applications of diethyl malonate	Electrophilic substitution: Halogenation, Nitration and sulphonation
S-4-6	SLO-1	Introduction, Safety Measures	Lassaigne's Test for N, S, Cl, Br, I	Functional Group test for amine and nitro	Preparation of derivatives of amine	Single detection of organic compounds
	SLO-2					
S-7	SLO-1	Reimer–Tiemann reaction; Kolbe's–Schmidt Reactions;	Addition of Grignard reagents Addition of Gilman reagents	Succinic/phthalic acid	Preparation and synthetic applications of acetylacetone	Amines: Classification General methods of preparation
	SLO-2	Vilsmeier–Haack reaction.	Aldol condensation	Lactic, malic acid	Preparation and synthetic applications of acetylacetone	Physical properties Basicity of amines: Effect of substituent Solvent and steric effects
S-8	SLO-1	Fries and Claisen rearrangements with mechanism	Cannizzaro reaction Benzoin condensation	Tartaric, citric acids Maleic and fumaric acids	Preparation and synthetic applications of ethyl acetoacetate.	Distinction between 1°, 2° and 3° , amines using Hinsberg"s method, nitrous acid method
	SLO-2	Fries and Claisen rearrangements with mechanism	Knoevenagel condensation	Preparation and reactions of acid chlorides	Preparation and synthetic applications of ethyl acetoacetate.	Reactions with Mechanism: Gabriel Phthalimide Synthesis, Hoffmann Bromamide reaction
S-9	SLO-1	Ethers: properties; synthesis	Claisen–Schmidt condensation Mannich reaction	Preparation and reactions of esters and amides	Reactions of Acetylacetone and ethyl acetoacetate (alkylation, conversion to ketone, mono-and dicarboxylic acid).	Carbylamine Reaction Mannich Reaction
	SLO-2	Williamson ether synthesis	Stork enamine reactions	Preparation and reactions of amides	Reactions of Acetylacetone and ethyl acetoacetate (alkylation, conversion to ketone, mono-and dicarboxylic acid).	Hoffmann's exhaustive methylation Hofmann elimination reaction
S-10-12	SLO-1	Lassaigne's Test for N, S, Cl, Br, I	Functional Group test for alcohol, phenol and carboxylic acid	Preparation of derivatives of alcohol, phenol	Preparation of derivatives of carbonyls	Single detection of organic compounds
	SLO-2					
S-13	SLO-1	Synthesis and hydrolysis of t-butyl ethers	Wittig reaction Horner-Wadsworth-Emmons reaction	Comparative study of nucleophilic substitution at acyl group	Reactions of Acetylacetone and ethyl acetoacetate (alkylation, conversion to ketone, mono-and dicarboxylic acid).	Cope Elimination Nucleophilic substitution on the ring
	SLO-2	Synthesis and hydrolysis of t-butyl ethers	Baeyer Villiger oxidation, α-substitution reactions	Mechanism of acidic and alkaline hydrolysis of esters	Reactions of Acetylacetone and ethyl acetoacetate (alkylation, conversion to ketone, mono-and dicarboxylic acid).	Nitriles: Nomenclature and uses; Preparation from the dehydration of amides, aldoximes, Grignard reagents, dehydrogenation of primary amines;

Duration (hour)		18	18	18	18	18
S-14	SLO-1	Epoxide: synthesis, opening in presence of Lewis acid	Oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PCC)	Claisen condensation Dieckmann reactions	Reactions of Acetylacetone and ethyl acetoacetate (alkylation, conversion to ketone, mono-and dicarboxylic acid).	Preparation using substitution reaction in alkyl halides and tosylates; Addition reaction with HX, NH3 and reaction with aqueous ROH with mechanism
	SLO-2	Epoxide: synthesis, opening in absence of Lewis acid	Oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH4, NaBH4, MPV, PDC and PCC)	Reformatsky reactions	Uses in synthesis of cycloalkanes	Reduction reactions-catalytic reduction and Stephen's reaction, Condensation reactions-Thorpe Nitrile Condensation with mechanism.
S-15	SLO-1	Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$	Oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV, PDC and PGC);	Hofmann bromamide degradation.	Uses in synthesis of cycloalkanes	Isonitriles: Nomenclature and uses; Preparation of Isonitriles from Carbylamine reaction, substitution in alkyl halides and dehydrogenation of N-substituted formamides;
	SLO-2	Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$	Addition reactions of unsaturated carbonyl compounds: Michael addition	Curtius rearrangement	Uses in synthesis of cycloalkanes	Discussion on reactions with mechanism of hydrolysis and reduction; addition with – HX, X2 and sulphur
S-16-18	SLO-1 SLO-2	Lassaigne's Test for N, S, Cl, Br, I	Functional Group test for carbonyls, ester, unsaturation	Preparation of derivatives of alcohol, phenol	Single detection of organic compounds	Repeat experiment

Learning Resources

Theory:

1. R.T. Morrison and R.N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th edition, Pearson India, 2011.
2. J. Clayden, N. Greeves, and S. Warren, Organic Chemistry (Second Edition) Oxford publication 2012.
3. I. L. Finar, Organic Chemistry, Vol. 1, 6th edition, Pearson Education India 2002.
4. S. H. Pine , Organic Chemistry 5th edition, Mcgrawth Hill, Newyork, 1987.
5. Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc 2017.

Practicals:

1. B. S. Furniss, A. J. Hannaford, P. W. G. Smith, A. R. Tatchell, Practical Organic Chemistry, 5th Ed., Pearson, 2012
2. V. K. Ahluwalia, R. Aggarwal, Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2000.
3. V. K. Ahluwalia, S. Dhingra, Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press 2000.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23303T	Course Name	Thermodynamics and Surface Chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Learn the thermodynamics properties and its limitations	
CLR-2 :	Understand the concepts of energy, heat, work, enthalpy, entropy, free energies, and the relation between them.	
CLR-3 :	Understand the Carnot cycle and adiabatic expansion and compression	
CLR-4 :	Understand the concept of entropy and it's change in reversible and irreversible processes.	
CLR-5 :	Understand the surface chemistry of solids and thin films.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Explain three laws of thermodynamics	4	H	-	-	-	-	M	-	-	-	-	-	H	-	-	-
CLO-2 :	Explain the concept of thermochemistry and partial molar properties	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Derive the expression of equilibrium constants	4	H	-	-	-	M	-	L	-	-	-	-	-	-	-	-
CLO-4 :	Explain the concept of partial molar properties	4	H	-	-	H	M	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Explain the surface chemistry of the materials	4	-	H	-	-	-	-	H	L	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to chemical thermodynamics	Second law of thermodynamics	Free energy function	Third law of thermodynamics	Surface Chemistry - Introduction
	SLO-2	Applications and limitations of thermodynamics	Need for second law of thermodynamics	Helmholtz free energy equation	Entropy, molar properties and free energy	Adsorption by solids
S-2	SLO-1	System- open, closed and isolated system	Spontaneous process- Cyclic process	Variation of free energy with T, P and V	Gibbs-Duhem equation	Chemisorption
	SLO-2	Macroscopic properties Phase, variable and state of a system	Cyclic process - Carnot cycle- Efficiency of heat engine	Criteria for irreversible process	Dependence of thermodynamic parameter on composition, temperature, pressure	Applications of adsorption
S-3	SLO-1	Thermodynamics equilibrium, processes and properties of the system	Entropy change- Isothermal, Isobaric and Isochoric process	Criteria for reversible process	Chemical potential in case of system of ideal gas - derivation	Adsorption of gases by solids
	SLO-2					
S-4	SLO-1	Tutorial: Properties of macroscopic system	Tutorial: Calculation of change of internal energy	Tutorial: Calculation of Inversion Temperature	Tutorial: Gibbs-Duhem equation – Practice	Tutorial: Calculate the volume of the gas
	SLO-2					
S-5	SLO-1	First law of thermodynamics - Internal energy, State functions	Boltzmann equation	Limitation of criteria of reversible and irreversible process	Clapeyron-Clausius equation - derivation	Factors influencing adsorption
	SLO-2					
S-6	SLO-1	Heat capacity- relationship between Cp and	Standard entropy	Gibbs Helmholtz equation - derivation	Application of Clapeyron-Clausius equation for liquid – vapour equilibria	The Freundlich adsorption isolhenn

Duration (hour)		12	12	12	12	12
		Cv in gaseous system				
	SLO-2	Isothermal expansion	Entropy change in an isothermal expansion of. an ideal gas		Application of Clapeyron-Clauses equation for solid-liquid equilibria	The Langmuir theory of adsorption
S-7	SLO-1	Work done in reversible isothermal expansion	Physical significance of entropy	Fugacity and physical significance	Chemical equilibria: Criteria of thermodynamic equilibrium	The Langmuir theory of adsorption
	SLO-2	Work done in irreversible isothermal expansion and Adiabatic expansion	Calculation of entropy changes of an ideal gas with change in P, Vand T	Activity coefficient and significance	Law of mass action - Vant Hoff reaction isotherm	The BET theory of multilayer adsorption
S-8	SLO-1	Tutorial: Nature of heat and work-practice	Tutorial: Expansion of ideal gas - properties	Tutorial: Determination of Fugacity	Tutorial- Applications of law of mass action	Tutorial: Calculation of adsorption of gases on solids
	SLO-2					
S-9	SLO-1	Nature of heat and work-practice	Work. done in Reversible Isothermal Expansion	Determination of Fugacity	Tutorial - Applications of law of mass action	Calculation of adsorption of gases on solids
	SLO-2					
S-10	SLO-1	Enthalpy of solutions - Kirchoff equation	Entropy of mixture of ideal gas	Inversion temperature and standard states	Thermodynamic derivation of relation between Gibbs free energy of a reaction and reaction coefficient.	Derivation of the BET equation
	SLO-2					
S-11	SLO-1	Bond energies-Introduction and applications	Boltzmann equation	Maxwell equation	Equilibrium constants and their dependence on T and P	Types of adsorption isotherms
	SLO-2					
S-12	SLO-1	Hess law of constant heat summations and applications	Standard entropy and physical significance of entropy	Relation between Joule-Thomson coefficient and other thermodynamic parameter	Raoults law, Osmotic pressure- relation between osmotic pressure,	Adsorption from solution and Insoluble surface films on liquids
	SLO-2					

Learning Resources	**Theory:** 1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, Shobulal Nagin Chand and Co, 2001. 2. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLal Nagin Chand and Co, 2013. 3. P.W.Atkins, Physical Chemistry, W.H. Freeman and Company 2006. 4. 4. P.C. Hiemenz, Principles of colloids and surface chemistry,2ndEd.,Marcel DekkerInc., 1986

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	**1.** *Dr. G. Madhuraiveeran,* SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	**2.***Prof. M. Arthanareeswari, SRMIST*

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Course Code	UPY23G01J	Course Name	Allied Physics	Course Category	G	Generic Elective Course	L	T	P	O	C
							3	0	3	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	understand the fundamentals of physics			
CLR-2:	evaluate and learn the structural, optical, nuclear and electronic properties of solids			
CLR-3:	emphasize the significance of green technology and its applications			
CLR-4:	gain comprehensive knowledge and sound understanding of fundamentals of light and material properties			
CLR-5:	recognize how and when physics methods and principles can help address problems in their major			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Understand and solve problems on fundamentals of physics	2	80	75	H	H	-	-	-	-	-	H	-	-	-	H	-	-	-
CLO-2 :	Acquire knowledge on materials properties	2	80	70	H	H	-	-	-	-	-	H	-	-	-	H	-	-	-
CLO-3 :	Correlate the acquired knowledge and use it for various applications	2	75	70	H	H	-	-	-	-	-	H	-	-	-	H	-	-	-
CLO-4 :	Familiarize themselves with interaction of light and matter	2	80	75	H	H	-	-	-	-	-	H	-	-	-	H	-	-	-
CLO-5 :	Apply physics methods and principles to solve problems in the majors.	2	80	75	H	H	-	-	-	-	-	H	-	-	-	H	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Sources of conventional energy	Space lattice basis	Kinetic theory of gases	Electric charge - conservation of charge, Permittivity	Time period - amplitude – phase
	SLO-2	Need for non - conventional energy resources	Unit Cell, lattice parameters	Ideal gas laws	Coulomb's law	Wave nature of light
S-2	SLO-1	Solar energy and solar cells and its applications	Two dimensional and three dimensional Bravais lattices	Van Der Waal's equation of states	Electric field	Huygens's principle
	SLO-2	Bio mass energy	The seven crystal systems	Derivation of Van Der Waal's equation of states	Electric potential	Interference and Coherence
S-3	SLO-1	Generation and applications of bio mass energy	Cubic crystal system and symmetry	Pressure of an ideal gas	Gauss's law	Young's double slit experiment
	SLO-2	Wind energy generation and applications	Reciprocal lattice and its importance	Derivation of Pressure of an ideal gas	Applications of Gauss's law	Interference from thin films
S-4 to S-6	SLO-1	Introduction to the Lab experimentation	Calculation of lattice cell parameters by X-ray diffraction	Determination of specific heat capacity of the liquid by Newtons's law of cooling	Calibration of Voltmeter using potentiometer	Determination of dispersive power of a prism using spectrometer
	SLO-2					
S-7	SLO-1	Nuclear energy - Atomic structure	Density and atomic packing fraction	Laws of thermodynamics	Conductors and dielectrics	Michelson's interferometer
	SLO-2	Alpha, beta and gamma radiation	Crystal directions and planes	Entropy	Electric Current	Diffraction - Wave theory of light
S-8	SLO-1	Law of radioactive decay, Decay constant	Introduction to Miller indices	Change of entropy in reversible processes	Ohm's law	Light and Optics

	SLO-2	*Half-life and mean life*	*Interplanar distance*	*Change of entropy in irreversible processes*	*Magnetic induction*	*Fermat's principle*
S-9	**SLO-1**	*Nuclear energy*	*Hexagonal closely packed (HCP) structure*	*Low temperature*	*Permeability and susceptibility*	*Laws of reflection and refraction*
	SLO-2	*Applications of nuclear energy*	*Derivation of HCP atomic packing fraction*	*Joule - Kelvin effect-introduction*	*Numerical Problems/Demos/ Simulations/Seminars on Permeability and susceptibility*	*Total internal reflection*
S-10 to S-12	**SLO-1**	*Study of the I-V Characteristic of a Solar Cell*	*Dielectric constant Measurement*	*Determination of thermal conductivity of a bad conductor using Lee's disc method*	*Calibration of Ammeter using potentiometer*	*Study of attenuation and propagation characteristics of optical fiber cable*
	SLO-2					
S-13	**SLO-1**	*Mass defect*	*Diamond crystal structure*	*J-K effect- theory*	*Magnetic field due to a current carrying conductor-Biot-Savart's law*	*Mirrors and lenses*
	SLO-2	*Nuclear binding energy*	*Derivation of APF for diamond structure*	*Applications of J-K effect*	*Ampere's circuital law*	*Lens makers formula*
S-14	**SLO-1**	*Fission reaction*	*X-ray diffraction*	*Linde's process*	*Faraday's law*	*Defects of images*
	SLO-2	*Evaluating nuclear energy generation by fission reaction*	*Problems/Demos/ Simulations/Seminars on X-ray diffraction*	*H, He, Nitrogen gas liquefaction*	*P and N type semiconductors*	*Coma distortion*
S-15	**SLO-1**	*Fusion reaction*	*Single crystal diffraction*	*Adiabatic demagnetization-introduction*	*Junction Diode*	*Spherical aberration in lenses*
	SLO-2	*Fusion energy cycles*	*powder diffraction*	*Working principle of adiabatic demagnetization-*	*Characteristics of Junction Diode*	*Chromatic aberration in lenses*
S-16 to S - 18	**SLO-1**	*Hall effect- Hall coefficient determination*	*Revision class for experiments*	*Determination of specific heat capacity of the liquid by Joule's calorimeter method*	*Band gap determination using Post Office Box – Specific resistance*	*Revision class for experiments*
	SLO-2					

Learning Resources	1. *Modern Physics, Murugeshan and K. Sivaprasath, (S. Chand publications, revised edition, 2015).* 2. *Fundamentals of Physics, Resnick R. and Halliday D., (Wiley Publication, 8th Edition, 2011)*	3. *Heat and Thermodynamics, Zemansky M. W. and Ditlman R.H., (Tata McGraw Hill, 2011)* 4. *Allied Physics I, Sundaravelusamy A., (Priya Publications, 2009)*

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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					~~G~~	***Generic elective course***	**L**	**T**	**P**	**O**	**C**

Course Code	UPY23G02T	Course Name	Laser Physics	Course Category			3	1	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
CLR-1 :	acquire the knowledge on laser beam characteristics	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-2 :	acquire knowledge for solving problems in laser physics	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLR-3 :	analyze Fabry-Perot cavity to understand laser resonator																		
CLR-4 :	gain knowledge on Q-switched and mode-locked lasers																		
CLR-5 :	acquire the knowledge on lasers classes and laser safety																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	understand the basic characteristics of a laser	2	80	75	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	analyse Fabry Perot cavity to understand a laser resonator	2	80	70	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-3 :	learn Rate equations to understand the dynamics of a laser	2	75	70	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-4 :	understand the conditions of stable resonators	2	80	75	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-5 :	Knowledge on various types of lasers and the physics of higher harmonic generation	2	80	70	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	General Introduction to lasers	Cavity life time and Quality factor	Geometrical optics analysis of optical resonators	Introduction to Q-switching	Coherence properties of laser light
	SLO-2	Spontaneous and stimulated emission Stimulated absorption	Ultimate line width of a laser	Condition for stable resonators	Dynamics of the Q-switching process	Temporal coherence
S-2	SLO-1	The laser idea	Einstein's A and B Coefficients	Stability diagram for optical resonators	Electro-optical Q-switching	Spatial coherence
	SLO-2	Gain medium, pumping scheme and optical feedback	Ratio of A and B at thermal equilibrium	Sources of resonator loss	Introduction to mode locking	Young's double slit experiment to understand spatial coherence
S-3	SLO-1	Properties of laser beams: Monochromaticity	Introduction to resonators	Laser rate equations	Mathematical interpretation for mode locking	Specific laser systems
	SLO-2	Directionality, coherence	Fabry-Perot cavity	Introduction to four level laser system	Mathematical interpretation for mode locking	Ruby laser
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
S-5	SLO-1	Modes of a cavity	Basic apparatus	Mathematical formulation of rate equations for four level laser system	Passive mode locking	He:Ne laser
	SLO-2	Black body radiation	Elementary theory of Fabry-Perot cavity	Mathematical formulation of rate equations for four level laser system	Active mode locking	Carbon dioxide laser
S-6	SLO-1	Black body radiation	Transmission spectrum of a Fabry-Perot cavity	Condition for population inversion	Concept of Gain saturation	Dye lasers, semiconductor lasers
	SLO-2	Calculation of mode density for black body	Coefficient of finesse/Quality factor	Threshold condition for four level system	Hole burning	DBR lasers

S-7	**SLO-1**	*Calculating number of photons per mode for black body*	*Fundamental Gaussian beam*	*Calculating threshold for He-Ne laser*	*Spatial hole burning*	*Nd:YAG laser*
	SLO-2	*Comparison of black body radiation with laser radiation*	*Gaussian beam in homogeneous medium*	*Integrating cavity rate equation*	*Longitudinal and transverse mode selection*	*Higher harmonic generation*
S-8	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
S-9	**SLO-1**	*Line shape functions*	*Gaussian beam focusing*	*Rate equations under steady state condition*	*Single mode operation*	*Physics of harmonic generation*
	SLO-2	*Line-broadening mechanisms*	*Gaussian beam focusing*	*Rate equations under steady state condition*	*Multi-mode lasers*	*Physics of harmonic generation*
S-10	**SLO-1**	*Homogeneous broadening*	*Higher order Hermite Gauss beams*	*Variation of laser power around the threshold*	*Gain competition*	*Second harmonic generation*
	SLO-2	*Inhomogeneous broadening*	*Higher order Hermite Gauss beams*	*Variation of laser power around the threshold*	*Gain competition*	*Third harmonic generation*
S-11	**SLO-1**	*Natural, Doppler and Collison broadening*	*Analysis of higher order Hermite Gauss beams*	*Optimum output coupling*	*Optical amplifiers*	*Classification of lasers*
	SLO-2	*Natural, Doppler and Collison broadening*	*Analysis of higher order Hermite Gauss beams*	*Laser spiking*	*Optical amplifiers*	*Laser safety*
S-12	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*

Learning Resources	1. K. Thyagarajan and A.K. Ghatak, Lasers Theory and Applications, 1st Ed., Macmilan Publishers, 2010. 2. O. Svelto, Principles of lasers, 4th Ed., Springer, 1998.	3. A. Yariv, Quantum Electronics, 3rd Ed., John Wiley, New York, 1989 4. Seigman, Lasers, 3rd Ed., Oxford Univ. Press, 1986. 5. B.E.A. Saleh and M.C. Teich, Fundamentals of Phtonics, 2nd Ed., Wiley, 2012.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. N Vijayan, NPL, nvijayan @nplindia.org	*Dr. N Vijayan, NPL, nvijayan @nplindia.org*	*Dr. K Shadak Alee, SRMIST*
Mr. R Seshadri, Titan Company Limited, seshadri@titan.co.in	Dr. M. Ameen Poyli, International School of Photonics, Cochin University of Science and Technology; ameenpoyli@cusat.ac.in	*Dr. Anand M Shrivastav, SRMIST*

Course Code	ULT23AE1J	Course Name	Applied Tamil – I	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1:	தமிழின் எழுத்து, சொல் வளர்ச்சி வரலாற்றை அறியச் செய்தல்	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-2:	மொழியைப் பிழையின்றி எழுதும் ஆற்றலை அடையச் செய்தல்																		
CLR-3:	வாய்மொழி வழக்காறுகளின் நுட்பங்களைத் தெரியச் செய்தல்																		
CLR-4:	கடிதம் எழுதும் முறை, கட்டுரை வரையும் முறை அறியச் செய்தல்																		
CLR-5:	படைப்பாற்றல் திறனை வளரச் செய்தல்																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1:	சொற்களைச் சரியான பொருண்மையில் பயன்படுத்தும் திறன் பெறுதல்	*2*	*75*	*60*	*H*	*L*	*H*	*M*	*H*	*H*	*L*	*M*	*H*	*M*	*L*	*H*	-	-	-
CLO-2:	மொழியைப் பிழையின்றி எழுதுவதன் வழி மொழி ஆளுமை பெறுதல்	*2*	*80*	*70*	*H*	*M*	*H*	*L*	*M*	*H*	*L*	*H*	*M*	*L*	*H*	*H*	-	-	-
CLO-3:	வாய்மொழி மரபின் கூறுகள் வழி, மக்களின் வாழ்வியல் விழுமியங்களை அறிந்துகொள்ளுதல்	*2*	*70*	*65*	*H*	*L*	*H*	*M*	*H*	*H*	*M*	*H*	*L*	*H*	*M*	*H*	-	-	-
CLO-4:	அலுவலகப் பயன்பாடு, திறன் மேம்பாடு ஆகியவற்றை நுட்பமாகத் தெரிந்துகொள்ளுதல்	*2*	*70*	*70*	*H*	*M*	*H*	*L*	*H*	*M*	*M*	*H*	*H*	*L*	*H*	*H*	-	-	-
CLO-5:	கவிதை, கதை படைக்கும் ஆற்றலை அறிந்துகொள்ளுதல்	*2*	*80*	*70*	*H*	*M*	*H*	*H*	*M*	*H*	*L*	*M*	*H*	*L*	*H*	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	தமிழின் தொன்மை	மெய்யெழுத்துகளின் வகைகள்	வாய்மொழி மரபு, எழுத்து மரபு	தொடர் அமைப்பு	காலந்தோறும் கவிதை
	SLO-2	தமிழின் சிறப்புகள்	மூவினம்	வாய்மொழி மரபில் அனுபவம்	எளிய தொடர்	கவிதை வடிவம்
S-2	SLO-1	கருத்து – பரிமாற்றம்	ஒற்று இடுதல்	வாழ்வியல் தத்துவம்	நெடுந்தொடர்	மரபுக்கவிதை
	SLO-2	பயன்பாட்டுத் தமிழ்	வல்லினம் மிகும் இடங்கள்	பழமொழிகள்	பத்தி எழுதுதல்	வசனகவிதை

S-3	SLO-1	காலந்தோறும் தமிழ்	வல்லினம் மிகா இடங்கள்	பழமொழியும் மனித வாழ்வியலும்	ஒரு பொருளை மையமாகக் கொண்டு எழுதுதல்	புதுக்கவிதை/ புதிய வடிவக் கவிதைகள்
	SLO-2	எழுத்துகள் - அறிமுகம்	எழுத்துப்பிழை நீக்கம்	பழமொழியின் வடிவம்	காலந்தோறும் கடிதங்கள்	கவிதைக் களங்கள்
S-4	SLO-1	தமிழ் எழுத்து வரலாறு	பிழை நீக்கி எழுதுதலின் அவசியம்	வட்டார மொழி	தமிழில் கடித இலக்கியம்	கவிதை உள்ளடக்கம்
	SLO-2	எழுத்துகளின் வரிவடிவம்	பிழைகளும் மொழிச் சிக்கல்களும்	வட்டார மொழியில் சொலவடை	கடித வகைகள்	கவிதை எழுதும் முறை
S-5	SLO-1	எழுத்துகளின் பிறப்பு	எதிர்ச்சொல் வரலாறு	பழமொழியும் சொலவடையும்	கடிதம் எழுதும்முறை	தன்னுணர்ச்சிக் கவிதை
	SLO-2	உயிர் எழுத்துப் பிறப்பு	எதிர்ச்சொல்லின் உருவாக்கம்	பேச்சுநடையும் சொலவடையும்	அலுவல் கடிதம்	இயற்கை/ சமூகம் - கவிதை
S-6	SLO-1	மெய்யெழுத்துப் பிறப்பு	இணைச்சொல்லும் எதிர்ச்சொல்லும்	மரபுத்தொடர்	வாழ்த்து/ பாராட்டுக் / நட்புக் கடிதம்	காலந்தோறும் கதைகள்
	SLO-2	மொழி முதல் எழுத்துகள்	தமிழில் எதிர்ச்சொற்கள்	பழமொழி மரபுத் தொடர் வேறுபாடு	கட்டுரை வகைகள்	கதைகளில் கற்பனையும் உண்மையும்
S-7	SLO-1	மொழி இறுதி எழுத்துகள்	ஒரெழுத்து ஒருமொழி – அறிமுகம்	தமிழில் மரபுத்தொடர்	கட்டுரை எழுதும் முறை	வாய்மொழிக் கதை
	SLO-2	எழுத்து வேறுபாடும் பொருளும்	ஒரெழுத்து ஒருமொழியும் பொருளும்	விடுகதை	கட்டுரைக் களங்கள்	ஒரு பக்கக் கதை
S-8	SLO-1	ணகர - னகர - நகர வேறுபாடு	சொற்களின் தன்மைகள்	நுண்ணறிவு வெளிப்படுதல்	போட்டிக் கட்டுரை	சிறுகதை
	SLO-2	லகர – ளகர - ழகர வேறுபாடு	ஒரு சொல் பல பொருள்	கதை மரபில் நாட்டுப்புறக் கதைகள்	அனுபவக் கட்டுரை	கதை எழுதும் முறை
S-9	SLO-1	சொல்லும் பொருளும்	ஒரு பொருள் பல சொல்	தமிழில் நாட்டுப்புறக் கதைகள்	பயணக் கட்டுரை	சமூக உணர்வின் வெளிப்பாடு
	SLO-2	காலந்தோறும் சொற்கள்	சொல் உருவாக்கத்தின் பயன்கள்	நாட்டுப்புறக் கதைகளும் சமூக வரலாறும்	இதழியல் கட்டுரைகள்	நிகழ்வைக் கதை வழியே வெளியிடல்

Learning Resources	1. நல்ல தமிழ் எழுத வேண்டுமா?, அ. கி. பரந்தாமனார், பாரி நிலையம், 2010. 2. நாட்டுப்புற இயல் ஆய்வு, சு. சக்திவேல், மணிவாசகர் பதிப்பகம், சென்னை, 2006. 3. படைப்புக்கலை, மு. சுதந்திரமுத்து, அறிவுப் பதிப்பகம், சென்னை, 2008.

	4. கதையியல், க. பூரணச்சந்திரன், அடையாளம் பதிப்பகம், சென்னை, 2012. 5. இணைய வழித் தரவுகள் : https://tamilheritage.org/

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
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		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

Course Code	ULH23AE1J	Course Name	Applied Hindi-I	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Explain and appreciate the Constant moral values of India	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-2 :	Focus on Evaluating the social changes through prose																		
CLR-3 :	To Display moral and social values in the field of religion and communal Unity																		
CLR-4 :	To make translation of good literature and any relevant document from the Hindi Language to English and vice –versa																		
CLR-5 :	To help the learners to tackle Administrative terminology																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	***Understand the various forms of Prose and different aspects of social issues***	*2*	*75*	*80*	*H*	*H*	*H*	*M*	*L*	*H*	*L*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-2 :	***To create an awerness on Ramayanan***	*2*	*80*	*90*	*H*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-3 :	***To Examine the accuracy in Translation***	*2*	*75*	*95*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*H*	*M*	*M*	*H*	*H*	-	-	-
CLO-4 :	*To Provide technical writing skills*	*2*	*80*	*90*	*H*	*H*	*L*	*H*	*M*	*H*	*L*	*H*	*H*	*M*	*H*	*H*	-	-	-
CLO-5 :	***To evaluate the nuance in essays***	*2*	*85*	*90*	*M*	*H*	*M*	*H*	*L*	*H*	*H*	*L*	*H*	*M*	*H*	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	KAHANI	NIBANDH	BAL RAMAYAN	ANUVAD	PARIBHASHIK SHABDAVALI
	SLO-2	AVDHARNA	VDHARNA	KHATHA VASHTU	AVDHARNA	ARTH
S-2	SLO-1	ARTH	ARTH	AVADHPURI MEN RAM	ARTH	PARIBHASHA
	SLO-2	SWARUP	SWARUP	RAM KE ADARSH KE PRATI PRERIT KARNA	SWARUP	SWARUP
S-3	SLO-1	PARIBHASHA	PARIBHASHA	RAMAYAN KE PRATI RUCHI JAGANA	PARIBHASHA	PRAKAR
	SLO-2	KAHANI KE TATVA	MAHABHARAT KE AMAY KA BHARAT-BHALKRISHNA BHATT	RAMAYAN KA SAMAJ MEN MAHATVA	PRAKAR	AVADHARNA
S-4	SLO-1	UDDESHYA	LEKHAK PARICHAYA	LOKJEEVAN KE PRATI JAGRUP KARNA	MAHATVA	PRAYOJAN
	SLO-2		PATH KA VISLESHAN	JANGAL AUR JANKPUR	UDDESHYA	UDDESHYA
S-5	SLO-1	ANTASH MAN KI JAGRITI	UDDESHYA	GURU KE PRATI ADAR BHAV	ANUBAD PRAKRIYA	MAHATVA
	SLO-2	EIDGAH – KAHANI PREMCHAND	AMAJIK SAMRASTA	VIRTA KE BHAV KO JAGANA	VIVIDH PRAYOG	PRAYOG
S-6	SLO-1	KAHANI KA PARICHAYA	PAURANIK KAHANIYO SE AVAGAT KARANA	VIDHARM KA PRATIFAL	HINDI SE ANGREZI ANUVAD	UDDESHYA
	SLO-2	KAHANI VISLESHAN	MAHABHARAT EVAM RAMAYAN KE SAMAJ KI TULNA	VAN JEVAN SE AVAGAT KARANA	ANGREZI SE HINDI ANUVAD	TAKANIKI SHABDAVALI KA MHATVA
S-7	SLO-1	BAL MANOVIGYAN	BABUL AUR KAKTASH-RAMDARASH MISHRA	SITA KE ADARSH CHARITRA SE AVAGAT KARANA	ANUVAD KA PRAYOJAN	HINDI SE ANGREZI SHABD
	SLO-2	ASMANTA KA CHITRAN	LEKHAK PARICHAY	RAM KE CHARITRA SE AVAGAT KARANA	ANUVAD KA PRAYOG	ANGREZI SE HINDI SHABD

S-8	SLO-1	DIP SE DIP JALE-USHA YADAV	PATH KA VISLESHAN	VIRTA KE BHAV JAGANA	SHROT BHASHA KA GYAN	EK DIN EK SHABD
	SLO-2	SAPNE KE LIYE SANGHARSH	MANVATA KO JIVIT RAKHANE KI PRERNA	PATH KA VISLESHAN	LAKSHYA BHASHA KA GYAN	SHABDON KA VISLESHAN
S-9	SLO-1	SAMASYA KA SMADHAN JAD MEN HOTA HAI	AAJ KE SANDARBH ME MAHABHARAT KI UPYOGITA	PATH PRICHARCHA	ANUVAD KA DAYITVA	PATH PRICHARCHA
	SLO-2	PRASHNABHAYASH	PRASHNABHAYASH	PRASHNABHAYASH	ANUVAD KA ABHYASH	PRASHNABHAYASH

Learning Resources	***Edited Book: "PRAYOJAN MULOK HINDI", SRIJONLOK PUBLICATION, 2023, New Delhi.*** 1. Srijanlok Literary Magazine, Ara (Bihar – 802301) 2. https://hindisamay.com/ 3. https://ncert.nic.in/textbook.php?fhbr1=0-12 ***4.*** Prayojan mulak Hindi, Dr. Sontakke ***5.*** https://rajbhasha.gov.in/hi/ol_clause		*PUNRIKSHAN*

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Shri. Santosh Kumar Editor : Srijanlok Magazine Place: Vashishth Nagar, Ara – 802301	*1. Prof.(Dr.) S.Narayan Raju, Head, Department of Hindi,CUTN, Tamilnadu*	*1. Dr.S Preeti. Associate Professor & Head, SRMIST*
		2. Dr. Md.S. Islam Assistant Professor, SRMIST
		3.Dr. S. Razia Begum, Assistant Professor, SRM IST
		4, Dr.Nisha Murlidharan Assistant Professor, VDP,SRM IST

Course Code	ULF23AE1J	Course Name	French for Specific purpose-I	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Strengthen the language of the students both in oral and written	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
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																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*To acquire knowledge about French language*	2	75	80	H	M	H	H	M	H	H	L	M	M	H	L	-	-	-
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	2	80	90	M	H	L	H	H	M	H	M	L	L	H	M	-	-	-
CLO-3 :	*To develop content using the features in French language*	2	75	80	H	H	L	M	H	M	L	H	M	M	H	H	-	-	-
CLO-4 :	*To interpret & Translate the French language into other language*	2	75	90	H	L	M	H	M	H	H	M	L	H	M	L	-	-	-
CLO-5 :	*To improve the communication, intercultural elements in French language*	2	80	75	M	H	H	L	M	M	H	H	M	L	H	M	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	**TP de chimie**	**Le jour des examens**	L'impératif négatif	Comprendre une lettre de motivation	Comprendre la structure d'un rapport de stage
	SLO-2	Les exemples	Les activités	-Le passé composé avec être	Les exemples	Trouver des mots clés-
S-2	SLO-1	- Un TP au laboratoire-	Le sms à la française -	Les exemples	Repérer le présent	Les activités
	SLO-2	Les exemples	Les activités	Le passé composé des verbes pronominaux	Les activités	Comprendre un texte technique-
S-3	SLO-1	Comprendre un TP	Les examens	**-La recherche de stage** -	, le passé composé et	Les activités
	SLO-2	Les exemples	Les activités	Les exemples	Les activités	Les exemples
S-4	SLO-1	-Suivre un protocole expérimental -	-Donner des conseils	Les activités	le futur dans un texte	Relever des arguments dans un texte-
	SLO-2	Les activités	Les exemples	Le stage en France	Les exemples	Les activités
S-5	SLO-1	Lire des équations chimiques -	-Écrire et comprendre un sms -	Les activités	**- Le rapport de stage et le domaine des carburants** -	Les exemples
	SLO-2	Les activités	Comprendre une interdiction	Le CV français	Les activités	Les activités
S-6	SLO-1	Identifier des formules chimiques à l'oral	Les activités	Les exemples	Le stage	Les activités
	SLO-2	Les exemples	-Donnez des consignes -	La lettre de motivation-	Les exemples	Les pronoms COI
S-7	SLO-1	- L'infinitif pour exprimer un ordre ou	Les exemples	Comprendre une offre de stage	La méthode du plan détaillé-	Les exemples
	SLO-2	Les activités	Comprendre	Les exemples	Les activités	Les exemples
S-8	SLO-1	un conseil (dans les consignes) -	Les exemples	Les activités	Les exemples	Les activités
	SLO-2	Les exemples	et parler d'actions passées-	Comprendre et réaliser un CV	Le contenu du rapport de stage	Quelques verbes et leur préposition

S-9	**SLO-1**	La nominalisation	Les exemples	Les activités	Les exemples	Les activités
	SLO-2	Les exemples	L'impératif des verbes pronominaux	Les exemples	Les activités	Les exemples

Learning Resources	***Theory:*** 1. **"*Tech French*"** French for Science and Technology, Ingrid Le Gargasson, Shariva Naik, Claire chaize, Les éditions Didier, India, 2011. ***2.*** *https://www.fluentu.com/blog/french/french-grammar* ***3.*** *https://www.elearningfrench.com/learn-french-grammar-online-free.html* ***4.*** *https://www.lawlessfrench.com/grammar* ***5.*** *https://blog.gymglish.com/2022/12/15/basic-french-grammar*

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
1. Mr. Kavaskar Danasegarane Process Expert Maersk Global Service Center Pvt. Ltd	*1. Dr. C.Thirumurugan Professor, Department of French, Pondicherry University*	*1. Mr. Kumaravel K. Assistant Professor & Head, SRMIST, KTR*
2.Mr. Sharath Raam Prasad Character Designer, Animaker Company Pvt.		*2. Mrs. Abigalai Assistant Professor, SRMIST, VDP*

Course Code	UCY23S03L	Course Name	Instrumental Methods of Analysis	Course Category	C	Discipline Specific Core	L	T	P	O	C
							0	0	3	2	1

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Gain exposure to the practical knowledge of Instruments and their handling	
CLR-2 :	Gain insight into the principle, instrumentation and interpretation of simple compounds in UV spectroscopy	
CLR-3 :	Learn about the analysis of different organic functional groups	
CLR-4 :	Gain knowledge about the characterization of simple compounds using different techniques	
CLR-5 :	Know how to maintain the record of experiments conducted	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand different characterization techniques in simple molecules	4	H	-	-	-	H	-	M	-	-	-	-	-	-	-	-
CLO-2 :	Get awareness of safety techniques and handling of chemicals	4	-	-	-	-	-	L	-	-	H	-	-	H	-	-	-
CLO-3 :	Understand how to carry out green synthesis and its applications	4	H	-	-	-	-	-	H	-	-	L	-	-	-	-	-
CLO-4 :	Understand the Principles of UV spectroscopy,	4	H	-	-	H	-	-	M	-	-	-	-	-	-	-	-
CLO-5 :	Apply the techniques for structure determination of simple molecules	4	L	-	-	-	-	-	H	-	H	-	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1 to3	SLO-1	Introduction	Validating Beer – Lambert's law by finding the absorbance of a dye in UV-visible spectrophotometer	Separation and Identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values	Determination of a The concentration of acid by pH meter	Demonstration Practical Session
	SLO-2					
S-4 to 6	SLO-1	IR absorption spectra)	Determination of concentration of mixture of acids by conductometric method	Chromatographic separation of the active ingredients of plants, flowers and Juices by TLC	Determination of the isoelectric pH of a protein	Repeat Class -1
	SLO-2	(study of aldehydes and ketones				
S-8 to 9	SLO-1	Determination of a mixture of cobalt and Nickel using a UV-visible spectrophotometer	Estimation of Chloride by Potentiometric Titration (Precipitation reaction)	Synthesis of zinc oxide nanoparticle by sol-gel method	Cyclic Voltammetry of the Ferrocyanide/Ferricyanide Couple	Repeat Class -2
	SLO-2					
	SLO-2					

Learning Resources	**Theory:** 1. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, Shobulal Nagin Chand and Co, 2001. 2. P. L. Soni, A Textbook of Inorganic Chemistry, Sultan Chand and Co., 1977. 3. R. Gopalan, Text Book of Inorganic Chemistry, 2nd edition, Hyderabad, Universities Press, (India), 2012. 4. R.T. Morrison and R.N. Boyd, S. K. Bhattacharjee, Organic Chemistry, 7th edition, Pearson India, 2011. 5. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLal Nagin Chand and Co, 2013.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*2. Dr. Srinivasarao Kancharla, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	***2.****Prof. M. Arthanareeswari, SRMIST*

Course Code	UCD23V02T	Course Name	Industry Oriented Employability Skills for Science	Course Category	V	Value Addition course	L	T	P	O	C
							2	0	0	2	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:
CLR-1 :	Demonstrate various principles involved in solving mathematical concepts related to permutation and combination and probability and interpret data
CLR-2 :	Learn the basic mechanics of grammar and develop resume-building practice and presentation skills in students
CLR-3 :	Understand the object oriented features
CLR-4 :	Prepare students for job interviews
CLR-5 :	Instill confidence in students and develop the necessary skills to face interview

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behaviour	Life Long Learning
CLO-1 :	Understand the concepts of permutation and combinations, probability and approach questions in a simpler and innovative method	3	80	70	M	M	-	M	-	H	-	M	H	M	-	H	-	-	-
CLO-2 :	Understand the different parts of speech and use them in sentences appropriately and also the importance of resume preparation	3	85	75	M	-	-	M	-	H	-	-	-	-	H	-	-	L	H
CLO-3 :	Understand the importance of object oriented features	3	85	80	H	M	M	M	M	H	L	-	-	-	-	-	M	-	H
CLO-4 :	Face interviews confidently	3	85	80	M	M	H	M	M	H	L	-	-	-	-	-	M	-	H
CLO-5 :	Develop their domain skills to face the interview	3	85	80	M	M	H	M	M	H	L	-	-	-	-	-	M	-	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Permutation and Combination – Introduction*	Change of voice	*Object Oriented Programming - Introduction*	Overloading & Overriding – *Introduction*	Time Complexity – *Introduction*
	SLO-2	*Permutation and Combination – Problems*	*Change of voice*	*Introduction to Monolithic, POP, Structures, OOP*	Overloading & Overriding	Time Complexity
S-2	SLO-1	*Probability – Introduction*	*Change of speech*	*Translators – Introduction*	Virtual Functions & Abstract Class – *Introduction*	Stacks & Queue - Applications
	SLO-2	*Probability – Problems*	*Change of speech*	*Translators*	Virtual Functions & Abstract Class	Stacks & Queue - Applications
S-3	SLO-1	*Data Sufficiency – Introduction*	Resume Writing - Introduction	Class – *Introduction*	Dangling Pointer – *Introduction*	Linked List & Operations – *Introduction*
	SLO-2	*Data Sufficiency – Problems*	Resume Writing - Introduction	Class	Dangling Pointer	Linked List & Operations
S-4	SLO-1	Puzzles - Selections	Resume Writing - Session 1	Object Abstraction – *Introduction*	Garbage Collector – *Introduction*	Types of Trees & BST – *Introduction*
	SLO-2	Puzzles - Selections	Resume Writing - Session 1	Object Encapsulation	Garbage Collector	Types of Trees & BST
S-5	SLO-1	Puzzles - Distribution	Types of Interviews - Group / Stress / HR	*Polymorphism, Inheritance and Dynamics Binding – Introduction*	Algorithm and Data Structures - Introduction	AVL Tree Operations – *Introduction*
	SLO-2	Puzzles - Distribution	Types of Interviews - Group / Stress / HR	*Polymorphism, Inheritance and Dynamics Binding*	Logical Thinking & Arrays	AVL Tree Operations
S-6	SLO-1	Cubes & Cuboids	Presentations - Introduction	*Function Execution Sequence - Introduction*	Structures & Pointers – *Introduction*	Introduction to P, NP, NP-Hard & NP-Complete Problems
	SLO-2	Cubes & Cuboids	Presentations - Activity	*Stack & In Line Functions - Introduction*	Structures & Pointers	Introduction to P, NP, NP-Hard & NP-Complete Problems

Learning Resources

1. *Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition 2020.*
2. *Scott Bennett, The Elements of Resume Style: Essential Rules for Writing Resumes and Cover Letters That Work, AMACOM, 2014*
4. Greg Perry, Dean Miller, C Programming Absolute Beginne, Que Publishing, 3rd Edition 2013.
5. Cay S. Horstmann, Core Java Fundamentals, Volume 1, 11th Edition, Prentice Hall, 2018
6. Langsam, Augenstein, Tanenbaum, Data Structures Using C and

	3. *Raymond Murphy, Intermediate English Grammar, Cambridge University Press, 2007*	C++, 2nd Edition, Pearson Education, 2015.

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	10%	10%	30%	30%
	Understand				
Level 2	Apply	50%	50%	40%	40%
	Analyze				
Level 3	Evaluate	40%	40%	30%	30%
	Create				
	Total	**100 %**	**100 %**	**100 %**	**100 %**

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

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. M. Ponmurugan, Executive PMOSS, Cognizant Technology Solutions India Pvt.Limited, Chennai	*Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeedam, Coimbatore*	*Dr. Sathish K, HOD, Department of Career Guidance, FSH, SRMIST*
		Dr. Muthu Deepa M, Assistant Professor, Department of Career Guidance, FSH, SRMIST

Course Code	UCY23P01L	Course Name	Internship-I	Course Category	P	*Internship/Apprenticeship / Project/ Community Outreach*	L	T	P	O	C
							0	0	0	0	1

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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.*																		

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	*Identify areas for future knowledge and skill development*	*3*	*80*	*70*	*H*	*H*	-	-	-	-	-	-	*L*	-	*M*	-	-	-	-
CLO-2 :	*understanding of what is expected in the job market and what their standard of performance should be*	*3*	*85*	*75*	-	*H*	-	-	-	-	-	-	*M*	-	*L*	-	-	-	-
CLO-3 :	*Build professional, as well as academic, contacts and begin the process of networking and support for your future careers.*	*3*	*75*	*70*	-	*H*	-	-	-	-	-	-	-	-	*M*	-	-	*H*	-
CLO-4 :	*Acquire knowledge of the industry in which the internship is done.*	*3*	*85*	*80*	*H*	*H*	-	-	-	-	-	-	*L*	-	-	-	-	-	*M*
CLO-5 :	*practical experience within the business environment*	*3*	*85*	*75*	-	-	-	-	-	*H*	-	-	-	-	*M*	-	-	-	*H*

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 %*

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*3. Dr. T, Pushpa Malini SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	**2.***Prof. M. Arthanareeswari, SRMIST*

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Semester-IV

Course Code	UCY23401T	Course Name	Coordination Chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
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:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	Understand the basic terms and use standard rules to name coordination compounds	4	H	-	-	-	-	-	M	-	-	-	-	-	H	-	-
CLO-2:	Discuss the various types of isomerism possible in a metal complex.	4	-	H	-	H	-	L	-	-	-	-	-	-	-	-	-
CLO-3:	Correlate the gradational development of theories of coordination complexes due to splitting of orbitals.	4	-	H	-	-	-	-	M	-	-	-	-	-	-	H	-
CLO-4:	Gaining the knowledge of magnetic properties and color of complexes	4	M	-	-	-	H	-	-	-	-	-	-	-	H	-	-
CLO-5:	Realize the important properties of transition metals and use Latimer diagrams to predict and identify different types species	4	-	H	-	-	-	L	-	-	-	-	-	-	-	H	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to coordination chemistry: Ligands-monodentate, bidentate, and polydentate ligands	Introduction of Stability of Coordination Complexes: Stability of complexes	Introduction of Theory of Coordination Complexes: Valence bond theory (VBT): Assumptions,	Introduction of Reaction mechanisms in coordination compounds-I	Introduction of reaction mechanisms in coordination compounds-II: Electron transfer reactions,
	SLO-2	Coordination sphere, coordination number				
S-2	SLO-1	Ambidentate ligands, bridging ligands	Thermodynamic stability- Stable and unstable complexes. Kinetic stability-labile and inert complexes	VBT as applied to octahedral, tetrahedral and square planer complexes	Labile and inert complexes on the basis of valence bond theory	One electron transfer reaction, Inner sphere mechanism and Outer sphere mechanism
	SLO-2	Bridged complexes, flexidentate ligands Chelation, chelate effect, formation of metal-metal bond in dimers				
S-3	SLO-1	Nomenclature of coordination compounds	Stepwise and overall formation of coordination complexes	Magnetism and drawbacks of VBT	Ligand substitution reactions in octahedral complexes. Ligand Dissociation, association mechanism and Interchange mechanisms	Marcus's theory and its applications. Two electron transfer reactions
	SLO-2	Werner 's coordination theory- Salient features and limitatiosn Designation and formation of	Relation between stepwise and overall stability constant	Crystal field theory (CFT): salient features. Crystal field splitting of	Reaction profile of dissociative and association mechanisms.	complementary and non-complementary electron transfer reactions

Duration (hour)		12	12	12	12	12
		Co(III) ammines and experimental verifications		d-orbitals in tetrahedral and Octahedral complexes	Factors affecting rates of substitution reactions.	
S-4	SLO-1	Tutorial: Formula to Name	Tutorial: calculation related to stepwise stability constant	Tutorial: Problem solving related to VBT	Tutorial: equations related to substitution reactions	Tutorial: equations related to Inner sphere mechanism
	SLO-2					
S-5	SLO-1	Sidgwick's electronic concepts of coordination bond in coordination compounds	Factors affecting stability of coordination compounds	tetragonal complexes	Mechanism of hydrolysis reactions	Non-complementary electron transfer reactions
	SLO-2	Sidgwick's effective atomic number (EAN) rule	Properties of metal ions and ligands	square planar complexes	Acid hydrolysis-octahedral complexes with π-donor inert ligand	Molecular rearrangements of four-coordinate and
S-6	SLO-1	Application of EAN rule in coordination complexes	Stability of chelates	Factors influencing the magnitude of CFT	Acid hydrolysis-octahedral complexes with π-donor inert ligand	Molecular rearrangements of six-coordinate complexes
	SLO-2	Limitations of Sidgwick's concept	Steric effects on chelates	Crystal field stabilization energy (CFSE) of dx ions	Π-acceptor inert ligand	Synthesis of coordination compounds using electron transfer reactions
S-7	SLO-1	Isomerism in coordination compounds: Structural isomerism	Electron delocalization	High-spin complexes	Without π-donor and π-acceptor inert ligand	Synthesis of coordination compounds using electron transfer reactions
	SLO-2	Conformation linkage, ionization and hydrate	Electron delocalization	and low-spin complexes	Without π-donor and π-acceptor inert ligand	Metal-assisted reactions
S-8	SLO-1	Tutorial: Calculation related to EAN	Tutorial: stability of complexes	Tutorial: Problem solving related to CFT	Tutorial: equations related to hydrolysis reactions	Tutorial: equations related to rearrangements
	SLO-2					
S-9	SLO-1	Ligand coordination,	Methods for the determination of stability constants	Applications of CFT-colour in coordination compounds	Experimental tests of mechanisms and stereochemistry	Aldol condensation
	SLO-2	coordination position Polymerization isomerisms	Composition of a complex-spectrophotometric method	Magnetic moment values of complex	Base hydrolysis-associative SN2	Ester hydrolysis phosphate ester,
S-10	SLO-1	Stereoisomerism: geometrical isomerism	Continuous variation method (job's method),	Limitations of CFT	Dissociative SN1CB mechanisms	aminoesters and amide hydrolysis
	SLO-2	Stereoisomerism: geometrical isomerism	Bjerrum's method and Irving method	Jahn-teller theorem-crystal field splitting	Dissociative SN1CB mechanisms	Template effect
S-11	SLO-1	Optical isomerisms-4 and 6 coordinate complexes.	Rossotti method and limitations	Jahn-teller splitting in tetragonally distorted octahedral geometry	Stereochemistry of dissociative mechanism	Synthesis of macrocyclic ligands
	SLO-2	Optical isomerisms-4 and 6 coordinate complexes.	Rossotti method and limitations	Jahn-teller splitting in square planar geometry	Racemization reaction	Reaction of coordinated ligands
S-12	SLO-1	Practice: construct the structure based on geometrical isomerism	Practice: stability constants	Practice: Problem solving related to Magnetic moment	Practice: equations related to hydrolysis reactions	Practice: macrocyclic ligands
	SLO-2					

Learning Resources	1. B. W. Pfennig, Principles of Inorganic chemistry. John Wiley & Sons, 2015. 2. K. F. Purcell, J. C. Kotz, Inorganic Chemistry W.B. Saunders Co, 1977. 3. J. E. Huheey, Inorganic Chemistry, Prentice Hall, 1993. 4. P. W. Atkins, T. Overton, Shriver and Atkins' inorganic chemistry 6th Ed. Oxford University Press, USA, 2010. 5. F. A. Cotton, G. Wilkinson, G., Advanced Inorganic Chemistry Wiley-VCH, 1999. 6. C. E. Barnes, Inorganic Chemistry 4th Ed. (Catherine E. Housecroft and Alan G. Sharpe). Journal of Chemical Education, 2003. 7. F. Basolo, R. C. Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967. 8. N. N. Greenwood, A. Earnshaw, Chemistry of the Elements, Butterworth-Heinemann, 1997. **9.** G. L. Miessler, D. A.Tarr, Inorganic Chemistry 3rd Ed.(adapted), Pearson, 2009.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice

Level 1	Remember	30%	-	30%	-	30%	-	20%	-	30%	-
	Understand										
Level 2	Apply	50%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	20%	-	20%	-	20%	-	30%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*Dr. Mihir Ghosh, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	*Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23402T	Course Name	Heterocyclic Compounds, Natural Products and Biomolecules	Course Category	C	Discipline Specific Core	L	T	P	O	C
							4	0	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Understandand and gain knowledge on the importance of heterocyclic chemistry.	
CLR-2 :	Know the role of heterocyclic compound for the development of therapeutic drugs	
CLR-3 :	Understand the methods of isolation, purification and structural elucidation of natural products.	
CLR-4 :	Gain basic knowledge on biomolecules and to build the concept of metabolism for biological systems.	
CLR-5 :	Gain knowledge about enzymes, enzymatic reactions and inhibition.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Familiar with their particular properties, chemical reactions, criterion of aromaticity with reference to heterocyclic compounds.	4	H	-	H	-	-	-	M	-	-	-	-	-	-	-	-
CLO-2 :	Know general methods of synthesis of heterocyclic compounds.	4	-	H	-	-	H	L	-	-	-	-	-	-	-	-	-
CLO-3 :	Learn a practical approach to the structure elucidation of organic compounds with specific examples of alkaloids and terpenes.	4	-	-	H	-	M	-	M	-	-	-	-	-	-	-	-
CLO-4 :	Demsonstrate and imply the synthetic chemistry knowledge of carbohydrates	4	H	H	-	-	-	-	-	-	L	-	-	-	-	-	-
CLO-5 :	Understand the synthetic importance of amino acids, peptides, enzymes, nuclei acids and lipids	4	M	H	-	-	-	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Heterocyclic compounds: Introduction	General discussion on Structure, aromaticity 6-membered rings containing one heteroatom	Alkaloids: Introduction	Carbohydrates: Occurrence, classification and their biological importance	α-Amino Acids – Reactions
	SLO-2	Heterocyclic compounds: Introduction	General discussion on Structure, aromaticity 6-membered rings containing one heteroatom	Alkaloids: Introduction	Carbohydrates: Occurrence, classification and their biological importance	Zwitterions, pKa values and Isoelectric point, Electrophoresis
S-2	SLO-1	Heterocyclic compounds: importance, classification	Basicity and relative reactivity towards electrophilic substitution reactions (amongst six membered rings)	Natural occurrence	Monosaccharides: Constitution and absolute configuration of glucose	Peptides and its classification
	SLO-2	Heterocyclic compounds: importance, classification	Basicity and relative reactivity towards electrophilic substitution reactions (amongst six membered rings)	Natural occurrence	Monosaccharides: Constitution and absolute configuration of fructose	determination of their primary structures-end group analysis
S-3	SLO-1	Nomenclature of heterocyclic compounds (containing only one hetero atom)	General methods of synthesis for pyridine (Hantzsch synthesis)	Classification and uses	Monosaccharides - stereoisomerism, Mutarotation.	Synthesis of peptides using N-protecting, C-protecting and C-activating groups

Duration (hour)		12	12	12	12	12
	SLO-2	Nomenclature of heterocyclic compounds (containing only one hetero atom)	General methods of synthesis for Indole (Fischer indole synthesis)	Classification and uses	Epimers and anomers Osazone formation	Synthesis of peptides using N-protecting, C-protecting and C-activating groups
S-4	SLO-1	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
	SLO-2	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	Proteins and its classification
S-5	SLO-1	Basicity and relative reactivity towards electrophilic substitution reactions (amongst five membered rings)	Quinoline Synthesis: Skraup synthesis, Friedlander"s synthesis	General methods for structure elucidation: Hoffmann"s exhaustive methylation and Emde"s method	Haworth projections and conformational structures	primary, secondary and tertiary structures of proteins
	SLO-2	Basicity and relative reactivity towards electrophilic substitution reactions (amongst five membered rings)	Knorr quinoline synthesis, DoebnerMiller synthesis	General methods for structure elucidation: Hoffmann"s exhaustive methylation and Emde"s method	Haworth projections and conformational structures	primary, secondary and tertiary structures of proteins
S-6	SLO-1	General methods of synthesis for Furan (Paal-Knorr synthesis, Feist-Benary synthesis and its variation)	Bischler-Napieralski reaction, PictetSpengler reaction, Pomeranz-Fritsch reaction)	Structure elucidation of Nicotine	Interconversions of aldoses and Ketoses	Denaturation
	SLO-2	General methods of synthesis for Furan (Paal-Knorr synthesis, Feist-Benary synthesis and its variation)	Bischler-Napieralski reaction, PictetSpengler reaction, Pomeranz-Fritsch reaction)	Structure elucidation of Nicotine	Interconversions of aldoses and ketoses	Enzymes: Introduction
S-7	SLO-1	Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis)	Discuss the reaction mechanism for Pyridine and Indole, Electrophilic substitution Sulphonation	Synthesis and physiological action of Nicotine	Killiani- Fischer synthesis	Classification and characteristics of enzymes
	SLO-2	Pyrrole (Hantzsch synthesis)	Discuss the reaction mechanism for Pyridine and Indole, Electrophilic substitution Sulphonation	Synthesis and physiological action of Nicotine	Ruff degradation	Mechanism of enzyme action (taking chymotrypsin as an example)
S-8	SLO-1	General methods of synthesis for Thiophene (Paal-Knorr synthesis)	Discuss the reaction mechanism for Quinoline and Isoquinoline: Electrophilic substitution Sulphonation	Terpenes : Introduction, Occurrence and Uses	Disaccharides – reducing and non reducing sugars	Factors affecting enzyme action

Duration (hour)		12	12	12	12	12
	SLO-2	General methods of synthesis for Thiophene (Hinsberg synthesis)	Discuss the reaction mechanism for Quinoline and Isoquinoline: Electrophilic substitution Sulphonation	Terpenes : Introduction, Occurrence and Uses	Disaccharides – Structure elucidation of maltose	Coenzymes and cofactors (NAD, FAD)
S-9	SLO-1	Properties: Physical properties	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Electrophilic substitution: Halogenation	Classification, isoprene and special isoprene rule	Disaccharides – Structure elucidation of lactose	Specificity of enzyme action (including stereospecificity)
	SLO-2	Chemical reactions of Furan	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Electrophilic substitution: Formylation	Classification, isoprene and special isoprene rule	Disaccharides – Structure elucidation of lactose	Enzyme inhibitors and their importance
S-10	SLO-1	Chemical reactions of Furan	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Electrophilic substitution: Mercuration	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
	SLO-2	Chemical reactions of Furan	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Electrophilic substitution: Carboxylation	General methods of structure elucidation including distinction between isopropylidene and isopropenyl group	Disaccharides – Structure elucidation of sucrose	Nomenclature of nucleosides and nucleotides
S-11	SLO-1	Chemical reactions of Pyrrole	Discussion the reaction mechanism for , Pyridine, Indole, Quinoline and Isoquinoline: Oxidation	Citral: Elucidation of structure	Amino acids and its classification	Structure of DNA and RNA
	SLO-2	Chemical reactions of Pyrrole	Discussion the reaction mechanism for Pyridine, Indole, Quinoline and Isoquinoline: Reduction	Citral: Elucidation of structure	α-Amino Acids: Synthesis	Biological roles of DNA and RNA
S-12	SLO-1	Chemical reactions of thiophene	Reactions showing acidic /basic character	Synthesis of Citral, its industrial application.	α-Amino Acids: Synthesis and Ionic properties	Concept of heredity: Genetic Code, Transcription and Translation
	SLO-2	Chemical reactions of thiophene	Reactions showing acidic /basic character	Synthesis of Citral, its industrial application.	α-Amino Acids: Synthesis and Ionic properties	Lipids : Introduction to oils and fats

Learning Resources

Theory:

1. G. L. Thomas Heterocyclic chemistry, Pearson Education, 3. ed. 1997 (ISBN 0-582-27843-0).
2. R. M. Acheson, Introduction to the Chemistry of Heterocyclic compounds, John Welly&Sons ,1976.
3. A. J. John, K. Mills, Heterocyclic chemistry.– 5th ed 1995.
4. R. K. Bansal, Heterocyclic Chemistry, Synthesis, Reactions and Mechanisms, Wiley Eastern Ltd., 1990.
5. I. L. Finar, Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) 2002.
6. J. M. Berg, J. L. Tymoczko, L. Stryer, Biochemistry. VIth Edition. W.H. Freeman and Co., 2006.
7. 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

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Samarendra Maji,* SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari, SRMIST*

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Course Code	***UCY23403T***	***Course Name***	***Chemical kinetics and Electrochemistry***	***Course Category***	*C*	***Discipline Specific Core***	***L***	***T***	***P***	***O***	***C***
							3	***1***	***0***	***2***	***4***

Pre-requisite Courses	***Nil***	**Co-requisite Courses**	***Nil***	**Progressive Courses**	***Nil***

Course Offering Department	*Chemistry*	Data Book / Codes/Standards	*Nil*

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1:	*gain knowledge on the importance of*	
CLR-2 :	*enable the students to acquire knowledge to determine kinetic parameters.*	
CLR-3 :	Understand about the basic electrochemistry	
CLR-4 :	Explain the various theories of Electrochemical energy storage systems	
CLR-5 :	Gain knowledge about the electrical double layer and electrode kinetics	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the basic principles of chemical kinetics.	*4*	*H*	-	-	-	-	-	*M*	-	-	-	-	*H*	-	-	-
CLO-2 :	Gain knowledge about the steady state approximation	*4*	*H*	*H*	-	-	*H*	-	-		-	-	-	-	-	-	-
CLO-3 :	Acquaint the student with the fundamental concepts of basic electrochemistry	*4*	*H*	-	-	-	*H*	-	*M*	-	-	-	-	-	-	-	-
CLO-4 :	Understand the principles of electrodes	*4*	*H*	-	-	*H*	-	-	-	-	*M*	-	-	-	-	-	-
CLO-5 :	Understand the basic principles of liquid junction potential	*4*	-	*H*	-	-	-	*L*	*H*	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction and basics of chemical kinetics	collision theory and reaction kinetics	reactions between ions	Introduction to Electrochemical cell	Types of electrolyte – concentration cells
	SLO-2	Rate law, Order and molecularity			Galvanic cell	Without transference,
S-2	SLO-1	integrated rate laws for zero	kinetic energy of molecules – Boltzmann and Maxwell interpretation,	ion-dipole and dipole dipole reactions	Reversible electrodes-	Concentration cell- With transference
	SLO-2	first and second order reactions			Metal –Metal ion electrodes, gas electrode, Metal – Insoluble metal salt electrode	
S-3	SLO-1	(example using acid catalyzed hydrolysis of methyl acetate)	Transition state theory: assumptions, expression for rate of reaction in presence of activated complex,	structure, significance of volume and entropy of activation, pressure effect	Oxidation-reduction electrodes	Liquid junction
	SLO-2	n^{th} order reactions	Eyring's equation for rate (elementary treatment)	Primary and secondary salt effects	Single electrode Potential	Determination of activity coefficient of electrolytes
S-4	SLO-1	Tutorial: pseudo first order reaction	Tutorial: Transition state theory: assumptions, expression for rate of reaction in presence of activated complex,	Tutorial: structure, significance of volume and entropy of activation, pressure effect	Tutorial: Oxidation-reduction electrodes	Tutorial: Concentration cell- With transference
	SLO-2					
S-5	SLO-1	factors affecting rate of a reaction	Lindemann theory of unimolecular reaction	Kinetics of photophysical and photochemical processes	Effect of concentration of electrolyte on cell potential	Determination of Transport number
	SLO-2	factors affecting rate of a reaction –	steady state approximation	complex photochemical processes, homogeneous catalysis	Effect of concentration of electrolyte on cell potential	Determination of the solubility product constants
S-6	SLO-1					

Duration (hour)		12	12	12	12	12
	SLO-2	concentration, pressure, temperature	Absolute reaction rate theory (ARRT)	general catalytic mechanisms,	Effect of concentration of electrolyte on cell potential	Determination of the solubility product constants
S-7	SLO-1	effect of temperature on reaction rate and activation energy (concept only).	Application of ARRT to simple bimolecular process	acid-base catalysis	Standard electrode potential	Determination of pH- using hydrogen electrode
	SLO-2	radioactive decay as first order phenomenon	study of kinetics of chain reaction like H2-Br2 reaction	catalysis by enzymes,	Electrochemical series	Energy storage devices
S-8	SLO-1	Practice: explain the effect of temperature on reaction rate	Practice: Absolute reaction rate theory (ARRT)	Practice: general catalytic mechanisms	Practice: Effect of concentration of electrolyte on cell potential	Practice: Explain different kind of energy storage devices
	SLO-2					
S-9	SLO-1	Opposing reactions, consecutive reactions	H2 and O2 explosive reaction	influence of concentration (single substrate, double substrate)	Electromotive force of a Galvanic cell	Fuel cell-(hydrogen-oxygen)
	SLO-2	parallel reactions	Determination of order of chain reaction	Faraday's laws of electrolysis	Activity and	Primary and secondary batteries
S-10	SLO-1	Chain reactions	Effect of ionic strength on rate constant of Persulphate Iodine reaction	Specific conductance, equivalent conductance	Mean ionic activity of an electrolyte	Kinetics of electrode process. Electrical aspects of surface chemistry,
	SLO-2	Arrhenius concept of activation energy,	Determination of order of chain reaction	Cell constant - Arrhenius theory Ostwald"s dilution law and Kohlrausch law	Concentration cell- Electrode concentration cell	electrical double layer, Stern treatment of the electrical double layer, free energy of a diffuse double layer
S-11	SLO-1	Temperature dependence of rate constant	Principle of microscopic reversibility	Nernst equation	Concentration cell- Electrode concentration cell	concentration polarization and over voltage
	SLO-2	Rate-determining step and steady-state approximation	And detailed balancing	Applications of EMF-Measurements	Electrolyte - Concentration cell	decomposition voltages
S-12	SLO-1	Tutorial: What do you mean by parallel reactions	Tutorial: Determination of order of chain reaction	Tutorial: explain the Faraday's laws of electrolysis	Tutorial: explain electromotive force of a Galvanic cell	Tutorial: reaction mechanism of Fuel cell
	SLO-2					

Learning Resources	Theory: 1. *P. W. Atkins, L. Jones, L. Laverman Chemical Principles: The Quest for Insight, 6th ed. W H Freeman and Company, New York, 2013.* *2. H. E. Avery, Basic Reaction Kinetics and Mechanism, Mcmillan Publishers Ltd., 1974.* *3. K. J. Laidler, Chemical Kinetics, Tata McGraw Hill 1987.* *4. G. Raj, Chemical Kinetics, Goel Publishing House 2002.* *5. P. W. Atkins, Physical Chemistry* W.H. Freeman and Company 8th edition 2018.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	20%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-

	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1.Dr. Srinivasa Rao, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	***2.*** *Prof. M. Arthanareeswari, SRMIST*

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Course Code	UPY23G03T	Course Name	Data, Statistics, and Inference	Course Category	G	Generic Elective Course	L	T	P	O	C
							3	1	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	understand Random Variables, Probability, and Probability Functions	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-2 :	understand measures of Centrality, Variance, and Covariance																		
CLR-3 :	understand ideas of Regression																		
CLR-4 :	understand the idea of Statistical Confidence																		
CLR-5 :	understand Hypothesis Testing																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	represent Data in different types of Graphical and Tabular forms	2	75	60	-	-	H	H	-	-	-	H	-	-	-	-	-	-	-
CLO-2 :	form Samples of Data and construct estimators for mean, variance, and covariance	2	80	70	-	-	H	H	-	-	-	H	-	-	-	-	-	-	-
CLO-3 :	fit functions to and estimate model parameters from data	2	70	65	-	-	H	H	-	-	-	H	-	-	-	-	-	-	-
CLO-4 :	test hypotheses given a data sample	2	70	70	-	-	H	H	-	-	-	H	-	-	-	-	-	-	-
CLO-5 :	express statements in terms of Statistical Confidence Intervals	2	80	70	-	-	H	H	-	-	-	H	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Types of Data	Normal Distribution	Parameter Estimation	χ^2 Cumulative	Goodness of Fit
	SLO-2	Representation of Data	Moments of Normal Distribution	Estimators for Mean, Variance, and Cov	χ^2 Confidence Intervals	Examples
S-2	SLO-1	Probability	Poisson Distribution as Limiting case of Binomial	Linear Regression	Likelihood Functions	t-distribution and t-statistic
	SLO-2	Random Variables	Normal Approximation	Least Square Estimation of Regression Parameters	Properties of ML Estimators	Conditions for t-testing
S-3	SLO-1	Probability Mass Function	Operations on a Normal Variable	Derivation of LLS estimators	ML with binned data	One sample test
	SLO-2	Probability Density Function	Operations on two Normal Variables	Derivation of LLS	Examples	Two sample test
S-4	SLO-1	Introduction to Python	Random Numbers from different distributions in Numpy	Least Square Fit Using Scipy	CI with open data: Chemistry	GoF: Epidemiology
	SLO-2					
S-5	SLO-1	Mean and Variance as Moments	Joint PDF	Bias and Consistency	CI with ML	Correlation between samples
	SLO-2	Skewness and Kurtosis	Marginal Distributions	Convergence and Robustness	Case Studies	Paired Testing
S-6	SLO-1	Cumulative Distributions	Covariance	Least Square for Polynomials	Combining Measurements with ML	Proportion testing
	SLO-2	Examples: Percentiles	Covariance Matrix	Examples	Estimated Variance	Applications of Proportion testing
S-7	SLO-1	Bernoulli Trial	Error Propagation	Least Squares with Binned Data	Hypothesis Testing	Introduction to Bayesian Statistics
	SLO-2	Binomial Distribution	Error Propagation with Covariance	Normalisation	Binary Classification	Prior and Posterior
S-8	SLO-1	Introduction to Numpy Arrays	Marginal Distributions and Joint PDFs	Binned Data Fit Using Scipy	ML to fit function with open data: Economics	Paired t-test: Nutrition
	SLO-2					

S-9	**SLO-1**	*Moments of Binomial Distribution*	*Statistical and Systematics Error*	*Confidence Interval (CI)*	*p-value*	*Bayesian Estimation*
	SLO-2	*Cumulative Binomial*	*Statistical Error as Variance*	*CI for Normally Distributed Estimator*	*Confidence Level*	*Connecting ML to Bayesian Estimation*
S-10	**SLO-1**	*Counting Statistics*	*Population and Sample*	*χ^2 Distribution`*	*Likelihood Ratio*	*Bayesian Testing*
	SLO-2	*Poisson Distribution*	*Sample Mean and Variance*	*Degrees of Freedom*	*Likelihood Ratio Test*	*Examples of Bayesian Testing*
S-11	**SLO-1**	*Moments of Poisson Distribution*	*Law of Large Numbers (Statement)*	*χ^2 from a Normal Distribution*	*χ^2 test*	*Bayesian Credibility*
	SLO-2	*Counting Statistics*	*Central Limit Theorem (Statement)*	*The variance of Normally Distributed Samples*	*Pearson's and Neyman's χ^2 test*	*Credible intervals*
S-12	**SLO-1**	*Plotting in Matplotlib*	*Visualising the Law of Large Numbers and the Central Limit Theorem*	*Counting Experiments: Decay*	*Likelihood Ratio Test: Atmospheric Science*	*Bayesian A/B testing: Retail*
	SLO-2					

Learning Resources	1. Introduction to the Theory of Statistics; A Mood, F Graybill, D Boes; McGraw Hill Education; 3rd edition (2017). 2. A First Course in Probability, S Ross; Pearson; 10th ed (2022). 3. A Students Guide to Data and Error Analysis; HJC Berendsen; Cambridge University Press. Statistics; RS Witte, JS Witte; Wiley; 11th ed (2017).	4. Statistical Methods in Experimental Physics; F James; World Scientific; 2nd edition (2006). 5. Statistical Inference; G Casella, R Berger; Cengage India Private Limited (2007). 6. Statistical Data Analysis; G Cowan; Oxford Science Publications (1998).

Learning Assessment

	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	30%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	50%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate Create	20%	-	20%	-	20%	-	20%	-	20%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr Arvind Holur Vijay, ML Engineer, Tri3d, India	*Dr Sandipan Dutta, Dpt of Mathematics and Statistics, Old Dominion University, USA.*	*Dr Triparno Bandyopadhyay, SRMIST.*
Dr Nabanita Ganguly, Data Scientist, Infosys, India.		*Dr Naga Rajesh A, SRMIST.*

Course Code	**UMA23G11T**	**Course Name**	**Allied Mathematics**	**Course Category**	**G**	**Generic Elective Course**	**L**	**T**	**P**	**O**	**C**
							3	**1**	**0**	**2**	**4**

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Understand the concept of sets, relations and functions	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Gain knowledge on the basics of logic																		
CLR-3 :	Obtain the knowledge on polynomial equations																		
CLR-4 :	Gain knowledge on Matrices and its applications																		
CLR-5 :	Comprehend the working principle of various calculus techniques																		
Course Learning Outcomes (CLO):	**At the end of this course, learners will be able to:**																		
CLO-1 :	Acquire the knowledge on sets and functions	3	80	85	M	H	-	-		-	-	-	-	-	-	H	-	-	-
CLO-2 :	Gain the ability to identify science and engineering problems logically	1	75	80	M	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about polynomial equations	3	85	80	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of Matrices in real life situations	3	80	75	M	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge of different calculus techniques	1	75	85	M	-	-	H	-	-	-	-	-	-	-	-	-	-	-

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	Sets - sets definition and representation of sets	Statements	Polynomial equations	Symmetric matrices,	Introduction to calculus
	SLO-2	Examples for sets and representations	Examples for statements	Examples for Polynomial equations	Skew symmetric matrices	Differential calculus - Introduction
S-2	SLO-1	Types of sets, operation on sets, Venn diagram	connectives, conjunction	Irrational roots	Hermitian, skew Hermitian matrices	Maxima and minima-Introduction
	SLO-2	Examples for types of sets and operations on sets	Examples for connectives, conjunction	Problems on irrational roots	Examples for different types of matrices	Simple problems on maxima and minima of functions of single variable
S-3	SLO-1	Relation - Types of Relation	Disjunction, negation	complex roots(up to third order equations only)	Orthogonal, Unitary matrices	More problems on maxima and minima
	SLO-2	Examples for types of relation	Examples for Disjunction, negation	Problems on equations with complex roots	Examples for Orthogonal, Unitary matrices	More problems on maxima and minima
S-4	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
S-5	SLO-1	Equivalence Relation	Tautology, Contradiction	Reciprocal equations	Cayley Hamilton Theorem	More problems on maxima and minima

	SLO-2	Examples and problems on equivalence relation	Problems on tautology, contradiction	Problems on reciprocal equation	Problems on Cayley Hamilton Theorem	Radius of curvature – Introduction
S-6	SLO-1	Function - Introduction	logical equivalence	Approximation of roots of a polynomial equation	Problems on Cayley Hamilton Theorem	Problems on Radius of curvature- Cartesian co – ordinate
	SLO-2	Types of functions	Examples for logical equivalence	Newton's Method-Introduction	Eigen values– Eigen vectors	Problems on Radius of curvature
S-7	SLO-1	Problems for different functions	tautological implications	Newton's method-Finding positive roots	Problems on Eigen values– Eigen vectors	More problèmes on radius of curvature
	SLO-2	Composite of two functions	Examples for tautological implications	More problems Newton's method-Finding positive roots	Problems on Eigen values– Eigen vectors	Partial differentiation
S-8	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
S-9	SLO-1	Examples for composite functions	Arguments , Validity of arguments	Problems on Newton's method- Finding reciprocal of a given number	Problems on Eigen values– Eigen vectors	Problems on partial differentiation
	SLO-2	Composite of three functions	Normal forms	Problems on Newton's method- Finding Square root of a given number	Problems on Eigen values– Eigen vectors	More problems on partial diferentiation
S-10	SLO-1	Examples for composite of three functions	Principal disjunctive normal form	Horner's method-Introduction	Cramer's rule-Introduction	Euler's theorem-Introduction
	SLO-2	Problems on functions	Problems for pdnf	Horner's method Finding positive roots	Solving system of linear equations-Crammer's rule	Problems on Euler's theorem
S-11	SLO-1	Problems on composite of two functions	Principle conjunctive normal form	Problems on Horner's method- finding roots between given values	Problems on Crammer's rule	More Problems on Euler's theorem
	SLO-2	Problems on composite of three functions	Problems for pcnf	More Problems on Horner's method	More Problems on Crammer's rule	More Problems on Euler's theorem
S-12	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial

Learning Resources	1. T. Veerarajan, Discrete Mathematics, 7th Edition, Tata-Mcgraw hill, New Delhi, 2006. 2. A. Singaravelu, ALLIED MATHEMATICS, 3rd Edition, Meenakshi Agency, Chennai, 2011.	3. P. R. Vittal, Allied Mathematics, 4th Edition Reprint, Margham Publications, Chennai, 2013. 4. S.G. Venkatachalapathy, Allied Mathematics, 1st Edition Reprint, Margham Publications, Chennai, 2007.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	50%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate Create	20%	-	20%	-	20%	-	20%	-	20%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Madhan Shanmugasundaram, Infosys Technologies madshan@gmail.com	1. Dr. Y.V.S.S. Sanyasiraju, IIT Madras sryedida@iitm.ac.in	1. Dr. V. Subburayan, SRMIST hod.maths.ktr@srmist.edu.in
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Course Code	ULT23AE2J	Course Name	Applied Tamil – II	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1:	அகராதி, கலைச்சொல் குறித்த நுட்பங்களை அறியச் செய்தல்	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLR-2:	நேர்காணல் செய்யும் திறனும் செய்தி வாசிப்பு முறைகளையும் தெரியச் செய்தல்																		
CLR-3:	விமர்சனத்தின் தன்மைகளும் செய்தியறிக்கை தயாரிக்கும் முறையையும் அறியச் செய்தல்																		
CLR-4:	பேச்சுக்கலையின் தனித்துவங்களைப் புரியச் செய்தல்																		
CLR-5:	கணினித்தமிழின் பல்வேறு நுட்பங்களைத் தெரியச் செய்தல்																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1:	அகராதித்துறை, கலைச்சொல்லாக்கத் துறையைத் தெரிந்துகொள்ளுதல்	*2*	*75*	*60*	*H*	*L*	*H*	*M*	*H*	*H*	*L*	*M*	*H*	*M*	*L*	*H*	-	-	-
CLO-2:	ஊடகங்களில் மொழி ஆளுமையோடு செயல்படும் திறன் பெறுதல்	*2*	*80*	*70*	*H*	*M*	*H*	*L*	*M*	*H*	*L*	*H*	*M*	*L*	*H*	*H*	-	-	-
CLO-3:	கலை, இலக்கிய விமர்சன முறைகளையும், செய்தியறிக்கை தயாரிக்கும் நுட்பங்களையும் தெரிந்துகொள்ளுதல்	*2*	*70*	*65*	*H*	*L*	*H*	*M*	*H*	*H*	*M*	*H*	*L*	*H*	*M*	*H*	-	-	-
CLO-4:	பல்வேறு வடிவங்களைக் கொண்ட பேச்சுக்கலையை அறிவதன்வழி, சிறந்த மேடைப் பேச்சாளராக உருவாகும் தகுதியைப் பெறுதல்	*2*	*70*	*70*	*H*	*M*	*H*	*L*	*H*	*M*	*M*	*H*	*H*	*L*	*H*	*H*	-	-	-
CLO-5:	தமிழைக் கணினி வழி, இணையம் வழி கொண்டுசேர்க்கும் உலகளாவிய செயல்பாடுகளை அறிந்துகொள்ளுதல்	*2*	*80*	*70*	*H*	*M*	*H*	*H*	*M*	*H*	*L*	*M*	*H*	*L*	*H*	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	தமிழில் அகராதிகள்	நேர்காணல் அறிமுகம்	விமர்சனம் – அறிமுகம்	பேச்சுக்கலை	கணினித்தமிழ்
	SLO-2	ஒரு மொழி/ இருமொழி அகராதி	ஆளுமைத்திறன்	விமர்சனத்தின் நோக்கம்	பேச்சின் அடிப்படைகள்	கணினி வழித் தட்டச்சு

S-2	SLO -1	பன்மொழி அகராதி	நோக்கம் – கண்டறிதல்	விமர்சன வகைகள்	தன்னம்பிக்கையும் பேச்சும்	தட்டச்சு செய்யும் மென்பொருட்கள்
	SLO -2	உயிர்/ மெய் எழுத்துகள்	நேர்காணல் முறைகள்	இலக்கிய விமர்சனம்	பேச்சின் வகைகள்	எழுத்துருக்கள்
S-3	SLO -1	உயிர்மெய் எழுத்துகள்	இனிய சொற்கள் பயன்பாடு	திரை விமர்சனம்	மேடைப் பேச்சு	யூனிகோடு எழுத்துருக்கள் / பிற எழுத்துருக்கள்
	SLO -2	அகராதிக்கான அடிப்படைகள்	நேர்காணல் வகைகள்	கலை விமர்சனம்	பட்டிமன்றப் பேச்சு	குரல் வழி தட்டச்சு
S-4	SLO -1	அகராதி உருவாக்கப் பயிற்சி	நேரடியாக வினா விடை	விமர்சகர் தகுதிகள்	சொற்பொழிவு முறை	எழுத்து வழி தட்டச்சு
	SLO -2	அகராதி உருவாக்கப் பயிற்சி	அச்சு ஊடக நேர்காணல்	தேர்ந்த புலமை	பேச்சின் நுட்பங்கள்	தட்டச்சு செய்யும் பயிற்சி
S-5	SLO -1	கலைச்சொல் அறிமுகம்	காட்சி ஊடக நேர்காணல்	எழுத்துவடிவ விமர்சனம்	பேச்சாளர்களும் பேசும் முறைகளும்	தட்டச்சு செய்யும் பயிற்சி
	SLO -2	பிறமொழிச் சொற்களும் தமிழில் கலைச் சொற்களும்	கேட்பு ஊடக நேர்காணல்	காட்சி வடிவ விமர்சனம்	பேச்சு - எடுத்துரைப்பும் உடல்மொழியும்	பிழை திருத்திகள்
S-6	SLO -1	கலைச்சொல்லாக்க நெறிமுறைகள்	கள ஆய்வில் நேர்காணல்	விமர்சனம் செய்யும் பயிற்சி	நவீன தொழில்நுட்பங்களில் பேச்சு முறைகள்	தமிழில் பிழை திருத்தம் செய்யும் மென்பொருட்கள்
	SLO -2	கலைச்சொல் உருவாக்க உத்திகள்	நேர்காணல் செய்யும் பயிற்சி	விமர்சனம் செய்யும் பயிற்சி	பேச்சாளர்க்குரிய தகுதிகள்	வலைப்பூ உருவாக்கம்
S-7	SLO -1	துறைசார் சொற்கள்	நேர்காணல் செய்யும் பயிற்சி	செய்தியறிக்கை	பேச்சுப் பயிற்சி	வலைப்பூவில் எழுதும் முறைகள்
	SLO -2	புதிய கண்டுபிடிப்புகளும் கலைச்சொற்களும்	செய்தி வாசிப்பு முறைகள்	சமூக நிகழ்வை எழுதுதல்	பேச்சுப் பயிற்சி	வலைப்பூவின் பயன்கள்
S-8	SLO -1	பயன்பாட்டுச் சொற்கள்	செய்தி வாசிப்பு நுட்பங்கள்	செய்தியாளர்க்குரிய தகுதிகள்	கலந்துரையாடலின் நோக்கம்	தமிழ் இணைய நூலகங்கள்
	SLO -2	கலைச்சொல்லாக்கப் பயன்பாடுகள்	உச்சரித்தல்	உற்றுநோக்குதல்	கலந்துரையாடலின் தனித்தன்மைகள்	இணைய நூலகப் பயன்பாடுகள்
S-9	SLO -1	கலைச்சொல் உருவாக்கப் பயிற்சி	பிழையின்றி வாசித்தல்	சமநிலையில் எழுதுதல்	தம் கருத்தைத் தெளிவாக உரைத்தல்	தமிழ்த் தொடரடைவுகள்
	SLO -2	கலைச்சொல் உருவாக்கப் பயிற்சி	வாசித்தலும் உணர்வும்	செய்தியறிக்கை தயாரித்தல்	கலந்துரையாடல் பயிற்சி	தொடரடைவின் பயன்பாடுகள்

Learning Resources	1. அகராதியியல், பெ. மாதையன், தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர், 1997. 2. பேச்சுக்கலை, ம. திருமலை, மீனாட்சி புத்தக நிலையம், மயூராவளாகம், மதுரை, 2009. 3. பேச்சாளராக, அ.கி.பரந்தாமனார், பாரி நிலையம், சென்னை, 1961 4. இணையத் தமிழ், சந்திரிகா சுப்பிரமணியன், சந்திரோதயம் பதிப்பகம், மதுரை, 2020. 5. நேர்காணல், மின்னூலகம், தமிழ் இணையக் கல்விக் கழகம், **https://www.tamilvu.org/**

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Expert from Higher Technical Institutions	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 & Head, Dept. of Tamil, FSH, SRMIST, KTR*
		2. Dr. R. Ravi, Assistant Professor and Head, Dept. of Tamil, FSH, SRMIST, VDP.
		3. Mr. G. Ganesh, Assistant Professor, Dept. of Tamil, FSH, SRMIST, RMP.
		4. Dr. T.R.Hebzibah beulah Suganthi, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.
		5. Dr. S.Saraswathy, Assistant Professor, Dept. of Tamil, FSH, SRMIST, KTR.

Course Code	ULH23AE2J	Course Name	*Applied Hindi – II*	Course Category	*AE*	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	*To find and analyze different types of Cinema*																		
CLR-2 :	*To Discover the print Media in the present World*																		
CLR-3 :	*Writing report for Employability*																		
CLR-4 :	*Writing Reviews and Create Job Oriented learning*																		
CLR-5 :	*To Acquire technical words for various job Prospects*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*To Understand the History and Documentary in Hindi Cinema*	*2*	*75*	*80*	*H*	*H*	*H*	*M*	*L*	*H*	*L*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-2 :	*To Comprehend Media Studies*	*2*	*80*	*90*	*H*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*L*	*L*	*H*	*M*	-	-	-
CLO-3 :	*To Evaluate report Writing*	*2*	*75*	*95*	*H*	*H*	*M*	*L*	*H*	*H*	*M*	*H*	*M*	*M*	*H*	*H*	-	-	-
CLO-4 :	*Enhance their Writing Skills in Media Studies*	*2*	*80*	*90*	*H*	*H*	*L*	*H*	*M*	*H*	*L*	*H*	*H*	*M*	*H*	*H*	-	-	-
CLO-5 :	*To Understand and usage of technical words in Hindi*	*2*	*85*	*90*	*M*	*H*	*M*	*H*	*L*	*H*	*H*	*L*	*H*	*M*	*H*	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	**SLO-1**	*HINDI CINEMA*	*MEDIA AUR HINDI BHASHA*	*REPORTARJ LEKHAN*	*FILM REVIEW& VIGYAPAN*	*PARIBHASHIK SHABDAVALI*
	SLO-2	*CINEMA KI AVDHARNA*	*AVDHARNA*	*AVDHARNA*	*ARTH*	*RTH*
S-2	**SLO-1**	*UDBHAV*	*SWARUP*	*SWARUP*	*PARIBHASHA*	*ARIBHASHA*
	SLO-2	*VIKASH*	*MAHATVA*	*DDESHYA*	*WARUP*	*WARUP*
S-3	**SLO-1**	*DOCUMENTRI MOVE KI AVDHARNA*	*MEDIA MEN BHASHA KA PRAYOG*	*AHATVA*	*AWADHARNA*	*RAKAR*
	SLO-2	*COMERCIAL MOVE KI AVDHARNA*	*UTTARDAYITVA*	*REPORTARJ LEKHAN KE PRATI RUCHI JAGANA*	*FILM REVIEW KA MAHATTVA*	*VADHARNA*
S-4	**SLO-1**	*PRAYOJAN*	*PRINT MEDIA*	*REPORTAJ KI BHUMIKA*	*VIGYAPAN AUR BAZAR*	*RAYOJAN*
	SLO-2	*UDDESHYA*	*ELECTRONIC MEDIA*	*PRAYOJAN*	*VIGYAPAN AUR ROZGAR*	*DDESHYA*
S-5	**SLO-1**	*MAHATVA*	*MEDIA KI JIMMEDARI*	*PRAYOG*	*PRINT VIGYAPAN*	*AHATVA*
	SLO-2	*PRAKAR*	*SMACHAR LEKHAN*	*UTTARDAYITVA*	*VIGYAPAN KI BHASHA*	*RAYOG*
S-6	**SLO-1**	*PRISHTHBHUMI*	*REPORTER KE GUN*	*RIPOTARJ LEKHAN*	*AWADHARNA*	*DDESHYA*
	SLO-2	*KARYASHALA*	*SAHAJTA*	*PUNRIKSHAN*	*RTH*	*AKANIKI SHABDAVALI KA MHATVA*
S-7	**SLO-1**	*DOCUMENTRY KI VIDHI*	*NISPAKSHTA*	*LEKHAN VIDHI*	*PARIBHASHA*	*HINDI SE ANGREZI SHABD*
	SLO-2	*DOCUMENTRY AUR COMERCIAL MOVE MEN ANTAR*	*PEET PATRAKARITA*	*SAMAJIK DAYRA*	*SWARUP*	*ANGREZI SE HINDI SHABD*
S-8	**SLO-1**	*COMERCIAL KI VIDHI*	*UTTARDAYITVA*	*SAHITYA ME RIPOTARJ LEKHAN*	*VIGYAPAN KE PRAKAR*	*EK DIN EK SHABD*
	SLO-2	*MOVE VISLESHAN*	*BHASHA GYAN*	*PARIYOJNA KARYA*	*VIGYAPAN KI VISHESHTAYEN*	*SHABDON KA VISLESHAN*
S-9	**SLO-1**	*PARICHARCHA*	*PARICHARCHA*	*PARICHARCHA*	*VIGYAPAN MANG*	*PATH PRICHARCHA*
	SLO-2	*PRASHNABHYASH*	*PRASHNABHYASH*	*PRASHNABHYASH*	*VIGYAPAN KA PRABHAV*	*PRASHNABHAYASH*

Learning Resources	***Edited Book: "PRAYOJAN MULOK HINDI", SRIJONLOK PUBLICATION, 2023, New Delhi.*** 1. Film Banti Hai aur Banati Bhi hai, Lekhika – Sonal, Neolit Publication 2. https://navbharattimes.indiatimes.com/entertainment/movie-review/articlelist/2325387.cms?curpg=3

	3. https://epustakalay.com/book/4858-hindi-patrakarita-by-dr-krishnbihari-mishra/ 4. https://hindisamay.com/ 5. https://rajbhasha.gov.in/hi/hindi-vocabulary

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Shri. Santosh Kumar Editor : Srijanlok Magazine Place: Vashishth Nagar, Ara – 802301	*1. Prof.(Dr.) S.Narayan Raju, Head, Department of Hindi,CUTN, Tamilnadu*	*1. Dr.S Preeti. Associate Professor & Head, SRMIST*
Alumni	***Student***	*2. Dr. Md.S. Islam Assistant Professor, SRMIST*
Ananya Singh Trainee Associate (Finance Operations) Cargill Business Services India Building 9,2nd and 3rd Floor, Cessna Business Park, Kaverappa Layout, Kadubeesanahalli, India, Bengaluru, Karnataka	Maimunah sheik Reg: RA2131001010006 Dept: of Biotechnology	*3.Dr. S. Razia Begum, Assistant Professor, SRM IST*
		4, Dr.Nisha Murlidharan Assistant Professor, VDP,SRM IST

Course Code	ULF23AE2J	Course Name	French for Specific purpose-II	Course Category	AE	Ability Enhancement Courses (AE)	L	T	P	O	C
							1	0	2	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Strengthen the language of the students both in oral and written	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
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																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	o enable the students to overcome the fear of speaking a foreign language and take position as a foreigner speaking French	2	75	80	H	M	H	H	M	H	H	L	M	M	H	L	-	-	-
CLO-2 :	*To strengthen the knowledge on concept, culture, civilization and translation of French*	2	80	90	M	H	L	H	H	M	H	M	L	L	H	M	-	-	-
CLO-3 :	*To develop content using the features in French language*	2	75	80	H	H	L	M	H	M	L	H	M	M	H	H	-	-	-
CLO-4 :	*To interpret the French language into other language*	2	75	90	H	L	M	H	M	H	H	M	L	H	M	L	-	-	-
CLO-5 :	*To improve the communication, intercultural elements in French language*	2	80	75	M	H	H	L	M	M	H	H	M	L	H	M	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	TOEIC	Les quantificateurs	Les prépositions de lieu	Les verbes irréguliers	La négation
	SLO-2	Qu'est-ce que c'est/	le génitif	Les activités	le futur et	l'interrogation
S-2	SLO-1	À qui est-il destiné ?	Les adjectifs	Les prépositions de temps -	le conditionnel	Les activités
	SLO-2	Les compétences évaluées	et pronoms possessifs	Les activités	les modaux	l'exclamation
S-3	SLO-1	Le nom	les pronoms	les temps et	La suggestion	Les activités
	SLO-2	Le pluriel des noms	Les pronoms personnels	Les activités	le conseil	l'emphase
S-4	SLO-1	Les indénombrables	les pronoms compléments	les aspects-	Les exemples	Les exemples
	SLO-2	Les noms composés	Les activités	Les activités	le reproche	Les activités
S-5	SLO-1	L'adjectif	pronoms réfléchis	Le présent simple	Les activités	l'impératif
	SLO-2	Les comparatifs	Les activités	Les activités	L'obligation	Les activités
S-6	SLO-1	les superlatifs	les adverbes	Le présent be+ing	la permission	la voix passive
	SLO-2	les articles définis (the)	Les activités	Les activités	l'interdiction	Les exemples
S-7	SLO-1	les articles indéfinis (a, an)	La place de l'adverbe dans la phrase	*Les exemples*	La capacité	les subordonnées relatives
	SLO-2	Les exemples	Les activités	Le prétérit simple - Le prétérit be+ V-ing	l'incapacité	Les activités
S-8	SLO-1	Les adjectifs	L'ordre des adverbes	Les exemples	les verbes à particule	Les subordonnées circonstancielles
	SLO-2	Les exemples	Les activités	- Le présent perfect be+ing	les verbes suivis de V-ing	Les activités
S-9	SLO-1	pronoms possessifs (this et that)	les prépositions-	Le past perfect simple -	d'un infinitif avec sans to	A ne pas confondre
	SLO-2	Les activités	Les exemples	Le past perfect be + ving -	Les exemples	Les activités

Learning Resources	***Theory:*** 1. **"*Réussir le noueau TOEIC*"** Détails des épreuves, méthodologie, grammaire, et vocabulaire, Studyrama. ***2.*** *https://www.fluentu.com/blog/french/french-grammar* ***3.*** *https://www.elearningfrench.com/learn-french-grammar-online-free.html* ***4.*** *https://www.lawlessfrench.com/grammar* ***5.*** *https://blog.gymglish.com/2022/12/15/basic-french-grammar*

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	30%	30%	30%	30%	20%	20%	20%	20%	30%	-
Level 2	Apply Analyze	40%	50%	50%	40%	50%	50%	50%	50%	50%	-
Level 3	Evaluate Create	30%	20%	20%	30%	30%	30%	30%	30%	20%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Expert from Higher Technical Institutions**	**Internal Experts**
1. Mr. Kavaskar Danasegarane Process Expert Maersk Global Service Center Pvt. Ltd	*1. Dr. C.Thirumurugan Professor, Department of French, Pondicherry University*	*1. Mr. Kumaravel K. Assistant Professor & Head, SRMIST, KTR*
2.Mr. Sharath Raam Prasad Character Designer, Animaker Company Pvt.		*2. Mrs. Abigalai Assistant Professor, SRMIST, VDP*

Course Code	UCY23S04L	Course Name	Inorganic Qualitative Analysis	Course Category	C	Skill Enhancement Course	L	T	P	O	C
							0	0	4	2	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Gain exposure to the practical knowledge of inorganic reactions	
CLR-2 :	Gain insight about the setting up a basic reaction for synthesis of simple compounds	
CLR-3 :	Learn about the analysis of different inorganic cations and anions	
CLR-4 :	Gain knowledge about the structural elucidation of synthesized compounds	
CLR-5 :	Know how to maintain the record of experiments conducted	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the separation of inorganic cations and anions	4	H	-	-	H	-	M	-	-	-	-	-	H	-	H	-
CLO-2 :	Get awareness of safety techniques and handling of chemicals.	4	H	H	-	-	H	-	-	-	L	-	-	-	H	-	-
CLO-3 :	Understand how to carry out different types of reactions	4	H	-	-	H	M	-	-	-	-	H	-	-	-	-	-
CLO-4 :	Apply the techniques for preparation of inorganic compounds	4	H	-	-	H	-	-	-	-	H	-	-	H	H	-	-
CLO-5 :	Acquire insight about the setting up a reaction	4	-	H	-	-	-	-	H	-	-	L	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1 To S- 4	SLO-1	Semi Micro Qualitative Analysis	Semi Micro Qualitative Analysis-3	Semi Micro Qualitative Analysis-6	Preparation of Inorganic compounds: Preparation of Prussian Blue	Preparation of Potassium trioxalato ferrite (II).
	SLO-2	Introduction and demonstration	Qualitative analysis of a mixture containing one anion and one cation.	Qualitative analysis of a mixture containing one anion and one cation.	Preparation of Inorganic compounds: Preparation of Prussian Blue	Preparation of Potassium trioxalato ferrite (II).
S-5 to S-8	SLO-1	Semi Micro Qualitative Analysis-1	Semi Micro Qualitative Analysis-4	Semi Micro Qualitative Analysis-7	Preparation of Tetrammine Copper(II) sulphate tetrahydrate	Preparation of Copper(II) chloride.
	SLO-2	Qualitative analysis of a mixture containing one anion and one cation.	Qualitative analysis of a mixture containing one anion and one cation.	Qualitative analysis of a mixture containing one anion and one cation.	Preparation of Tetrammine Copper(II) sulphate tetrahydrate	Preparation of Copper(II) chloride.
S-9 to S-12	SLO-1	Semi Micro Qualitative Analysis-2	Semi Micro Qualitative Analysis-5	Semi Micro Qualitative Analysis-8	Preparation of Tristhiourea copper(II) sulphate dihydrate	Preparation of (N,N)-bis(salicyldehyde)ethylen edi amine Salen H_2; and its cobalt complex [Co(Salen)].
	SLO-2	Qualitative analysis of a mixture containing one anion and one cation. .	Qualitative analysis of a mixture containing one anion and one cation.	Qualitative analysis of a mixture containing one anion and one cation.	Preparation of Tristhiourea copper(II) sulphate dihydrate	Preparation of (N,N)-bis(salicyldehyde)ethylen edi amine Salen H_2; and its cobalt complex [Co(Salen)].

Learning Resources	1. *A. I. Vogel, A text book of Quantitative Analysis, ELBS 1986.* 2. *G. Marr, B. W. Rockett, Practical Inorganic Chemistry, Van Nostrand Reinhold Company,* 1972. 3. *H. T. Clarke., A Handbook of Quantitative & Qualitative Analysis, Arnold Heinemann, 1975.*

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember	-	30%	-	30%	-	20%	-	20%	-	30%
	Understand										
Level 2	Apply	-	50%	-	40%	-	50%	-	50%	-	50%
	Analyze										
Level 3	Evaluate	-	20%	-	30%	-	30%	-	30%	-	20%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*Dr. S. Shanmugan, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCD23V05T	Course Name	Career Readiness and Professional Skills	Course Category	V	Value Addition Course	L	T	P	O	C
							2	0	0	2	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			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Enable students to understand reasoning skills and mathematical concepts	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLR-2 :	Prepare students for job interviews																		
CLR-3 :	Learn structured query language (SQL) to an intermediate/advanced level																		
CLR-4 :	Learn the benefits of Python as a scripting language																		
CLR-5 :	Develop life-long skills students can use to seek jobs, internships and make career changes																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	Solve the problems on reasoning	3	80	75	H	M	-	-	-	M	-	H	-	H	-	H	M	-	-
CLO-2 :	Face interviews confidently	3	80	75	-	-	M	-	M	-	-	-	L	-	H	-	-	H	H
CLO-3 :	Understand the importance and major issues of database security and the maintenance of data integrity	3	75	70	H	M	-	M	H	-	M	-	-	-	-	M	-	H	M
CLO-4 :	Utilise essential programming components including variables, conditional logic, loops, and functions to create simple programs	3	75	70	H	-	M	M	-	H	-	-	-	M	-	H	-	H	M
CLO-5 :	Assist students in choosing a career path during their course	3	75	70	-	M	M	-	H	-	M	-	-	-	H	-	-	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Partnership	Self-Image and Self-Presentation	SQL - Introduction to SQL	SQL – Joins	Class coding basics
	SLO-2	Partnership related solving problems	Etiquettes	SQL Statement Classes	SQL – inner joins –Join Syntax	Class coding basics – quiz session
S-2	SLO-1	Cryptarithmetic	Interview Skills - Introduction	Introduction to Databases	Introducing Python	Understanding Data Structures
	SLO-2	Cryptarithmetic – solving problems	Do's and Don'ts during Interview	SQL - Databases & RDBMS	Introducing Python Object Types	Python for Data
S-3	SLO-1	Ordering, Ranking	Mock Interview – Session 1	SQL data types - Introduction	Python - Data Types & Operators	Python Data Types
	SLO-2	Grouping	Mock Interview – Session 2	SQL data types	Python's Core Data Types	Overview of Python Data Types
S-4	SLO-1	Venn Diagrams concepts	Mock Interview – Session 3	SQL - Syntax	Introduction to Functions	Python Structures
	SLO-2	Venn Diagrams solved questions	Mock Interview – Session 4	SQL – Data Type Syntax	Why use Functions	Overview of Python Data Structures
S-5	SLO-1	Types of Paragraph	HR Round – Practice Session	SQL – Commands Introduction	Python – Functions basic	Python – Collections
	SLO-2	Paragraph Forming Questions	HR personal Interview – Mock-Session	SQL - DDL, DML Commands	Coding functions	Improving Code readability
S-6	SLO-1	Types of Sentences	Email Etiquettes	SQL - Subqueries	Introduction to Classes	Collection Module
	SLO-2	Ordering of Sentences	Email Drafting – Do's and Don'ts	Non-correlated Subqueries	Why Use Classes?	Collection Module in Python

Learning Resources	1. *Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition 2018.* 2. *Dr. Agarwal.R.S, Quantitative Aptitude for Competitive Examinations, S. Chand and Company Limited, 2018 Edition 2020.* 3. *Edgar Thrope, Test of Reasoning for Competitive Examinations, Tata McGraw Hill, 6th Edition 2020.*	4. *Bhatnagar R P, English for Competitive Examinations, Trinity Press, 2016* 5. *C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.* 6. *Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.*

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	20%	10%	25%	25%
	Understand				
Level 2	Apply	50%	50%	50%	50%
	Analyze				
Level 3	Evaluate	30%	40%	25%	25%
	Create				
	Total	100 %	100 %	100 %	100 %

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

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Mr. M. Ponmurugan, Executive PMOSS, Cognizant Technology Solutions India Pvt. Limited, Chennai	*Dr. G. Saravana Prabu, Asst. Professor, Department of English, Amrita Vishwa Vidhyapeedam, Coimbatore*	*Dr. Sathish K, HOD, Department of Career Guidance, FSH, SRMIST* *Ms. Deepalakshmi S, Assistant Professor, Department of Career Guidance, FSH, SRMIST*

Course Code	***UMI23M01L***	**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)

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

Semester - V

Course Code	UCY23501T	Course Name	Chemistry of d and f-block elements	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Gain knowledge of characteristic of the d- and f-block elements	
CLR-2 :	Utilize the of some important compounds of d and f-block elements	
CLR-3 :	Address the magnetic properties and color of complexes	
CLR-4 :	Get knowledge on important properties of d- and f-block elements and their extraction	
CLR-5 :	Employ the importance of these elements and their compounds in our day to day life	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the general characteristic of the d- and f-block elements and the general horizontal and group trends in them	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Describe the preparation, property, structures and uses of some important compounds	4	-		-	-	H	-	-	L	-	-	-	-	H	-	-
CLO-3 :	Study the magnetic properties and color of complexes	4	H	-	-	-	M	-	-	-	-	-	-	-	-	H	-
CLO-4 :	Realize the important properties of d- and f-block elements and their extraction	4	H	-	-	H	-	-	L	-	-	-	-	-	-	-	-
CLO-5 :	Appreciate the importance of these elements and their compounds in our day to day life	4	-	H	-	-	-	-	H	-	M	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Transition Metals (d – block elements)	Charge-transfer spectra: ligand-to-metal charge transfer	Radii of Ln(III) cations	Oxidation states	Iron: Passivity-degree and theories Theories and conditions of rusting
	SLO-2	Position of d-block elements in the periodic table	metal-to-ligand charge transfer	Lanthanide contractions	Radii of tri and tetrapositive actinides	Protection of iron from rusting Commercial forms of Iron: Cast iron
S-2	SLO-1	general characteristics of d-block elements	Luminescence and circular dichroism	Cause and Consequences of Lanthanide contractions	actinides contractions Cause of actinides contraction	Manufacture of cast Iron from Heamatite
	SLO-2	metallic character atomic and ionic radii	optical rotatory dispersion stereochemical information from CD	Colour and magnetic properties of Lanthanide	Colour and Formation of complexes	Blast furnace: construction, functioning, chemical reaction takes place and by-products
S-3	SLO-1	Atomic volumes and densities, melting and boiling points	cooperative magnetism,	electronic spectra and Formation of complexes	Properties of actinides	Wrought Iron: Manufacture from cast iron. Properties and uses of cast and wrought iron
	SLO-2	Ionisation potentials oxidation states-colour and electronic spectra	magnetic properties Introduction	Properties dependent on standard reduction potential: reduction property	The later actinide elements.	Steel: Varieties of Steel Manufacture of steel: Bessemer's process

Duration (hour)		12	12	12	12	12
S-4	SLO-1	Practice: calculation in Ionisation potentials	Practice: calculation in magnetism	Practice: Problem solved in electronic spectra	Practice: identification of the complexes based on colour	Practice: Rusting Iron
	SLO-2					
S-5	SLO-1	complex formation, catalytic and magnetic properties	magnetic properties of tetrahedral and octahedral complexes: para and diamagnetism,	Electropositive character and liberation of hydrogen	Comparison between Lanthanide and actinides	Siemens-Martin's, Duplex and Electrical process. Properties and uses of steel. Comparison of cast iron, wrought iron and steel
	SLO-2	Comparison of transition elements and non- transition elements	ferromagnetism and antiferromagnetism	Extraction of lanthanides from Monazite sand	uranium-occurrence metallurgy	Silver: Extraction of silver from argentite and horn silver
S-6	SLO-1	synthesis and reactivity of vanadates	determination of magnetic properties Gouy's method	Separation of lanthanide elements: Fractional crystallization method	chemical properties of hydrides, oxides, and halides	To get silver from argentiferous lead and silver ornaments
	SLO-2	synthesis and reactivity of chromates	anomalous magnetic moment	Fractional precipitation method Change in oxidation method	Complexes of lanthanides and actinides.	Gold: Extraction of gold from alluvial sands and auriferous quartz
S-7	SLO-1	synthesis and reactivity of dichromate	magnetic susceptibility and the spin-only formula	Ion exchange method	Extraction, Properties and Uses of some d and f-block elements	Refining of gold Properties and use of gold
	SLO-2	synthesis and reactivity of molybdates	the effects of temperature on μeff	Solvent extraction method	Titanium: Extraction of Ti from rutile	Colloidal Gold and Purple of cassius
S-8	SLO-1	Practice: Reactivities	Practice: μeff and μs calculation	Practice: separation methods	Practice: Extraction and metallurgy	Practice: Different steels extraction
	SLO-2					
S-9	SLO-1	synthesis of tungstates	single molecular magnets	Production of lanthanide metals	Extraction of Ti from Ilmenite	Mercury: Extraction of mercury from cinnabar
	SLO-2	reactivity of tungstates	spin and orbital contribution to the magnetic moment spin cross over rule	Uses of lanthanides and their compounds	Purification and properties of Titanium	Purification and uses of mercury Amalgams: Iron and copper amalgam
S-10	SLO-1	synthesis and reactivity of of Manganite	Inner Transition Metals (f – block elements)	Comparison between d- and f-block elements	Uses of Titanium	Thorium: Extraction of Thorium from monazite sand
	SLO-2	synthesis and reactivity of of permanganate	Classification of f – block elements Position of lanthanides elements in the periodic table	Actinides: Introduction Position of actinides elements in the periodic table	Vanadium: Extraction of V from carnotite	Extraction of Thorium by electrolysis Properties and uses of Thorium
S-11	SLO-1	synthesis of polycations	general characteristics of lanthanides	general characteristics of actinides	Extraction of V from varnodinite	Uranium: Extraction of Uranium from pitchblende
	SLO-2	reactivity of polycations	Occurrence and Electronic configurations Oxidation states	Occurrence and Electronic configurations	Purification, Properties and uses of V metal	Properties and uses of Uranium
S-12	SLO-1	Practice: Reactivities	Practice: magnetic moment problems	Practice: Lanthanides and Actinides	Practice: Extractions	Practice: Purifications
	SLO-2					

Learning Resources	1. S. Prakash, G.D. Tuli, S. K. Basu, R.D. Madan, Advanced Inorganic Chemistry – I Sultan Chand & Sons Publishers 2006. 2. P. L. Soni, A Textbook of Inorganic Chemistry, Sultan Chand and Co., 1977. 3. R. Gopalan, Text Book of Inorganic Chemistry, 2nd edition, Hyderabad, Universities Press, (India), 2012. 4. K. F. Purcell, J. C. Kotz, Inorganic Chemistry W.B. Saunders Co, 1977. 5. J. E. Huheey, Inorganic Chemistry, Prentice Hall, 1993.

	6. P. Atkins, T. Overton, Shriver and Atkins' inorganic chemistry 6th Ed. Oxford University Press, USA, 2010. **7.** C. E. Barnes, Inorganic Chemistry 4th Ed. (Catherine E. Housecroft and Alan G. Sharpe). Journal of Chemical Education, 2003.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember	30%	-	30%	-	20%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*Dr. S. Shanmugan, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram *Email: sukhendu@iisertvm.ac.in*	*Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23502J	Course Name	Analytical chemistry	Course Category	D	Discipline Specific Core	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	To make the students aware about the basic concepts in analytical chemistry (SI unit, mole concept, concentration terms etc.)	
CLR-2 :	To make the students aware about the general steps in chemical analysis and common laboratory apparatus.	
CLR-3 :	To make the students aware about errors in chemical analysis, accuracy, precision, uncertainty, and calibration curve.	
CLR-4 :	To make the students aware about quantitative methods of analysis.	
CLR-5 :	To make the students aware about various separation methods, spectroscopy, microscopy and mass spectrometry.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Explain the concept of SI unit, mole concept and concentration terms.	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Acquire knowledge about common laboratory apparatus.	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic terms in chemical analysis that includes error, accuracy, precision, uncertainty, and calibration curve.	4	H	-	-	-	M	-	L	-	-	-	-	-	-	-	-
CLO-4 :	Acquire knowledge about quantitative methods of analysis.	4	H	-	-	H	-	M	-	-	-	-	-	-	-	-	-
CLO-5 :	Acquire knowledge about spectroscopy, microscopy and mass spectrometry.	4	-	H	-	-	-	-	H	-	L	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Introduction to analytical chemistry.	Laws of chemical combinations.	Stoichiometry and stoichiometric calculations	Preparation of solutions, standard solutions.	Calibration and use of volumetric glassware, pH meter
	SLO-2	Chemical reactions and equations.	Atomic mass, average atomic mass, gram atomic mass	Introduction to solutions and their concentrations.	Introduction to analytical methods	Thermogravimetry (TGA) and applications
S-2	SLO-1	Seven basic units, derived units.	Unified mass(amu)	Mass percentage, molarity, calculations	General steps in chemical analysis.	Introduction to quantitative methods of analysis
	SLO-2	Dimensional analysis.	Mole concept and molar masses, formula mass.	Molality and calculations	Introduction to common laboratory apparatus - burettes, pipettes, meniscus readers, weighing bottles	Gravimetric analysis
	SLO-2	Significant figures.	Percentage composition	Normality and calculations.	Weighing balance, construction details, errors in weighing.	Volumetric analysis.
S-3	SLO-1	Error, accuracy, precision, uncertainty, and calibration curve.	Empirical formula and molecular formula	Parts per million, parts per billion, parts per trillion and calculations.	Funnels, chromatographic columns, desiccators, drying ovens, filter crucibles, rubber policeman.	Centrifugation methods.
	SLO-2					
S-4,5,6	SLO-1	Visiting a chemical laboratory to get a clear idea of different laboratory apparatus	Laboratory practice of weighing different samples in a weighing balance.	Determination of pH of different solutions using pH meter	Determination of concentration of acids by volumetric analysis	TGA analysis of different samples.
	SLO-2		Laboratory practice of using desiccators, chromatographic columns, burettes, pipettes etc.			

Duration (hour)		18	18	18	18	18
S-7	SLO-1	Polarography and applications.	Centrifugation methods	A brief introduction to UV-visible spectroscopy	Analysis of an Infra-red spectrum.	Basics of light microscopy
	SLO-2					
S-8	SLO-1	Introduction to separation methods.	Introduction to spectroscopy	UV-visible spectrometer and its parts.	A brief introduction to nuclear magnetic spectroscopy	Bright field microscopy and applications
	SLO-2	Solvent extraction	Electromagnetic waves	Analysis of a UV-visible spectrum.	nmr spectrometer and its parts.	Dark field microscopy and applications
S-9	SLO-1	Chromatography	Width of spectral lines - reasons	A brief introduction to Infra-red spectroscopy	Analysis of a nmr spectrum.	Phase contrast microscopy and applications
	SLO-2	Electrophoresis	A brief description about different spectroscopic techniques.	Infra-red spectrometer and its parts.	A brief introduction to microscopy	Fluorescence microscopy
S-10,11, 12	SLO-1	Laboratory practice of separation of mixtures by solvent extraction.	Sample measurements in a UV-visible spectrometer.	Sample measurements in an Infra-red spectrometer.	Sample measurements in a nmr spectrometer.	Sample measurements in Bright. Dark and Phase contrast microscope.
	SLO-2					
S-13	SLO-1	Confocal microscopy	Tunnelling electron microscopy	Classical ionization sources in mass spectrometry	MALDI	Detectors in mass spectrometry
	SLO-2					
S-14	SLO-1	An introduction to electron microscopy	Introduction to mass spectrometry	Ambient ionization sources in mass spectrometry	Paper spray ionization	Analysis of a mass spectrum
	SLO-2					
S-15	SLO-1	Scanning electron microscopy (SEM)	Mass spectrometer and its parts	Electrospray ionization	Analyzers in mass spectrometry	Applications of mass spectrometry
	SLO-2					
S-16,17, 18	SLO-1	Sample imaging by SEM.	Sample imaging in TEM.	Sample measurements using electrospray ionization source.	Sample measurements using mass spectrometry	Elemental analysis by mass spectrometry
	SLO-2					

Learning Resources	Theory:
	1. A. S. Douglas, M. W. Donald, Fundamentals of Analytical Chemistry, 2022. 2. C. H. Daniel, Quantitative chemical analysis, 7th edition 2006. 3. R. V. Dilts, Analytical Chemistry – Methods of Separation, Van Nostrand 1974. 4. D. L. Pavia, G. M. Lampman, G. S. Kriz, Introduction to spectroscopy, 5th edition Cengage Learning 2015.

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Ravikiran Allada, Director,	Prof. G. Sekar, Department of Chemistry,	1.Dr. Rahul Narayanan, SRMIST

Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	IIT Madras Email: gsekar@iitm.ac.in	
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	**2.** *Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23503T	Course Name	Statistical Thermodynamics and Group Theory	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Understand the basic principles & concepts of statistical thermodynamics	
CLR-2 :	Strengthen the knowledge in numerical problems in statistical thermodynamics.	
CLR-3 :	Understand the basic concepts of Born-Oppenheimer approximation & Partition function	
CLR-4 :	Understand the concept of group theory and applications.	
CLR-5 :	Understand the crystal systems and symmetry operations.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Learn the basic principles of statistical thermodynamics.	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Acquaint students with the numerical problems in statistical thermodynamics.	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Gain the knowledge about concepts & approach of statistical thermodynamics	4	H	-	-	-	M	-	-	-	L	-	-	-	-	-	-
CLO-4 :	Learn the concept of group theory and applications	4	H	-	-	H	-	-	M	-	-	-	-	-	-	-	-
CLO-5 :	Explain the crystal systems and symmetry operations	4	-	H	-	-	-	L	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to Statistical Thermodynamics	Thermodynamic properties in terms of the partition function	Bose-Einstein condensation	Group theory-Basic concepts	Use of G.O.T. to construct character tables for molecular point groups
	SLO-2	Introduction to Statistical thermodynamics	Thermodynamic properties In terms of the partition function	Bose-Einstein condensation	Group theory-Basic concepts	molecular point groups
S-2	SLO-1	Types of statistics	Thermodynamic properties of an ideal monatomic gas	Thermodynamic properties of an ideal BE gas	Symmetry elements and symmetry operations	Character tables for point groups
	SLO-2	Maxwell-Boltzmann statistics	Thermodynamic properties of an ideal monatomic gas	Thermodynamic properties of an ideal BE gas	Symmetry elements and symmetry operations	Crystallographic symmetry
S-3	SLO-1	Bose-Einstein statistics	Thermodynamic properties of an ideal diatomic gas	Quantum statistics: ideal Fermi-Dirac gas	Group postulates	Crystal Systems
	SLO-2	Maxwell-Boltzmann statistics -Practice	Types of Statistics-Practice	Calculation of rotational constant	Calculate the fractions of fluorine atoms	Matrix-practice
S-4	SLO-1	Bose-Einstein statistics-Practice	Statistics-Practice	rotational partition function - Measurement	Relative population of the two quanrum states – Measurements	Crystal Systems - Practice

Duration (hour)		12	12	12	12	12
	SLO-2	Bose-Einstein statistics-Practice	Statistics - Practice	Calculation of rotational constant	Relative population of the two quanrum states - Examples	Symmetry of crystals-Practice
S-5	SLO-1	Fermi-Dirac statistics	Vibrational partition function	Fermi-Dirac distribution	Types of groups	Molecular symmetry and crystallographic symmetry
	SLO-2	Fermi-Dirac statistics	Vibrational partition function	Thermodynamic properties of an ideal FD gas·	Types of groups	Quasicrystals
S-6	SLO-1	Evaluation of Lagrange's undertermined multipliers	Statistical thermodynamics of ortho- and para hydrogen Application of BE statistics to black body radiation	Molar partition function of a system	Point groups	Applications of group theory
	SLO-2	Evaluation of Lagrange's undertermined multipliers	Vibrational partition function	Partition function for a real gas	Other postulates	Decomposing a reducible representation into its irreducible representations
S-7	SLO-1	Molecular partition function of an ideal gas	Application of BE statistics to black body radiation	Equilibrium constant of an ideal gas reaction in terms of partition functions	Point groups	Group theory and normal modes of vibrations of polyatomic molecules
	SLO-2	Fermi-Dirac statistics - Practice	Molecular Partition functions - Practice	Zero-point energy - practice	Group representation - Practice	Vilbration modes of NH_3 ·Molecule - Practice
S-8	SLO-1	Evaluation of Lagrange's Undetermined Multipliers - Practice	Molecular Partition functions for Ideal Gas - Practice	Electronic Partition Function - Measurement	Group representation – Practice with examples	Vilbration modes of BF_3 ·Molecule - Practice
	SLO-2	Maxwell-Boltzmann distribution equation - Practice	Translational Partition Function - Practice	Electronic Partition Function - Measurement	Reducible representation - Calculation	Vilbration modes of BF_3 ·Molecule - Practice
S-9	SLO-1	Translational partition function	Quantum statistics-Introduction	The Einstein theory of heat capacities	Representations of molecular point groups	Procedure for determining the irreducible representations of the vibrational modes in nonlinear molecules
	SLO-2					
S-10	SLO-1	Rotational partition function	Ideal Bose·Einstein gas	Heat capacities of monatomic crystals	Great orthogonality theorem	Nonnal modes of vibration of H20 molecule
	SLO-2	Vibrational partition function	Bose-Einstein distribution	The Debye theory of heal capacities	Important properties of irreps	Selection rules for atomic spectra - applications
S-11	SLO-1	Calculation Avogadro's number	Einstein gas calculation	Russell-Saunders coupling - Practice	Modes of vibration-representation - Practice	normal modes of vibration of a tetrahedral molecule
	SLO-2	Stirling approximation	Standard Integral-Practice	The Debye theory - Practice	H_2O-Modes of vibration-representation - Practice	Irreducible· Representations-Practice
S-12	SLO-1	Stirling approximation	Boltzmann distribution - Measurement	Calculate the electronic partition function	Coordinate axis system for H_2O-Practice	vibrations of an AB_2 molecule
	SLO-2					

Learning Resources	**Theory:**
	1. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 35th edition, New Delhi ShobanLal Nagin Chand and Co, 2013. 2. P. W. Atkins, Physical Chemistry, W. H. Freeman and Company 8th edition 2006. **3.** D. W. Ball, Physical Chemistry Textbook, Cengage India Private Limited, 2021 **4.** F. A. Cotton, Chemical Applications of Group Theory", John Wiley & Sons 2015

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	***1.*** *Dr. G. Madhuraiveeran,* SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	***2.*** *Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23D01T	Course Name	Nanomaterials and Nanochemistry	Course Category	D	Discipline Specific Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Acquire sound knowledge about nanochemistry	
CLR-2 :	Understand the fundamentals of nanochemistry	
CLR-3 :	Learn the synthesis of nanomaterials	
CLR-4 :	Gain deep knowledge about the analytical techniques to characterize the nanomaterials	
CLR-5 :	Learn carbon nanostructures and their synthesis	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the phenomenon underlying the nanomaterials based products in use	4	H	-	-	-	-	M	-	-	-	-	-	H	-	-	-
CLO-2 :	Identify the suitable methods for the synthesis of any specific nanomaterial	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Guide for the suitable technique to characterize nanomaterial and understand the obtained results	4	H	-	-	-	M	-	L	-	-	-	-	-	-	-	-
CLO-4 :	Synthesize and carbon nanomaterials and modify them and design based on the requirement	4	H	-	-	H	-	-	-	-	L	-	-	-	-	-	-
CLO-5 :	Understand the parameters responsible for the catalytic efficiency of nanomaterials and tune them for better performance	4	-	H	-	-	-	-	H	-	M	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to nanoscience and nanotechnology	Basics of nanofabrication methods	Discussion on various techniques available for characterizing the nanomaterials for their size, shape, morphology	Bonding in carbon, new carbon structures	Nanocatalysis: fundamentals
	SLO-2	Introduction to nanoscience and nanotechnology	top-down, bottom-up approaches	Scanning electron microscope (SEM) and examples	Bonding in carbon, new carbon structures	homogeneous vs heterogeneous catalysis
S-2	SLO-1	discussion on various phenomenon at nanoscale	gas phase, liquid phase, solid phase synthesis	Discussion on various techniques available for characterizing the nanomaterials for their size, shape, morphology	carbon clusters	effect of surface area, effect of particle size
	SLO-2	discussion on nano size	self-assembly, templated synthesis,	Transmission electron microscope(TEM), examples and a comparison with SEM	discovery of C60	shape and morphology
S-3	SLO-1	discussion on nano shape	Sol-gel synthesis	Discussion on various techniques available for characterizing the nanomaterials for crystalline phase	alkali doped C60, superconductivity in C60	effect of composition
	SLO-2	discussion on nano surface	Synthesis through electrodeposition	X-ray powder diffraction (XRD)	larger and smaller fullerenes	bimetallic system etc
S-4	SLO-1	Tutorial: discuss nano size	Tutorial: discuss the advantages of sol-gel synthesis	Tutorial: explain the experimental part of XRD	Tutorial: discuss the superconductivity in C60	Tutorial: effect of composition

Duration (hour)		12	12	12	12	12
	SLO-2	Tutorial: discuss about nano surface	Tutorial: how to synthesis nanostructured materials by electrodeposition	Tutorial: discuss the various techniques available for characterizing the nanomaterials for crystalline phase	Tutorial: explain bonding in carbon, new carbon structures	Tutorial: explain about effect of surface area, effect of particle size
S-5	SLO-1	Discussion on surface energy	fundamentals of nanoparticle formation	Discussion on various techniques available for characterizing the nanomaterials for oxidation states	carbon nanotubes: synthesis	nanomaterials for photo-catalysis: Introduction and overview
	SLO-2	Discussion on surface stabilization	Thermodynamic approach, supersaturation	X-ray photoelectron spectroscope (XPS)	single walled carbon nanotubes	dye degradation
S-6	SLO-1	characteristic length	Nucleation and growth of nanoparticles	textural properties (surface area, pore volume, pore size)	structure and characterization of carbon nanotubes	organic transformations
	SLO-2	self-assembly	homo vs hetero nucleation	N2 sorption techniques for textural properties of the materials	structure and characterization of carbon nanotubes	plasmon assisted photo-catalysis
S-7	SLO-1	defects	Synthesis of nanoparticles, Metallic, semiconducting	Thermal analysis	mechanism of formation	band gap tuning in nanomaterials
	SLO-2	size quantization	Synthesis of nanoparticles, Metallic, semiconducting	TGA	chemically modified carbon nanotubes	band gap tuning and photocatalytic performance
S-8	SLO-1	Tutorial: Discuss on surface stabilization	Tutorial: explain about the nucleation and growth of nanoparticles	Tutorial: N2 sorption techniques for textural properties of the materials	Tutorial: explain about the chemically modified carbon nanotubes	Tutorial: explain band gap tuning in nanomaterials
	SLO-2	Tutorial: discuss about different kind of defects	Tutorial: what arethe different synthesis techniques of nanoparticles	Tutorial: explain TGA	Tutorial: discuss about structure and characterization of carbon nanotubes	Tutorial: discuss about plasmon assisted photo-catalysis
S-9	SLO-1	surface plasmon	Synthesis of nanoparticles: quantum dots, oxides, hybrids	Solid state NMR for characterizing functionalized materials.	Doping, functionalizing nanotubes	Nanomaterials for water splitting
	SLO-2	conductivity	Synthesis of nanoparticles: quantum dots, oxides, hybrids	Peculiar Examples of materials characterized using NMR	application of carbon nanotubes	Nanomaterials for water splitting
S-10	SLO-1	tunneling,	micelles and microemulsion as templates for synthesis	Scanning tunnelling microscope (STM)	Carbon nanowires	nanomaterials for CO2 capture
	SLO-2	magnetism	0D, 1D and 2D nanoparticles,	Examples of materials characterized using STM	synthetic strategies: gas phase and solution phase growth	nanomaterials for CO2 capture
S-11	SLO-1	defects	core-shell nanoparticles	Atomic force microscope (AFM)	growth control	nanomaterials for CO2 conversion
	SLO-2					
S-12	SLO-1	Tutorial: explain conductivity	Tutorial: discuss about 0D, 1D and 2D nanoparticles	Tutorial: what are the uses of STM and NMR?	Tutorial: What are the application of carbon nanotubes	Tutorial: discuss the nanomaterials for CO2 conversion
	SLO-2	Tutorial: explain magnetism	Tutorial: explain about core-shell nanoparticles	Tutorial: discuss about atomic force microscope (AFM)	Tutorial: discuss about gas phase and solution phase growth	Tutorial: discuss the nanomaterials for CO2 capture

Learning Resources	Theory: 1. C. N. R. Rao, A. Muller, A. K. Cheetam, (Eds), The Chemistry of Nanomaterials, John Wiley & Sons 2004. 2. C. P. Poole, Jr. F. J. Owens, Introduction to Nanotechnology, Wiley Interscience, New Jersey. 2003. 3. K. J. Klabunde, Nanoscale materials in Chemistry, Wiley- Interscience, New York, 2001 4. T. Pradeep, Nano: The Essentials in Understanding Nanoscience and Nanotechnology, Tata McGraw Hill, New Delhi, 2007. 5. T. Tang and P. Sheng, Nano Science and Technology – Novel Structures and Phenomena, Taylor & Francis, New York, 2004

	6. U. Heiz, and U. Landman,Nanocatalysis, Springer, New York, 2006

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

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Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	***1.*** **Dr. Srinivasa Rao, SRMIST**
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	***2.*** *Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23D02T	Course Name	Energy and Fuels	Course Category	D	Discipline Specific Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Demonstrate broad knowledge of chemistry of Energy and Fuel	
CLR-2 :	Impart the basic knowledge about the types and characteristics of energy and fuels	
CLR-3 :	Develop skills in the analysis of various energy sources and fuels-based chemicals	
CLR-4 :	Develop competence in the analysis of various physico-chemical properties of energy systems and fuels	
CLR-5 :	Impart knowledge about green energy and fuel systems	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Gain insight about energy and fuel resources	4	H	-	-	-	-	M	-	-	-	-	-	H	-	-	-
CLO-2 :	Understand various categories of energy conversion and storage systems	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Attain knowledge about electrochemical/solar energy storage systems	4	H	-	-	-	M	M	-	-	-	-	-	-	-	-	-
CLO-4 :	Understand the green hydrogen fuels	4	H	-	-	H	-	-	L	-	-	-	-	-	-	-	-
CLO-5 :	Perceive the importance of energy and fuels in future	4	-	H	-	-	M	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Definition and units of energy and power	Introduction to Solar energy	Introduction to alternative fuels	Natural Fuels	Carbonization of Coal, Fractionation of Coal Tar
	SLO-2	Conservation of energy	Photovoltaic cells-components and uses	Need for alternative fuels	Synthetic Fuels	Uses of Coal Tar based Chemicals
S-2	SLO-1	Energy resources	Electrochemical double layer capacitor (EDLC)	Types of alternative fuels	Manufactured Solid Fuels and their Characteristics	Requisites of a Good Metallurgical Coke
	SLO-2	Introduction to energy conversion and storage systems	Electrochemical double layer capacitor (EDLC)	Introduction to non-renewable and Types	Manufactured Solid Fuels and their Characteristics	Coal Gasification-Hydrogasification Catalytic Gasification
S-3	SLO-1	Need of energy Storage and conversion systems	Structure, Performance and Applications of EDLC	Fuel Production	Charcoal, Briquettes, and Bagasses	Petroleum and Petrochemical Industry: Composition of crude petroleum
	SLO-2					Paraffinic, Asphalitc and Mixed Base Type Crude Petroleum; Petroleum Products
S-4	SLO-1	Energy Conversion Parameter-Practice	Calculation of capacitance	Practice-Renewable energy sources	Practice: Solid Fuels	Practice: Coal Gasification-Hydrogasification, Petroleum and Petrochemical Industry
	SLO-2					
S-5	SLO-1	Types of energy systems	Introduction to electric vehicle and hybrid vehicles	Introduction and Types	Manufactured Liquid Fuels and their Characteristics	Introduction to Green Hydrogen Fuel
	SLO-2					

Duration (hour)		12	12	12	12	12
S-6	SLO-1	Methods of energy production and storage	Advantages and drawbacks of electric and hybrid vehicles	Methods of Production	Gasoline or Petrol	Hydrogen Production Methods
	SLO-2	Electrochemical energy production-Basics	System components– Different configurations of Hybrid vehicles	Characteristics of Fuels	Diesel Fuel	Electrochemical/Photo chemical Production of Hydrogen
S-7	SLO-1	Electrochemical energy conversion and storage	Power split devices-Basics	Solid Fuel	Kerosene Oil and Blast Furnace Gas	Combustive properties of hydrogen
	SLO-2	Electrochemical energy conversion and storage-Applications	High energy and power density batteries	Solid Fuel	Coal liquefaction	Problems associated with Hydrogen as Fuel and Solutions
S-8	SLO-1	Energy Density Calculation	Devices-Practice	Practice-solid fuel	Practice-Methods to fuel sources	Practice: Hydrogen production systems ,Hydrogen Fuels
	SLO-2					
S-9	SLO-1	Magnetic and, chemical energy systems-Introduction	Introduction to Bio Energy Technologies	Liquid Fuel	Water Gas, Producer Gas, and Oil Gas	Hydrogen Gas Storage
	SLO-2					
S-10	SLO-1	Primary Batteries and Secondary Batteries-Fundamentals	Introduction to Wind Energy systems	Gaseous Fuel	Composition and Uses of Gaseous Fuels	Performance, Emission and CombustionAanalysis in Engines
	SLO-2					
S-11	SLO-1	Introduction to Li-ion battery and solid-state batteries	Introduction to Fuel cell vehicles	Natural and Coal Gas	Uses of coal in various industries – Fuel and Non-fuel	Safety Aspects of Hydrogen Fuel
	SLO-2					
S-12	SLO-1	Practice-Differences between batteries	Fuel Cell Components - Practice	Practice-Different fuels	Practice: Coal in various industries – Fuel and Non-fuel	Practice: Hydrogen storage system
	SLO-1					

Learning Resources	Theory: 1. P. Mason, Energy and Fuel Hardcover – 2020. 2. F. Díaz-González, A. Sumper, O. Gomis-Bellmunt, Energy storage in power systems, 1st Ed., Wiley, 2016. 3. A. Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008. 4. R. A. Dave, IP, Modern Petroleum Technology,Vol 1, Upstream,Ed. 6th ed., John Wiley & Sons. Ltd, 2000. **5.** Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK,1990.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Expert from Industry	*Experts from Higher Technical Institutions*	*Internal Experts*
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	***1.** Dr. G. Madhuraiveeran,* SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	***2.** Prof. Dr. M. Arthanareeswari, SRM IST*

Course Code	UCY23G02T	Course Name	Polymer chemistry and its uses	Course Category	G	Generic Elective Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Exposure to polymers and their chemistry	
CLR-2 :	Get knowledge on synthesis, properties and applications of different kinds of polymers	
CLR-3 :	Learn this course will develop skills on synthesis of conducting polymers and 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 with polymers and their applications in today's on demand applications	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Develop knowledge on polymer science	4	M	-	-	-	H	-	-	-	-	-	-	H	-	-	-
CLO-2 :	Synthesis of different types of polymers and their uses	4	-	H	-	-	H	-	L	-	-	-	-	-	-	-	-
CLO-3 :	Get knowledge on ionic, conducting and biopolymers	4	M	-	-	-	H	-	H	-	-	-	-	-	-	-	-
CLO-4 :	Modern use of polymers for today's on-demand applications	4	H	-	-	H	-	-	-	H	-	-	-	-	-	-	-
CLO-5 :	Use of polymer in medical science	4	-	L	-	-	H	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to polymer	Introduction to LCPs	Synthesis of bioionic polymers (example 1)	polyaromatic conducting polymers: synthesis	Use of polymer for designing drug carriers
	SLO-2	Use	Use	Synthesis of bioionic polymers (example 1)	Examples	controlled drug release
S-2	SLO-1	Step-growth polymerization mechanism	Application of LC main-chain polymers (example 1)	Applications of bioionic polymers (example 1)	Polyaniline, polypyrrole & polythiophene	pH-responsive polymers
	SLO-2	example	Application of LC main-chain polymers (example 2)	Applications of bioionic polymers (example 2)	Use	Application
S-3	SLO-1	Radical chain polymerization: mechanism	Side-chain LC polymers (example 1)	Ionic crosslinking and ion exchange	Poly(3,4-ethylenedioxythiophene) (PEDOT)	Photoresponsive polymers
	SLO-2	Example	Side-chain LC polymers (example 2)	Use	poly(p-phenylene sulfide), poly(vinyl carbazole)	Application
S-4	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-5	SLO-1	Ionic chain polymerization: mechanism	Properties of side- chain LC polymers	Ionomers based on polyethylene	Applications of conducting polymers: polymer rechargeable batteries	Magnetically responsive polymers
	SLO-2	Examples	Applications	Polystyrene	Examples	enzyme responsive polymers
S-6	SLO-1	Chain Copolymerization: mechanism	Photochromic LCPs	Polyelectrolytic complexes	Applications of conducting polymers: polymer: sensors/biosensor	Shape memory polymers
	SLO-2	Examples	chiral-photochromic LCPs	Applications	Examples	Applications

Duration (hour)		12	12	12	12	12
S-7	SLO-1	Ring opening polymerization: mechanism	LC block copolymers	Inorganic ionic polymers (synthesis)	Electrochemical actuators	Smart hydrogels
	SLO-2	Examples	Use	Applications	Examples	Applications
S-8	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-9	SLO-1	Polymer stereo chemistry	LC composites	Synthesis of conducting polymers	Electroluminescent	Polymers in tissue engineering
	SLO-2	Examples	Applications	Examples	Applications	Examples
S-10	SLO-1	Coordination polymerization	Synthesis of ionic polymers (example 1)	Polyacetylene	Introduction to biopolymers and biodegradable polymers	Polymers for medical devices (synthesis)
	SLO-2	Examples	Synthesis of ionic polymers (example 2)	poly(p-phenylene vinylene) (PPV)	Examples	Examples
S-11	SLO-1	Characterization of polymers (chemical)	Applications of ionic polymers (example 1)	Polyheterocyclic conducting polymers: synthesis	Characterization of biopolymers: NMR	Polymers nanocomposites (synthesis)
	SLO-2	Characterization of polymers (physical)	Applications of ionic polymers (example 2)	Examples	Mass spectroscopy	Examples
S-12	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					

Learning Resources	Theory: 1. A. R. West, Basic Solid State Chemistry, 2nd Ed., John Wiley &Sons Ltd., 1999. 2. K. J. Klabunde, Nanoscale materials in Chemistry, Wiley Interscience, New York, 2001. 3. C. Giacovazzo, Fundamentals of Crystallography, Oxford University Press, 2002. 4. W. D. Callister and D. G. Rethwisch, Materials Science and Engineering: An Introduction,9th Ed., Wiley, 2013. 5. 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.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	30%	-	30%	-	20%	-	20%	-	30%	-
Level 2	Apply / Analyze	40%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate / Create	30%	-	20%	-	30%	-	30%	-	20%	-
	Total	100 %		100 %		100 %		100 %		100 %	

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Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*1.* ***Dr. Avijit Baidya****, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	***2. Prof. Dr. M. Arthanareeswari, SRM IST***

Course Code	*UPY23G04T*	Course Name	*Solar Technology*	Course Category	G	*Generic Elective Course*	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1:	Acquire basic knowledge on estimation of solar radiation at the earth's surface	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO - 1	PSO - 2	PSO - 3
CLR-2:	Familiarize with the principles of thermal energy collection and storage																		
CLR-3:	Understand the physics of pn junction solar cell																		
CLR-4:	Know about various PV materials and their importance in solar cell technology																		
CLR-5:	Familiarize with various concepts of solar photovoltaic system design and installation																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1:	*Know about the present energy scenario and the potential of solar energy option for future energy*	2	80	75	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
CLO-2:	*Have a knowledge of the solar thermal collectors and the need for thermal energy storage*	2	80	70	H	-	H	-	-		-	-	-	H	-	-	-	-	-
CLO-3:	*Gain a fundamental understanding of solar photovoltaics*	2	75	70	H		H	-	-	H	-	-	-	-	-	-	-	-	-
CLO-4:	*Apply various concepts to describe how electricity is produced and utilized with commercially available solar panels*	2	80	75	-	H	-	-	H		-	-	-	H	-	-	-	-	-
CLO-5:	*Differentiate between solar thermal and solar photovoltaic technologies and their applications*	2	80	75	-	H	-	-	-	-	-	H	-	H	-		-	-	-

Duration (hour)		**12**	**12**	**12**	**12**	**12**
S-1	**SLO-1**	Introduction to energy scenario and need for solar option	Introduction to concentrating collectors	Solar thermal applications Types of solar heating and cooling Systems	Semiconductors as solar cell material Monocrystalline and polycrystalline materials	Solar module and array concepts
	SLO-2	Solar radiation at and outside the earth's atmosphere	Definition of terms and types of concentrating collectors,	Natural circulation water heating System, Forced circulation water heating system	Formation of energy bands and band gap Concept of direct and indirect band gap	Series and parallel connection of cells
S-2	**SLO-1**	Solar spectrum, solar constant and concept of air mass	Compound parabolic collector, Geometry	Concept of solar space heating Space heating systems using active methods	Charge carriers in semiconductors	Mismatch in series connection, Mismatch in parallel connection
	SLO-2	The Sun-Earth movement, declination angle, and apparent motion of the Sun	Tracking requirements, Calculation of solar swing	Passive heating concepts	Carrier concentration and distribution	Design and structure of solar modules Basic concepts and fabrication process
S-3	**SLO-1**	Solar radiation geometry	Performance analysis of compound parabolic collector	Thermal storage wall, attached green house and sunspace	Concept of electric field and energy band bending	Power ratings of PV modules
	SLO-2	Definition of various angles and mathematical expression relating them	Symmetric and asymmetric cases	Solar thermal heating market: Present and future	Qualitative understanding of carrier generation and recombination	Effect of temperature
S4	**SLO-1**	Calculation of declination angle, local apparent time, hour angle, and angle of incidence on a solar collector	Problems/Demos/ Simulations/Seminars	Case study Solar thermal heating market: Present and future	Problems/Demos/ Simulations/Seminars: Energy to wavelength conversion Electrons and hole concentrations in doped semiconductors	Problems/Demos/ Simulations/Seminars: Series and parallel connecting of cells of different parameters
	SLO-2					
S-5	**SLO-1**	Empirical estimation of solar radiation on horizontal surface	Performance analysis of compound parabolic collector	Solar space heating technology:	Introduction to pn junction Qualitative analysis of formation of	Introduction to balance of system (BoS)

				Practical applications and present market	pn junction under equilibration conditions	Need for batteries and converters
	SLO-2	Monthly average hourly global and diffuse radiation	State-of-the art in CPC	Introduction to space cooling and refrigeration	pn junction in non-equilibrium condition	Concept of maximum power point tracking
S-6	SLO-1	Solar radiation on tilted surfaces	Cylindrical parabolic collector, Orientation and tracking modes	Solar absorption refrigeration system	Biasing of a pn junction and the current-voltage equation of a pn junction diode	Concepts in PV system design
	SLO-2	Empirical equation for direct, diffuse, reflected, and total radiation	Performance analysis	Passive cooling concepts	pn junction under illumination	Stand-alone PV system configurations
S-7	SLO-1	Measurement of solar radiation, principle of pyranometer and pyrheliometer	Derivation of instantaneous collection efficiency, Paraboloid dish collector	Ventilation and ground cooling concept	Generation of photovoltage Light generated current	Concept of Hybrid PV systems
	SLO-2	Calculation of monthly average daily global radiation on horizontal surfaces at different locations.Calculation of solar flux on tilted surfaces	Central receiver collector Heliostats and the receiver	Evaporative cooling,Radiative cooling Basic principles and design concepts	I-V equation of solar cells	Qualitative idea of Types and issues with hybrid systems
S-8	SLO-1	Calculation of monthly average daily global radiation on horizontal surfaces at different locations Calculation of solar flux on tilted surfaces	Estimation of instantaneous collection efficiency for given conditions	Case study: Solar space cooling technology: Practical applications and present market	Mapping solar cell parameters in an I-V curve Efficiency measurements	Case Study: Performance analysis of standalone and hybrid PV systems
	SLO-2					
S-9	SLO-1	Solar thermal collection,Liquid flat-plate collector	Present technology and future of concentrating collectors	Solar thermal power plants Low temperature power generation systems	Basic silicon solar cell	Grid-connected PV systems
	SLO-2	Performance analysis of liquid flat -plate collector	Introduction to thermal energy Storage, Basic methods for storing thermal energy	Medium temperature systems Power generation cycle using cylindrical parabolic concentrating collectors	Structure and efficiency limits	System installation
S-10	SLO-1	Transmissivity-absorptivity product and instantaneous collection efficiency	Sensible heat storage types and properties of sensible heat storage materials	High temperature systems	Introduction to thin films solar cell technologies	Operation and maintenance of PV systems
	SLO-2	Overview of the effect of various parameters on performance	Phase change materials and latent heat storage arrangements	High temperature systems using paraboloid dish and central receiver concepts	Key material properties and efficiency limits	Practical issues
S-11	SLO-1	Selective surfaces, spacing, number of cover, fluid temperature, and dust on the top cover	Thermochemical storage Thermochemical storage reactions	Solar distillation and desalination technology	Effect of band gap on efficiency	Concept of simple payback period
	SLO-2	Alternatives to the conventional Collector, Evacuated tube collector designs	Case study: Analysis of a liquid storage tank	Solar drying and solar cooking	Beyond single junction e fficiency limit, Approaches to overcome single junction efficiency limit	Lifecycle costing Annualized LCC Unit cost of generated electricity
S-12	SLO-1	Calculation of instantaneous efficiency Calculation of transmissivity-absorptivity product	Case study: Analysis of a liquid storage tank Well-mixed and thermal stratification conditions	Tutorial: Solar thermal power plants: National and International status Solar distillation and desalination: Industrial plants	Case study: GaAs solar cell	Tutorial: Safety handling of PV systems
	SLO-2					

Learning Resources	1. *Solar Energy: Principle of Thermal Storage and Collection, S. P. Sukhatme and J.K.Nayak (Tata McGraw Hill, 3rd Edition, 2008)* 2. *Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki (PHI Learning Private Limited, 2011)* 3. *Principles of Solar Engineering, D. Yogi Goswami (CRC Press, 3rd Edition, 2015)*	4. *Solar Energy: Fundamentals and Application, H. P. Garg and J. Prakash (Tata McGraw–Hill Publishing, 7th Reprint, 2000).* 5. *Physics of Solar Cells: From Basic Principles toAdvancedConcepts, Peter Werfel (Wiley–VCH, 2009).*

Learning Assessment			
	Bloom's	Continuous Learning Assessment (50% weightage)	

	Level of Thinking	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#		Final Examination (50% weightage)	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. M Krishna Surendra, Saint Gobain Research, krishana.muvvala@saint-gobain.com	Prof. S Balakumar, University of Madras, balakumar@unom.ac.in	*Dr. Archana J, SRMIST*

Course Code	UCY23S05L	Course Name	Organic Chemistry Practical-II	Course Category	S	Skill Enhancement Course	L	T	P	O	C
							0	0	3	2	1

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		Learning
CLR-1 :	Practice separation techniques used in organic synthesis	Level of Thinking (Bloom)
CLR-2 :	Know how isolate natural products	
CLR-3 :	Learn orthogonal protection of functional groups	
CLR-4 :	Gain practical experience about oxidation and reduction	
CLR-5 :	Practice green chemistry	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Acquire knowledge about advanced methods of organic synthesis	4	H	-	-	M	-	H	-	-	-	-	-	-	-	-	-
CLO-2 :	Learn synthetic procedures: aqueous workup, distillation, reflux, separation, isolation, and crystallization	4	H	H	-	-	-	-	-	-	-	H	-	-	-	-	-
CLO-3 :	Experience the procedure for natural product isolation	4	H	-	L	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Perform multicomponent reaction and green chemistry	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Characterize the compounds by using modern analytical techniques	4	H	-	-	-	-	H	-	-	-	L	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1 to 3	SLO-1	Distillation at normal pressure: Single and mixture of compounds	Isolation of natural product: caffeine from tea leaves	Orthogonal protection of amine and acid functional groups	Multistep synthesis: Cyclohexanone → cyclohexanone oxime → caprolactone	Multicomponent synthesis: Mannich reaction
	SLO-2					
S-4 to 6	SLO-1	Distillation at reduced pressure: Single and mixture of compounds	piperene from black pepper	Oxidation of alcohol: Benzyl alcohol → benzyl aldehyde	Chalcone → chalcone dibromide → Isozazole	Green chemistry: Direct Oxidative esterification of Aldehyde
	SLO-2					
S-7 to 9	SLO-1	Separation using column chromatography -melting point measurement	Extraction of Eugenol from Cloves	Reduction of carbonyl compound: 4-nitrobenzaldehyde → 4-nitrobenzyl alcohol	Benzophenone → benzopinacol → benzopinacolone	Organic synthesis in water
	SLO-2					

Learning Resources	1. A. Vogel, Textbook of Practical Organic Chemistry, 5th Ed., Prentice Hall 1989. 2. M. Fieser, Fieser and Fieser's Reagents in Organic Synthesis, Wiley 2016. 3. F. G. Mann, B. C. Saunders, Practical Organic Chemistry, 4th Ed., Longmans 1989.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	30%	-	30%	-	20%	-	20%	-	30
	Understand										
Level 2	Apply	-	50%	-	40%	-	50%	-	50%	-	50
	Analyze										
Level 3	Evaluate	-	20%	-	30%	-	30%	-	30%	-	20
	Create										

	Total	100 %	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Susnata Pramanik, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari,* *SRM IST*

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Course Code	UCY23P02L	Course Name	Internship-II	Course Category	P	*Internship/Apprenticeship / Project/ Community Outreach*	L	T	P	O	C
							0	0	0	0	1

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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.*																		

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	*Identify areas for future knowledge and skill development*	*3*	*80*	*70*	*H*	*H*	-	-	-	-	-	-	*L*	-	*M*	-	-	-	-
CLO-2 :	*understanding of what is expected in the job market and what their standard of performance should be*	*3*	*85*	*75*	-	*H*	-	-	-	-	-	-	*M*	-	*L*	-	-	-	-
CLO-3 :	*Build professional, as well as academic, contacts and begin the process of networking and support for your future careers.*	*3*	*75*	*70*	-	*H*	-	-	-	-	-	-	-	-	*M*	-	-	*H*	-
CLO-4 :	*Acquire knowledge of the industry in which the internship is done.*	*3*	*85*	*80*	*H*	*H*	-	-	-	-	-	-	*L*	-	-	-	-	-	*M*
CLO-5 :	*practical experience within the business environment*	*3*	*85*	*75*	-	-	-	-	-	*H*	-	-	-	-	*M*	-	-	-	*H*

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 %*

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari, SRMIST*

Semester - VI

Course Code	UCY23601T	Course Name	Pericyclic Reaction, Photochemistry and Polycyclic Aromatic Hydrocarbons (PAH)	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Acquire knowledge in the fundamentals of pericyclic reaction.	
CLR-2 :	Provide knowledge of key aspects of cycloaddition reaction	
CLR-3 :	Understand the orbital analysis of sigmatropic rearrangements	
CLR-4 :	Replace either thermal activation or the use of reactive substances with light for the transformation of organic molecules.	
CLR-5 :	Enable students to understand the preparation and reactions of polyaromatic hydrocarbons	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Develop an in-depth knowledge with mechanistic understanding in pericyclic reaction	4	-	H	-	-	-	M	H	-	-	-	-	-	-	-	-
CLO-2 :	Predict the stereochemistry of the product obtained from the reaction of a given diene with a given dienophile.	4	H	H	-	-	-	-	L	-	-	-	-	-	-	-	-
CLO-3 :	Identify sigmatropic rearrangements including hyrdride shifts, Cope and Claisen	4	-	-	H	-	M	-	-	H	-	-	-	-	-	-	-
CLO-4 :	Acquire an in-depth understanding of photochemical processes and apply it to the synthesis of organic molecules	4	M	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the concepts of aromaticity in understanding reactions in polyaromatic reactions	4	H	-	-	-	-	L	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Molecular orbitals of conjugated alkenes;	cycloaddition reaction	sigmatropic reaction	Organic photochemistry – introduction, definitions, importance	Polynuclear Hydrocarbons: Introduction, Classification, Structure
	SLO-2	Molecular orbitals of conjugated alkenes;	cycloaddition reaction	sigmatropic reaction	Organic photochemistry – introduction, definitions, importance	Nomenclature and uses
S-2	SLO-1	Stereochemistry of electrocyclic reaction	antarafacial and suprafacial modes of cycloaddition	sigmatropic reaction	Electronic excitation and spin configurations	Aromaticity of polynuclear hydrocarbons
	SLO-2	stereochemistry of electrocyclic reaction	antarafacial and suprafacial modes of cycloaddition	sigmatropic reaction	Jabolanski diagram	Structure elucidation of Naphthalene
S-3	SLO-1	Disrotatory and conrotatory pathways	antarafacial and suprafacial modes of cycloaddition	sigmatropic reaction	Energy transfer and electron transfer processes	General methods of preparation of naphthalene, phenanthrene and anthracene: Howarth method
	SLO-2	Disrotatory and conrotatory pathways	antarafacial and suprafacial modes of cycloaddition	sigmatropic reaction	Quenching of excited states	Friedel Craft acylation

Duration (hour)		12	12	12	12	12
S-4	SLO-1	Discussion with various examples	Discussion with various examples	Discussion with various examples	Detailed discussion with examples	Discuss synthesis of substituted PAH
	SLO-2					
S-5	SLO-1	FMO approach of electrocyclic reaction	symmetry allowed and forbidden reaction	selection rules	Photochemistry of carbonyl compounds	Diels Alder reaction
	SLO-2	FMO approach of electrocyclic reaction	symmetry allowed and forbidden reaction	selection rules	Photochemistry of carbonyl compounds	Elbs reaction
S-6	SLO-1	Woodward-Hoffman rules;	FMO approach	selection rules	Photochemistry of carbonyl compounds	Pschorr Synthesis
	SLO-2	Woodward-Hoffman rules;	FMO approach	selection rules	Photochemistry of olefins	Relative reactivity of naphthalene, phenanthrene and anthracene in comparison to benzene.
S-7	SLO-1	Selection rules for electrocyclic reaction;	selection rules	[1,3] and [1,5] H shifts and [3,3] shifts with reference to Claisen and Cope rearrangements	Photochemistry of olefins	Properties: Physical properties
	SLO-2	Selection rules for electrocyclic reaction	selection rules	[1,3] and [1,5] H shifts and [3,3] shifts with reference to Claisen and Cope rearrangements	Enones and Dienones	Discussion on Addition and oxidation reactions with mechanism
S-8	SLO-1	Understand in detail the selection rule with example on electrocyclic reaction	Understand in detail the selection rule with example on cycloaddition reaction	Discuss with more examples sigmatropic reaction	Discuss in detail photochemistry of carbonyl compounds with more examples	Discuss synthesis of substituted PAH
	SLO-2					
S-9	SLO-1	Correlation diagram	Diels-Alder reaction	[1,3] and [1,5] H shifts and [3,3] shifts with reference to Claisen and Cope rearrangements	Photochemistry of aromatic molecules	Discussion on Electrophilic substitution- Friedel Craft reaction with mechanism
	SLO-2	Correlation diagram	Diels-Alder reaction	[1,3] and [1,5] H shifts and [3,3] shifts with reference to Claisen and Cope rearrangements	Di-π-methane rearrangement,	Discussion on Chloromethylation with Mechanism
S-10	SLO-1	Aromatic transition state	exo and endo selectivity	[1,3] and [1,5] H shifts and [3,3] shifts with reference to Claisen and Cope rearrangements	Barton-McCombie reaction,	Discussion on Halogenation, Formylation with mechanism
	SLO-2	Aromatic transition state	exo and endo selectivity	[1,3] and [1,5] H shifts and [3,3] shifts with reference to Claisen and Cope rearrangements	Norrish type-I and II cleavage reaction.	Discussion on Nitration, Sulphonation with mechanism
S-11	SLO-1	Huckel-Mobius approach	reactivity and regioselectivity of D-A reaction	ene reaction	Norrish type-I and II cleavage reaction.	Discussion on Reduction reaction, Diels Alder reaction with mechanism

Duration (hour)		12	12	12	12	12
	SLO-2	Huckel-Mobius approach	reactivity and regioselectivity of D-A reaction	ene reaction	Supramolecular organic photochemistry	Discussion on Reduction reaction, Diels Alder reaction with mechanism
S-12	SLO-1	Correlation diagram: Electrocyclic reactions, Detailed explanation	Stereochemistry of cycloaddition reaction	Discuss with more examples sigmatropic reaction	More examples on Norrish type-I and II cleavage reaction	Chemical properties of PAH
	SLO-2					

Learning Resources	Theory: 1. M. B. Smith, J. March, March's Advance Organic Chemistry, 6th Ed., John Wiley and Sons, Inc 2007. 2. J. Clayden, N. Greeves, S. Warren, Organic Chemistry 2nd Ed., Oxford 2012. 3. I. Fleming, Pericyclic Reactions, Oxford chemistry primers, ISSN 1367-109X 2015. 4. F. A. Carey, R. J. Sundberg, Advanced Organic Chemistry Part B: Reactions and Synthesis, 5th Edition. Springer 2007. 5. J. Singh, J. Singh, Photochemistry and Pericyclic Reactions, 3rd Edition. New Age – 2012. 6. 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 2010. 8. I. L. Finar and A. L. Finar, Organic Chemistry Vol. 2, Addison-Wesley 5th edition 2002. Preparatory Course Material 1. N. D. P. Singh, Organic Chemistry and Pericyclic Reactions, NPTEL Course material, Department of Chemistry, Indian Institute of Technology Kharagpur (Link: https://archive.nptel.ac.in/courses/104/105/104105038/)

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23602T	Course Name	Quantum chemistry and molecular spectroscopy	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1:	*Acquire knowledge about the basics of Quantum mechanics*	
CLR-2 :	*Understand the application of quantum mechanics to 1D,3D and SHO systems*	
CLR-3 :	*Understand the application of quantum mechanics to Rigid rotator, Hydrogen atom and many electrons system*	
CLR-4 :	*Gain knowledge on the basic principles of light-matter interactions and learn quantum mechanical methods to analyze the interactions*	
CLR-5 :	*Acquire knowledge in the fundamentals of electronic spectroscopy*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	*State laws of distribution and determine the distribution and partition coefficient*	*4*	*H*	-	-	-	-	-	*M*	-	-	-	-	*H*	-	-	-
CLO-2 :	*Solve Schrodinger wave equation for 1D,3D and SHO system*	*4*	*H*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Solve Schrodinger wave equation for Rigid rotator, Hydrogen atom*	*4*	*H*	-	-	-	*M*	-	*L*	-	-	-	-	-	-	-	-
CLO-4 :	*Understand the basic principles of light-matter interactions and learn quantum mechanical methods to analyze the interactions*	*4*	*H*	-	-	*H*	-	*M*	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply quantum mechanical methods to obtain selection rules and spectra of di- and poly-atomic molecules in microwave, infrared, Raman, UV-Vis spectroscopy*	*4*	-	*H*	-	-	-	-	*H*	-	-	-	*L*	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	de-Broglie 's concept,	orthogonality of the particle in a one-dimensional box wave functions	separation of variable in polar spherical coordinates and its solution	diatomic rigid rotor molecules	nuclear spin effects
	SLO-2					
S-2	SLO-1	Experimental verification- Compton effect	average position and average momentum of a particle in a one-dimensional box	separation of variable in polar spherical coordinates and its solution	effect of isotope substitution	polarization of Raman lines
	SLO-2				vibrational and vibration transition probability and selection rules	Basics of Raman spectroscopy and Raman Effect
S-3	SLO-1	Heisenberg 's uncertainty principle	illustration of the uncertainty principle	principal, azimuthal and magnetic quantum numbers and the magnitude of their values	transition probability and selection rules	Basics of Raman spectroscopy and Raman Effect
	SLO-2	derivation of Schrodinger wave equation	and correspondence principle with reference to the particle in a one-dimensional box.	principal, azimuthal and magnetic quantum numbers and the magnitude of their values	pure rotational spectra	Selection rules

Duration (hour)		12	12	12	12	12
S-4	SLO-1	Tutorial: derive Schrodinger wave equation	Tutorial: explain the uncertainty principle explain separation of variable in polar spherical coordinates and its solution	Tutorial: discuss principal, azimuthal and magnetic quantum numbers and the magnitude of their values, explain effect of isotope substitution	Tutorial: explain transition probability and selection rules, discuss transition probability and selection rules	Tutorial: discuss the selection rules, : write a short not on polarization of Raman lines
	SLO-2	Practice: discuss diatomic rigid rotor molecules				
S-5	SLO-1	requirements of the acceptable wave function.	Schrodinger wave equation for a particle in a three-dimensional box and the concept of degeneracy of energy levels	probability distribution function	rotational spectra of diatomic molecules	vibrational Raman transitions
	SLO-2	Operators, linear operators, method of getting the following quantum mechanical operators	Schrodinger wave equation for a particle in a three-dimensional box and the concept of degeneracy of energy levels	probability distribution function	rotational spectra of diatomic molecules	Stokes lines
S-6	SLO-1	Position, Momentum, kinetic energy, potential energy, total energy, angular momentum	Schrodinger wave equation for linear harmonic oscillator	radial distribution function and shape of atomic orbitals (s, p & d).	harmonic oscillator-rigid rotor approximation	Application and advantages of **Raman spectroscopy**
	SLO-2					
S-7	SLO-1	Position, Momentum, kinetic energy, potential energy, total energy, angular momentum	solution by polynomial method	Region of electromagnetic spectrum	harmonic oscillator-rigid rotor approximation	Vibronic spectroscopy of diatomic molecules
	SLO-2	Hermicity and proving the quantum mechanical operators are Hermitian operation	zero-point energy and its consequence commutator algebra-evaluation of commutators	Interaction of electromagnetic radiation with matter	anharmonicity effect normal modes of vibration	Vibronic spectroscopy of diatomic molecules Franck-Condon factor
S-8	SLO-1	Practice: Momentum, kinetic energy, potential energy, total energy	Practice: zero-point energy and its consequence commutator algebra-evaluation of commutators	Practice: Region of electromagnetic spectrum	Practice: harmonic oscillator-rigid rotor approximation	Practice: Vibronic spectroscopy of diatomic molecules
	SLO-2	Practice: Hermicity and proving the quantum mechanical operators are Hermitian operation	Practice: Schrodinger wave equation for linear harmonic oscillator	Practice: radial distribution function and shape of atomic orbitals (s, p & d).	Practice: harmonic oscillator-rigid rotor approximation	Practice: Application and advantages of **Raman spectroscopy**
S-9	SLO-1	eigen functions and eigen values	zero-point energy and its consequence	emission and absorption spectra	normal modes of vibration	Franck-Condon factor
	SLO-2	postulates of quantum mechanics	zero-point energy and its consequence	signal to noise ratio and resolving power	infrared spectra of linear and bent AB2 molecules	dissociation and pre-dissociation

Duration (hour)		12	12	12	12	12
S-10	SLO-1	eigen functions and eigen values	Schrodinger wave equation	emission and absorption spectra	normal modes of vibration	Franck-Condon factor
	SLO-2	Practice: postulates of quantum mechanics	Practice: zero-point energy and its consequence	Practice: signal to noise ratio and resolving power	Practice: infrared spectra of linear and bent AB2 molecules	Practice: Franck-Condon factor
S-11	SLO-1	Practice: eigen functions and eigen values	Practice: Practice: zero-point energy and its consequence	Practice: emission and absorption spectra	Practice: normal modes of vibration	Practice: dissociation and pre-dissociation
	SLO-2	Particle in a one-dimensional box	Solving of Schrodinger wave equation for Rigid rotator	width and intensity of spectral transitions	infrared spectra of linear and bent AB2 molecules	dissociation and pre-dissociation
S-12	SLO-1	quantisation of energy	energy of rigid rotator	width and intensity of spectral transitions	skeletal vibration and group frequency	rotational fine structure
	SLO-2	normalisation of wave function	Schrodinger wave equation for hydrogen atom	Fourier Transforms in spectroscopy	skeletal vibration and group frequency	solvent effects

Learning Resources	Theory: 1. R.K. Prasad, Quantum chemistry, 4th edition, New Age International., 2010. 2. A.K. Chandra, Introductory Quantum Chemistry, 4th ed., Tata McGraw Hill, 1994 3. J. M. Hollas, Modern Spectroscopy, 4th edition, John Wiley & Sons, Ltd., Chichester, 2004. 4. G. M. Barrow, Introduction to Molecular Spectroscopy, McGraw-Hill, 1962. 5. C. N. Banwell and E.M. Mc Cash, Fundamentals of Molecular Spectroscopy, 4th edition, Tata McGraw Hill, New Delhi, 1994.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Expert from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	**1. Dr. Srinivasa Rao, SRMIST**
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	**2.** *Prof. M. Arthanareeswari, SRMIST*

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Course Code	*UCY23603T*	*Course Name*	*Research Methodology*	*Course Category*	*G*	*Generic Core*	*L*	*T*	*P*	*O*	*C*
							4	*0*	*0*	*2*	*4*

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*

Course Offering Department	*Chemistry*	Data Book / Codes/Standards	*Nil*

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1:	Practice the basic skills of research paper, review paper and thesis writing	
CLR-2:	*Develop the skill of technical writing*	
CLR-3:	*Evaluate different methods of scientific writing and reporting*	
CLR-4:	*Enable the students to* write conference abstracts and research proposals	
CLR-5:	*Inculcate the knowledge of intellectual property and rights*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1 Fundamental Knowledge	**2** Application of Concepts	**3** Link with Related Disciplines	**4** Procedural Knowledge	**5** Skills in Specialization	**6** Ability to Utilize Knowledge	**7** Skills in Modeling	**8** Analyze, Interpret Data	**9** Investigative Skills	**10** Problem Solving Skills	**11** Communication Skills	**12** Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	Differentiate between various kinds of academic writings	*4*	*M*	-	-	-	*H*	-	*H*	-	-	-	-	-	-	-	-
CLO-2:	Practice the basic skills of performing a quality literature review.	*4*	-	-	-	-	*H*	-	-	*H*	*L*	-	-	-	-	-	-
CLO-3:	Target the research work to a suitable journal and communicate for publication	*4*	-	-	-	-	-	*H*	-	-	*H*	-	-	*H*	-	-	-
CLO-4:	*Develop competence in data collection and process of scientific documentation*	*4*	-	-	-	*H*	-	-	-	*H*	*H*	-	-	-	-	-	-
CLO-5:	Identify and avoid the plagiarism	*4*	M	-	-	-	-	-	*H*	-	*H*	-	-	-	-	-	-

Duration (hour)		**12**	**12**	**12**	**12**	**12**
S-1	**SLO-1**	Objectives of research	**Academic & research writing:**	Basic statistical distribution-applications	Modelling skills	Ethics in research – authors
	SLO-2	Introduction about research	Introduction	Basic statistical distribution applications continued	Static Model	Acknowledgement
S-2	**SLO-1**	types of research- Descriptive vs analytical	Basic Rules of academic writing	Sampling: Concepts of Statistical Population	Dynamic Model	Group discussion on ethics in research
	SLO-2	types of research - applied vs fundamental	Usage of language in academic writing	Sample, Sampling Frame	Limitations	The outcome of group discussion
S-3	**SLO-1**	types of research- quantitative vs qualitative	Types of academic writing	Sampling Error	Optimization studies	Ethical issues
	SLO-2	types of research- conceptual vs empirical	Descriptive	Sample Size	Maxima & Minima, Conditions of Optimality	Ethical committee (Human and animal)
S-4	**SLO-1**	Research methods and methodologies- Description	Analytical	Probability Sample	Linear Programming Problem (LPP) - explantion	Plagiarism
	SLO-2	Research methods and methodologies – Explanation	Persuasive and critical	Simple Random Sample	Linear Programming Problem (LPP) – graphical application	Tools to avoid plagiarism
S-5	**SLO-1**	Activity on research methods	Activity - academic writing	Activity – Sampling	Activity – Modelling skills	Activity – Report writing and plagiarism check
	SLO-2	Activity on research methods	Activity - academic writing	Activity- Sampling	Activity – Modelling skills	Activity – Report writing and plagiarism check
S-6	**SLO-1**	Literature review: Introduction	Academic quality measurement tools - significance	Systematic Sample	Data Preparation	Introducing about Project Proposal funding agencies

Duration (hour)		12	12	12	12	12
	SLO-2	Source of literature	Citation indices	Stratified Random Sample	Data Preparation-methods	Introducing about Project Proposal funding agencies (Group Discussion)
S-7	SLO-1	Process of literature review	Principles underlying - impact factor: SNIP, SJR	Multi-stage sampling	Data collection – Maintaining a laboratory record	Intellectual property
	SLO-2	Online literature databases	h-Index, i10 Index and Journal Citation Reports (JCR)	Multi-stage sampling-continued	Tabulation and generation of graphs	Intellectual property rights
S-8	SLO-1	Literature management tools – Introduction	Basic statistical distribution	Determining size of the sample - methods	Data Analysis:	Copy rights
	SLO-2	Literature management tools - Explanation	Binomial distribution	Determining size of the sample - application	Data Analysis: methods	Patent rights
S-9	SLO-1	Consolidation of Literature-review	Poisson distribution	Practical considerations in sampling and sample size	Univariate analysis: frequency tables	COPE guidelines
	SLO-2	Sample - Consolidated Literature-review	Normal distribution	Practical considerations in sampling and sample size	Univariate analysis: bar charts	Patent law
S-10	SLO-1	Review Paper Writing.	Exponential distribution	Sample test	Univariate analysis: pie charts,	Commercialization
	SLO-2	Review Paper Writing - Need	Geometric distribution	Student –t –test,	Univariate analysis: percentages	Royalty
S-11	SLO-1	Review Paper Writing – method of writing	Weibull distribution	Student-F- test	Bivariate analysis- Cross tabulations	trade related aspects of intellectual property rights (TRIPS)
	SLO-2	Review Paper Writing – Outcome of review papers	Problem - solving with statistical tools	χ^2-test	Bivariate analysis- Chi-square test including testing hypothesis of association	Group discussion: IPR
S-12	SLO-1	Practicing - Review Paper Writing	Practicing – Statistical distribution	Practicing – Sample test	Practicing – Data preparation and analysis	Group Discussion on Copy rights
	SLO-2	Practicing - Review Paper Writing	Practicing – Statistical distribution	Practicing – Sample test	Practicing – Data preparation and analysis	Group Discussion on AI tools dedicated for research

Learning Resources	Theory: 1. C. Dawson, Practical research methods. UBS Publishers, New Delhi, 2002 2. R. A. Walpole, R. H. Myers, S. L. Myers, K. Ye, Probablity and statstics for engineers and scientist, Pearson Prentice Hall, Pearson Education, Inc. 2007 3. C. K. Kothari, Research Methodology-Methods and Techniques (New Age International, New Delhi), 2004 4. S. P. Mukherjee, A guide to research methodology: An overview of research problems, tasks and methods. CRC Press, New Delhi, 2019. 5. P. D. Leedy, J. E. Ormrod, L. R. Johnson, Practical research: Planning and design (p. 360). Pearson Education, 2004. 6. V. Chandra, A. Hareendran, Research Methodology by Pearson 1st Edition. Pearson Education India, 2017.

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30%	-	30%	-	20%	-	20%	-	30%	-

Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	***1. Dr. T. Pushpa Malini***
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	***2.Prof. Dr. M. Arthanareeswari, SRM IST***

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Course Code	UCY23D03T	Course Name	Polymer and Industrial Chemistry	Course Category	D	Discipline Specific Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Acquire knowledge on synthesis of polymers and determination of molecular weight 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 in 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:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Can determine Molecular weight, Tg and Tm, and establish structure property relationships of polymers.	4	H	H	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Learn properties and applications of various useful polymers in our daily life	4	H	H	-	-	-	-	H	-	-	-	-	-	-	-	-
CLO-3 :	Get knowledge on specialty polymers, polymer blend and composites and plastic waste management	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Give an overview about the industrial fuels and demonstrate the sequential steps involved in the waste water	4	H	-	-	H	-	-	L	-	-	-	-	-	-	-	-
CLO-5 :	Demonstrate the manufacturing process of cement, glass and ceramics	4	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Polymers: monomer, oligomer and polymer, Nomenclature of polymers. .	Commercial Polymers: Plastics –Thermoplastics and themosets: Manufacture, properties and applications of the following plastics - LDPE, HDPE	Specialty polymers – Biopolymers, Conducting polymers,	Energy sources- Classification of fuels –solid-liquid and gaseous	Fertilizers- NPK-superphosphate-triple superphosphate-uses of mixed fertilizers
	SLO-2	Average Molecular Weight, Molecular weight, Distribution & Poly dispersity Index,	Manufacture, properties and applications of the following plastics - LDPE, HDPE	Specialty polymers – Biopolymers, Conducting polymers,	Energy sources- Classification of fuels –solid-liquid and gaseous	Fertilizers- NPK-superphosphate-triple superphosphate-uses of mixed fertilizers
S-2	SLO-1	Determination of molecular weight	Polypropylene, Polystyrene	Engineering polymers– applications. Pollution, hazards in rubber industry and their control.	Calorific value of fuels and its determination	Micronutrients and their role,
	SLO-2	Determination of molecular weight	PVC, PMMA,	Engineering polymers– applications.	Solid fuels – coal- lignite-sub-bituminous coal-bituminous coal and anthracite. Coking and non-	biofertilizers- plant growth harmones

Duration (hour)		12	12	12	12	12
				Pollution, hazards in rubber industry and their control.	coking coal. Liquid fuels – petroleum refining and Uses	
S-3	SLO-1	Classification of polymers, structure of polymer.	PAN, Polyacrylic acid (PAA),	Engineering polymers– applications. Pollution, hazards in rubber industry and their control.	Octane number. Production and uses of tetraethyl lead-ETBE and MTBE.	Pesticides-classification of pesticides with examples
	SLO-2	Classification of polymers, structure of polymer.	Polymethacrylic acid (PMAA).	Engineering polymers– applications. Pollution, hazards in rubber industry and their control.	Gaseous fuels - natural gas and gobar gas –production-composition and uses-gobar electric cell.	Insecticides - stomach poisons contact insecticides-fumigants
S-4	SLO-1 SLO-2	Determination of molecular weights (Mn and Mw) based on the given data.	Highlight the advanced polymer synthesis method (CRP) for the preparation of PS, PMMA, PAN, PAA and PMAA	Discuss the specialty and engineering polymers	Discuss the green energy and compare with the other fuel-based energy	Discuss the real life applications of the Fertilizers
S-5	SLO-1	Classification of polymers, structure of polymer.	Polyamides –Nylon 6.6 and Nylon 6.	Plastic Waste management – Chemical recycling –	Introduction- Hardness of water- temporary and permanent Hardness	Manufacture and uses of insecticides
	SLO-2	Types of polymerization	Aromatic polyamides – Nomex, Kevlar.	Plastic Waste management – Chemical recycling –	Estimation of hardness – EDTA method and alkali titration method.	Herbicides - manufacture of 2,4-D and 2,4,5-T
S-6	SLO-1	Types of polymerization	Polyesters –PET. Unsaturated polyesters.	incineration –Pyrolysis –mixed waste recycling –	Estimation of hardness – EDTA method and alkali titration method.	Fungicides - preparation of Bordeaux mixture-lime-sulphur creosote oil (formula only).
	SLO-2	Polymerization Techniques: Bulk, Solution, Emulsion and Suspension, Mechanisms	Polycarbonates –Acetal resins –Polysulphones-PPO	incineration –Pyrolysis –mixed waste recycling –	Water softening methods - Zeolite process- ion-exchange demineralisation mixed – bed deionisation.	Sugar industry - double sulphitation process
S-7	SLO-1	Polymerization Techniques: Bulk, Solution, Emulsion and Suspension, Mechanisms	Polycarbonates –Acetal resins –Polysulphones-PPO	value addition and application development for recycled materials.	Domestic waste water treatment. Purification methods – chlorination- break point chlorination. Reverse osmosis - Desalination.	Refining and grading of sugar
	SLO-2	Relative advantages and disadvantages.	Phenolic resins –Novalac formation – Resole formation.	value addition and application development for recycled materials.	Domestic waste water treatment. Purification methods – chlorination- break point chlorination. Reverse osmosis - Desalination.	Cement: Manufacturing – wet process and dry process-
S-8	SLO-1 SLO-2	Discuss which monomers can be polymerized *via* Bulk, Solution, Emulsion and Suspension	Recent research progress on the design and synthesis of aromatic polyamides and polycarbonates	Discuss in detail the plastic waste management	Other methods of waste water treatment	Discuss in detail the advantages and disadvantages of Fungicides and Herbicides
S-9	SLO-1	Structure of polymers, amorphous, semicrystalline and crystalline	Urea – formaldehyde, Melamine – formaldehyde resins.	Blends/Alloys – Composites –	Pollution: Air pollution – causes and effects. Acid rain-Greenhouse effect (global warming)-ozone layer depletion-photochemical oxidants. Control measures	Cement: Manufacturing – wet process and dry process-

Duration (hour)		12	12	12	12	12
		states in polymers			of air pollution. Water pollution	
	SLO-2	Structure of polymers, amorphous, semicrystalline and crystalline states in polymers	Synthetic Rubbers: Manufacture, general properties and applications of SBR, Polyisoprene,	Blends/Alloys – Composites –	Pollution: Air pollution – causes and effects. Acid rain-Greenhouse effect (global warming)	Cement: types-analysis of major constituents-setting of cement-reinforced concrete
S-10	SLO-1	Glass transition, melting and crystallization temperature.	Polybutadiene, Butyl rubber,	Blends/Alloys – Composites –	Pollution: ozone layer depletion-photochemical oxidants. Control measures of air pollution. Water pollution	Cement: types-analysis of major constituents-setting of cement-reinforced concrete
	SLO-2	Glass transition, melting and crystallization temperature.	Ethylene –propylene rubber, Neoprene rubber,	Examples and application in engineering, biochemical, agriculture, defense and aerospace	Water pollution – organic pollutants- chemical oxygen demand (COD)-	Glass: Composition and manufacture of glass. Types of glasses- optical glasscoloured glasses and lead glass.
S-11	SLO-1	Effect of structure on the chemical, mechanical, electrical and optical properties of polymers.	Speciality rubbers: Silicon rubbers, Nitrile rubbers,	Examples and application in engineering, biochemical, agriculture, defense and aerospace	biological oxygen demand (BOD) - total organic carbon and carbondioxide capture and sequestration.	Glass: Composition and manufacture of glass. Types of glasses- optical glass, coloured glasses and lead glass.
	SLO-2	Effect of structure on the chemical, mechanical, electrical and optical properties of polymers.	Polyacrylic rubbers – Hypalon –Fluorocarbon elastomers – Thermoplastic elastomer	Examples and application in engineering, biochemical, agriculture, defense and aerospace	biological oxygen demand (BOD) - total organic carbon and carbondioxide capture and sequestration.	Ceramics: Types-raw materials-white wares manufacture and uses
S-12	SLO-1	Discuss the structure and properties of polymers	Detail discussion on application of rubbers in different areas	Discuss the role of different kind of nanofillers on the properties of composite	Discuss more on air and water pollution	Understand the differences between ceramic and glassy materials
	SLO-2					

Learning Resources	**Theory:** 1. F. W. BillmeyerJr., Text Book of Polymer Science, Ed. Wiley-Interscience, 1984. 2. V. T. Gowariker, N. V. Viswanathan, and J. Sreedar, Polymer Science, 1988. 3. M. Morton, Rubber Technology, Chapman Hall, 1995. 4. J. Brydson, Rubber Chemistry, Butterworths, 1978. 5. P. Ghosh, Polymer Science and Technology of Plastics and Rubbers, Tata McGraw-Hill Publishing Company 1990. 6. P. J. Flory, Principles of Polymer Chemistry Springer, 2006. 7. Encyclopedia of Polymer Science and Technology, Johan Wiley and Sons, Inc 1965. 8. M. P. Stevens, Polymer Chemistry, Oxford University Press, Inc, 1990.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	20%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-

	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Samarendra Maji, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram *Email: sukhendu@iisertvm.ac.in*	*2. Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23D04T	Course Name	Supramolecular Chemistry	Course Category	C	Discipline Specific Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		Learning	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1:	learn the underlying principles of supramolecular chemistry																
CLR-2 :	Strengthen the knowledge of the students in supramolecular chemistry																
CLR-3 :	Explore noncovalent interactions to form supramolecular assembly																
CLR-4 :	Get a significant exposure in emerging field crystal engineering																
CLR-5 :	Find applications in molecular devices including smart actuators and molecular switches																
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the basic principles of supramolecular chemistry	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Acquaint students with the fundamental concepts of Molecular recognitions in supramolecular chemistry	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Gain knowledge about various noncovalent interactions to form supramolecular assemblies	4	H	-	-	-	M	-	-	H	-	-	-	-	-	-	-
CLO-4 :	Understand the concept of crystal engineering	4	H	-	-	H	-	-	L	-	-	-	-	-	-	-	-
CLO-5 :	Gain knowledge about the Host-guest chemistry	4	-	H	-	-	M	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Supramolecular chemistry	Basic understanding of Host-guest chemistry	Crystal engineering	Self-assembly of molecules:	Molecular electronic devices
	SLO-2	Importance	Synthesis and structure of crown ethers	Basis concepts	Design, synthesis and properties of the molecules	Examples
S-2	SLO-1	History	Synthesis and structure of crown ethers	Role of H-bonding, halogen bonding	Self-assembling by H-bonding,	Molecular wires
	SLO-2	Molecular recognition	lariat ethers, podands	Other weak interactions	Metal-ligand interactions and other weak interactions	Examples
S-3	SLO-1	Examples of supramolecular assemblies	Cryptands	Homosynthons	Amphiphilic molecules	Molecular rectifiers
	SLO-2	Chemical interactions leading to supramolecular assemblies	Spherands, calixarenes	Heterosynthons	Their aggregation	Examples
S-4	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2					

Duration (hour)		12	12	12	12	12
S-5	SLO-1	Supramolecular assemblies for various applications	Cyclodextrins, cyclophanes	Polymorphs, amorphous, phase transformation	Metallomacrocycles	Molecular switches
	SLO-2	Continued	Cryptophanes	Cocrystals, salts, coamorphous	examples	Logic gates
S-6	SLO-1	Ion pairing	Carcerands	Solid solution, eutectics	Catenane, synthesis	Relevance of Supramolecular chemistry to mimic biological systems
	SLO-2	Ion-Dipole Interactions	Hemicarcerands	their physico-chemical properties	Examples, applications	Continued
S-7	SLO-1	Dipole-Dipole interactions	Cucurbiturils	Design of molecular crystals towards achieving targeted applications	Rotaxanes, synthesis	Relevance of Supramolecular chemistry to mimic biological systems
	SLO-2	Dipole-Induced Dipole	Cyclophanes	Continued	Examples, applications	Continued
S-8	SLO-1	van der Waals or Dispersion Interactions	Zeolites, Intercalates	Solubility/permeability/tabletablity applications	Helicates, synthesis	Supramolecular catalysis
	SLO-2	Hydrogen bonding	Carcerands, Hemicarcerands	Mechanical properties of molecular crystals	Examples, applications	Examples
S-9	SLO-1	Halogen bonding	Host-guest interactions, pre-organization	Elastic, plastic crystals.	Knots, synthesis examples	Supramolecular catalysis
	SLO-2	Chalcogen bonding	Complementarity	Binary cocrystal	Examples, applications	Examples
S-10	SLO-1	Pnycotogen bonds	Lock and key analogy	Ternary cocrystals	Surfactants and Interfacial Self-Assemblies	cyclodextrins as enzyme mimics
	SLO-2	Cation-pi interactions	Binding of cationic, anionic, ion pair and neutral guest molecules.	Topochemical reactions	Liquid Crystals	Ion channel mimics
S-11	SLO-1	Anion-pi interactions	Examples	Cinnamic acids under light	Applications	Continued
	SLO-2	Edge-to-face vs. pi-pi Stacking Interactions N-H—pi interactions	Various examples to illustrate noncovalent interactions	Coordination polymers, Metal organic frameworks	Examples of recent developments in supramolecular chemistry	Crystal symmetry, Point groups
S-12	SLO-1	Sulfur-aromatic interactions, Pi-pi stacking	Important applications in catalysis, Making smart material	Covalent organic frameworks Examples/applications	Examples of recent developments in supramolecular chemistry	Space groups, Miller indices
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial

Learning Resources	Theory: 1. J. -M. Lehn, Supramolecular Chemistry-Concepts and Perspectives (Wiley-VCH, 1995). 2. P. D. Beer, P. A. Gale, D. K. Smith, Supramolecular Chemistry (Oxford University Press, 1999). 3. J. W. Steed, J. L. Atwood, Supramolecular Chemistry (Wiley,2000). 4. J. W. Steed, J. L. Atwood, 'Supramolecular Chemistry', 2nd Edition; ISBN: 978-1-118-68150-3.

Learning Assessment

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

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Sudarshan Mahapatra, Encube Ethicals Pvt. Ltd, sudarshan.m@encubeethicals.com	*Prof. G. Sekar, Department of Chemistry, IIT Madras Email: Pgsekar@iitm.ac.in*	*1. Dr. Palash Sanphui, SRMIST*
Dr. Ravikiran Allada, Head R&D, Analytical, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23G03T	Course Name	Food Chemistry	Course Category	C	Generic Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Basic understanding of food and nutrition, its importance, sources, healthy and unhealthy foods and food poisoning.	
CLR-2 :	Role of water in food, energy from food	
CLR-3 :	Understanding carbohydrates, proteins and fats, their properties and their role as food ingredient	
CLR-4 :	Understanding minerals, vitamins and enzymes and their role in food and health	
CLR-5 :	Understanding food safety, food hazards and food preservations	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Know food and nutrition, its importance in health.	4	H	H	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Know the role of water in food, energy values.	4	H	M	-	-		-	H	-	-	-	-	H	-	-	-
CLO-3 :	Learn different components of foods, their sources, properties, structures and functions	4	H	-	-	-		-	L	-	-	-	-	H	-	-	-
CLO-4 :	Learn the importance of minerals, vitamins and enzymes.	4	H	-	-		-	-	H	-	-	-	-	L	-	-	-
CLO-5 :	Learn about food safety, food hazards and food preservations	4	M	H	-	-	-	-	H	-	-	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction	Water: Introduction	Carbohydrates-composition, sources	Mineral functions, sources,	Food safety: Introduction
	SLO-2	Why food science	Chemistry of water	Classification	Bio-availability	Foodborne illness
S-2	SLO-1	Introduction to nutrition –	Water as a nutrient, function, sources, requirement	Structure, Functions.	deficiency of following minerals and effects: calcium,	Biological hazard to the food
	SLO-2	Functions of foods	water balance – effect of deficiency.	physical & chemical properties.	Iron	Chemical hazard to the food
S-3	SLO-1	definition of nutrition, nutrients.	Moisture in food: Hydrogen bonding	Other sweetening agents, functions of sugar in food	Iodine, Fluorine	Food protection systems
	SLO-2	Adequate, optimum and good nutrition, malnutrition.		changes during cooking and processing.	sodium, potassium	Labelling as a means of assuring food safety
S-4	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-5	SLO-1	Food as a source of nutrients	Free, bound and entrapped water	Proteins – composition	Vitamins – Classification, units of measurement, sources,	Food preservations: Introduction
	SLO-2	Different sources: vegetables, fruits, meats etc		Classification, sources,	functions	Heat preservation, Refrigeration, dehydration, concentration
S-6	SLO-1	Inter relationship between nutrition and health,	Water activity and Food stability.	Functions, determination of protein quality	deficiency diseases caused by following vitamins: Fats soluble vitamins – Vitamin A, D	Added preservatives

Duration (hour)		12	12	12	12	12
	SLO-2	visible symptoms of good health.		denaturation, and protein deficiency	Vitamin E and K	Other preservation techniques
S-7	SLO-1	Food guide-basic five food groups	Energy – Unit of energy, food as a source of energy	Amino acids – classification, Physio-chemical properties	Water soluble vitamins – Vitamin C	Nutritive value of the preserved food
	SLO-2	usage of food guide		modification of food protein through processing and storage	Vitamin B-complex	Safety of the preserved food
S-8	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-9	SLO-1	Use of food in body-digestion, absorption, transport, utilization of nutrients in the body	Energy value of food, the body's need for energy,	Lipids – composition, nomenclature	Enzymes. Nomenclature, specificity, catalytic regulations	Food additives: Introduction
	SLO-2		B.M.R. activities	saturated, unsaturated fatty acids	enzyme activity, controlling enzyme action	Functions
S-10	SLO-1	Food choice: Healthy	Utilization of food for energy requirements	classification, food sources,	Enzyme added to food during processing, modification of food by endogenous enzyme	Major additives used: coloring agents, flavoring agents
	SLO-2	Food choice: Unhealthy		functions of fats		Antioxidants, enzymes
S-11	SLO-1	Food poisoning	Acid – base balance	Physical and chemical properties of fat	Enzyme inhibitors in food	Food packaging: types, materials, functions
	SLO-2	Expiration dates		Role of food lipids in flavor		Food packaging: controlling atmosphere, protection
S-12	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					

Learning Resources	Theory: 1. V. A. Vaclavik, E. W. Christian, E. W., Essentials of Food Science, 3rd Ed., Springer 2008 2. R. L. Shewfelt, Introducing Food Science, CRC Press 2015. 3. E. R. Vieira, Elementary Food Science, 4th Ed., International Thomson Publishing 1999 4. S. R. Mudambi, S. M. Rao, M. V. Rajagopal, M. V. Food science. 2nd Edition. New Age International publishers, 2006. 5. M. Swaminathan, Handbook of Food & Nutrition. 5th Edition. Bangalore printing, 2012. 6. B. Srilakshmi, Food science. 3rd Edition. New Age International 2015.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Jayanta Samanta Research Assistant Professor* *Email: jayantas@srmist.edu.in*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram	*2.Prof. Dr. M. Arthanareeswari, SRM IST*

	Email: *sukhendu@iisertvm.ac.in*	

Course Code	*UPY23G05T*	Course Name	*Structure and Properties of Materials*	Course Category	G	*Generic Elective Course*	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	have basic knowledge on bonding in solid and their properties
CLR-2 :	realize an importance of types of imperfections in the materials.
CLR-3 :	explore the diffusion and its mechanisms in solids
CLR-4 :	understand the phase transition through phase diagram
CLR-5 :	explore the advanced high-strength composite materials

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	realize the role of bonding in solids and its functional properties	2	75	60	H	H	-	-	-	-	-	-	-	M	-	-	-	-	-
CLO-2 :	explore the type of imperfections in materials	2	80	70	H	-	-	H	-	-	-	M	-	-	-	-	-	-	-
CLO-3 :	understand the types of diffusion processes	2	70	65	H	-	-	H	-	-	-	-	-	M	-	-	-	-	-
CLO-4 :	distinguish the phase transitions via phase diagram	2	70	70	H	-	-	H	-	-	-	M	-	-	-	-	-	-	-
CLO-5 :	understand the significance of composite materials and their properties	2	80	70	H	H	-	-	M	-	-	-	-	-	-	-	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	introduction to material science and engineering	Introduction to crystal structure	solidification in metals	phase diagram - introduction	composite materials-introduction
	SLO-2	types of materials	space lattice and unit cell	formation of stable nuclei in liquid metal	importance of face diagram	composite materials-introduction
S-2	SLO-1	metallic and polymeric materials	crystal systems	growth of crystals in liquid metal	Gibbs phase rule	different types of composites
	SLO-2	Ceramic, composite and electronic materials	Bravais Lattices	formation of grain structure	Leaver rule	load data transfer in composite material
S-3	SLO-1	atomic structure and bonding	metallic crystal structures	industrial casting	Phase equilibria	matrix materials
	SLO-2	structure of atoms	BCC, FCC and HCP crystal structure	green structure in industrial casting	single and multi component system	role of matrix materials
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-5	SLO-1	Atomic number and atomic mass	Crystal structure analysis	growth of single crystals	concept of solid solution	reinforcement materials
	SLO-2	electronic structure of atoms	X ray diffraction	solidification of single crystals	different alloys	role of reinforcement material
S-6	SLO-1	hydrogen atom	Poly crystalline Materials	solid solutions in metals	Phase diagram	polymer materials
	SLO-2	structure of multi electron atoms	amorphous materials	substitutional and interstitial solid solutions	single and multi component system	classification of polymers
S-7	SLO-1	importance of electronic structure	crystalline imperfections	Diffusion n in solid	binary isomorphous system	ceramic materials
	SLO-2	chemical reactivity	types of defects in crystals	diffusion mechanisms	Eutectic system	metallic materials
S-8	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-9	SLO-1	Atomic and molecular bonding	Schottky defect	steady state diffusion	Ooling curve for pure element	polymer matrix composites
	SLO-2	types of atomic and molecular bonds	Frenkel defect	non steady state diffusion	cooling car for Alloys	polymer matrix composites
S-10	SLO-1	primary bonding	Defect Interaction	industrial applications of diffusion	Pb-Sn Phase diagram	ceramic matrix composites

	SLO-2	*types of primary bonding*	*Dislocations*	*carburization of steel*	*Determination of transition points*	*ceramic matrix composites*
S-11	**SLO-1**	*secondary bonding*	*Burgers Vector, Types of Dislocation*	*metallography*	*Applications of phase diagram*	*metal matrix composites*
	SLO-2	*types of secondary bonding*	*Dislocation movement*	*ASTM grain size and grain diameter*	*Applications of phase diagram*	*metal matrix composites*
S-12	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	1. W. Smith, J. Hashemi, Foundation of materials science and engineering, 5th McGraw - Hill Education, 2009 2. W.D. Callister, Jr. Materials Science & Engineering, 7th Ed., John Wiley & Sons 2007.	3. B.S Mitchell, An introduction to materials Engineering and science for Chemical and Materials Engineers, 1Ed, Wiley, 2003, 4. V. Raghavan, Materials Science & Engineering, Hall of India New Delhi 2001

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UCY23P04L	Course Name	Mini Project	Course Category	P	Internship/ Project/ Community Outreach	L	T	P	O	C
							0	0	5	0	2

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Produce competent, creative and imaginative graduates with a strong scientific acumen	
CLR-2	Apply of the acquired knowledge, skills, and tools pertinent to the field of Chemistry	
CLR-3	Promote independent and collaborative research work in the domain of chemistry	
CLR-4	Inculcate the ethical responsibility of the graduate in the scientific society	
CLR-5	Identify the challenges and solutions pertinent to the field of Chemistry	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1	demonstrate the key areas of research	4	H	-	-	-	H	-	H	-	-	-	-	-	-	-	-
CLO-2	develop laboratory and experiment related skills	4	-	H			H	H	-	-	-	-	-	-	-	-	-
CLO-3	posses' competence on data collection and process of scientific documentation	4	-	M	-	-	M	-	-	-	-	-	M	-	-	-	-
CLO-4	gain the knowledge of research ethics	4	-	-	-	-	M	M	-	H	-	-	-	-	-	-	-
CLO-5	solve problems in their area of research	4	-	-	H	-	-	-	H	-	-	-	-	M	-	-	-

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

Semester - VII

Course Code	UCY23701T	Course Name	Reagents in Organic Reactions	Course Category	C	Core Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

		Learning
CLR-1:	Gain knowledge on the importance of organic name reactions	
CLR-2 :	Acquire knowledge about oxidation/reduction reactions	
CLR-3 :	Promote the importance of rearrangement reactions	
CLR-4 :	Understand the uses of reagents and their mechanism	
CLR-5 :	Acquire basic understanding of asymmetric synthesis	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1 :	Understand the basic concepts of organic name reactions	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Gain knowledge about the organic reactions mechanism and uses	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand about the importance of rearrangement	4	H	-	-	-	M	-	-	-	H	-	-	-	-	-	-
CLO-4 :	Apply the name reactions to synthesize in the laboratory	4	H	-	-	H	-	-	M	-	-	-	-	-	-	-	-
CLO-5 :	Gain basic understanding of synthesis of chiral compounds	4	M	H	-	-	-	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Grignard reagent	Arndt-Eistert Synthesis	Aldol Condensation	Beckmann Rearrangement	Introduction to asymmetric synthesis
	SLO-2	Jones Reagent	Mannich Reaction	Acetoacetic Ester Condensation	Benzilic Acid Rearrangement	Basic principles and examples of stereospecific reactions
S-2	SLO-1	Lithium aluminium hydride	Dakin Reaction and Ene Reaction	Acyloin and Benzoin Condensation	Baker-Venkataraman Rearrangement	Stereoselective and Enantioselective
	SLO-2	Diisobutyl aluminium hydride	Darzens Reaction and Diels-Alder Reaction	Darzens and Dieckmann Condensation	Brook Rearrangement	Diastereoselective reactions
S-3	SLO-1	Pyridinium Di Chromate	Favorskii Reaction and Grubbs Reaction	Knoevenagel Condensation	Claisen, Cope and Oxy-Cope Rearrangement	Cram's rule
	SLO-2	Selenium dioxide	Hell-Volhard-Zelinsky Reaction and Hunsdiecker Reaction	Robinson Annulation Olefin Metathesis	Claisen, Cope and Oxy-Cope Rearrangement	Felkin-Cherest-Anh Rule
S-4	SLO-1	Discuss the scope of these oxidizing and reducing agents	Discuss in detail the application with suitable examples	Discuss in detail the application with suitable examples	Discuss in detail the application with suitable examples	Discuss the scope of stereochemistry organic transformation
	SLO-2					
S-5	SLO-1	Collins Reagent	Gabriel Synthesis Haloform Reaction	Swern Oxidation Baeyer-Villiger Oxidation and Oppenauer oxidation	Pinacol Rearrangement	"anti-Cram" product

Duration (hour)		12	12	12	12	12
	SLO-2	Collins Reagent	Kolbe-Schmitt Reaction and Mannich Reaction	Sharpless Epoxidation and Prevost Reaction	Wolff Rearrangement Fries Rearrangement	Industrial asymmetric synthesis
S-6	SLO-1	Baeyer's reagent	McMurry Reaction and Michael Addition	Woodward Reaction Carroll rearrangement	Newman-Kwart Rearrangement	Chiral Drugs
	SLO-2	Corey reagent	Mitsunobu Reaction and Prévost Reaction	Dihydroxylation with osmium tetroxide	Adamantane Rearrangement Wittig Rearrangement	Chiral Non-steroidal Anti-inflammatory Profen Drugs
S-7	SLO-1	Corey reagent	Reformatsky Reaction	Dihydroxylation with alkaline $KMnO_4$	Dimroth rearrangement Smiles rearrangement	Continued
	SLO-2	Corey-Suggs Reagent	Sandmeyer Reaction	Dihydroxylation of allylic alcohols	Lossen rearrangement Meisenheimer rearrangement	Synthesis of Enantiomerically Pure Nucleosides
S-8	SLO-1	Discuss the scope of these reagents	Discuss in detail the application with suitable examples	Discuss in detail the application with suitable examples	Discuss in detail the application with suitable examples	Discuss recent discoveries on chiral drugs
	SLO-2					
S-9	SLO-1	Fehling's reagent	Schmidt Reaction and Seebach Umpolung	Asymmetric dihydroxylation	Sommelet–Hauser rearrangement	(-)Carbovir
	SLO-2	Tollen's reagent	Simmons-Smith Reaction	Dihydroxylation of a chiral substrate	Carroll rearrangement	Lamivudine and Zidovudine
S-10	SLO-1	Sarett Reagent	Ullmann Reaction	Use of N-methylmorpholine N-oxide (NMO)	Sonogashira Coupling	Emtricitabine and Captopril
	SLO-2	Benedict's reagent	Vilsmeier Reaction and Wohl-Ziegler Reaction	Birch and Rosenmund Reduction	Suzuki and Stille Coupling	Duloxetine and Naproxen
S-11	SLO-1	Bestmann's reagent	Corey-Seebach Reaction	Meerwein-Ponndorf-Verley Reduction	Glaser and Hiyama Coupling	Thalidomide
	SLO-2	Burgess reagent.	Corey-Chaykovsky Reaction	Clemenensen reduction	Kumada and Negishi Coupling	Remedisvir
S-12	SLO-1	Discuss the scope of these reagents	Discuss in detail the application with suitable examples	Discuss in detail the application with suitable examples	Discuss in detail the application with suitable examples	Discuss the scope of these drugs for therapeutic application
	SLO-2					

Learning Resources	Theory: 1. W. Zerong Comprehensive Organic Name Reactions and Reagents ISBN: 9780471704508| Online ISBN: 9780470638859| DOI: 10.1002/9780470638859 2. Hassner and I. Namboothiri, Organic Syntheses Based on Name Reactions A practical guide to 750 transformations, ISBN 978-0-08-096630-4, 2012, 3rd edition. 3. Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Jr., Name Reactions and Reagents in Organic Synthesis, Wiley-Interscience, 2nd ed., 2005. 4. Mathias Christmann and Stefan Bräse, Asymmetric Synthesis: The Essentials, Wiley publication, 2007, ISBN 9783527320936. 5. L. Finar, Organic Chemistry, Volume I, 6th Ed., 2015, ISBN: 9788177585421, 9788177585421. 6. I. L. Finar, Organic Chemistry, Volume II, 5th Ed., ISBN: 9788177585414, 9788177585414.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30%	-	30%	-	20%	-	20%	-	30%	-
Level 2	Apply Analyze	40%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate Create	30%	-	20%	-	30%	-	30%	-	20%	-

	Total	100 %	100 %	100 %	100 %	100 %

Course Designers		
Expert from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Sudarshan Mahapatra, Encube Ethicals Pvt. Ltd, sudarshan.m@encubeethicals.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: Pgsekar@iitm.ac.in	1. Dr. Palash Sanphui, SRMIST
Dr. Ravikiran Allada, Head R&D, Analytical, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	2. Prof. M. Arthanareeswari, SRMIST

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Course Code	UCY23D05T	Course Name	Solid State Chemistry and its applications	Course Category	C	Discipline Specific Elective Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
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:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand basic concepts of solid-state chemistry and its applications	4	H	-	H	L	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Gain knowledge about crystal defects and non-Stoichiometry	4	H	-	M	H	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the mechanism of different types of synthesis	4	-	H	H		-	-	-	-	-	-	-	-	-	M	-
CLO-4 :	Familiar with different properties and their technological relevance	4	-	H	-	H	H	-	-	-	-	-	-	-	-	M	-
CLO-5 :	Gain deep knowledge about fabrication methods towards technological relevance	4	-	H	-	-	H	-	M	-	-	-	-	-	-	L	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Crystal Structures and Crystal Chemistry; Introduction	Crystal Defects: Types of Defect	Synthesis, Processing and Fabrication Methods	Thermal Properties: Introduction	Magnetic Properties: Introduction
	SLO-2	Classification of solids, differences between crystalline and amorphous solids, point group	Point, line and plane defects	Solid State Reaction	Lattice vibrations	Classification of magnetic materials
S-2	SLO-1	Crystallography-Law of constancy of interfacial angles, Law of rational indices and Miller indices, d-Spacing Formulae	intrinsic and extrinsic defects-vacancies	Shake 'n Bake Methods	phonon spectrum	Langevin diamagnetism
	SLO-2	Law of Symmetry and types of crystal symmetry, space lattice and unit cell-primitive and non-primitive unit cells	Schottky and Frenkel defects	Nucleation and Growth, Epitaxy and Topotaxy	lattice heat capacity	quantum theory of paramagnetism
S-3	SLO-1	Seven crystal systems, Bravais and non-Bravais lattices.	The Kroger–Vink notation for crystal defects	Examples of Solid-State Reactions	thermal expansion	cooperative phenomena ferro magnetism
	SLO-2	Close Packed Structures of Solids in ID, 2D and 3D.	The Kroger–Vink notation for crystal defects	Combustion Synthesis Mechanosynthesis	thermal conductivity	cooperative phenomena antiferro magnetism

Duration (hour)		12	12	12	12	12
		cubic closed packing, hexagonal closed packing,				
S-4	SLO-1	Practice: Miller indices related problem,Seven crystal systems, CCP, HCP and FCC	Practice: crystal defects Point, line and plane defects, : notations for crystal defects	Practice: Solid State Reaction , Synthesis methods	Practice: heat capacity related problem	Practice: magnetism
	SLO-2					
S-5	SLO-1	face-centred cubic and body-centred cubic structure. Total number of atoms per unit cell	Thermodynamics of Schottky and Frenkel defect formation. Colour centres	Low Temperature Methods Chimie Douce Methods-Alkoxide	Electrical Properties: introduction. Electrical conductivity and Ohm's law	cooperative phenomena ferri magnetism
	SLO-2	relationship between the edge length of a cubic unit cell and the radius of atom	Vacancies and interstitials in non-stoichiometric crystals	Sol–Gel Method Using Oxyhydroxides and Colloid Chemistry	Hall effect and band theory	magnetic domains and hysteresis
S-6	SLO-1	the relative density of packing -simple cubic	extrinsic and intrinsic defects	Citrate Gel and Pechini Processes	intrinsic and extrinsic semiconductors	super paramagnetism
	SLO-2	face-centred cubic and body-centred cubic system	extrinsic and intrinsic defects	Use of Homogeneous, Single-Source Precursors	hopping semiconductors. semiconductor/metal transition	Optical properties: Introduction. Optical reflectance
S-7	SLO-1	Types of crystals-Ionic crystals	Defect clusters or aggregates,	Hydrothermal and Solvothermal Synthesis	p-n junctions, superconductors	plasmon frequency
	SLO-2	Structures of NaCl, CsCl and Zinc blende	Interchanged atoms. order–disorder phenomena	Microwave Synthesis	Meissner effect	Raman scattering in crystals
S-8	SLO-1	Practice: Total number of atoms per unit cell related problem, : Structures of NaCl and Zinc blende Structure of CsCl	Practice: extrinsic defects intrinsic defects, disorder phenomena	Practice: Hydrothermal Synthesis methods Solvothermal Synthesis methods, Microwave Synthesis methods	Practice: band theory, intrinsic semiconductors , extrinsic semiconductors	Practice: plasmon frequency, Raman scattering, Optical reflectance
	SLO-2					
S-9	SLO-1	Structures of Wurtzite	X-Ray Diffraction	Intercalation and Deintercalation	type I superconductors	photoconduction
	SLO-2	Structures of Rutile	Bragg's law	Graphite Intercalation Compounds	basic concepts of BCS theory	photoluminescence,
S-10	SLO-1	Structures of Perovskit	diffraction methods-Laue method	Pillared Clays and Layered Double Hydroxides	manifestations of the energy gap	electroluminescence,
	SLO-2	Covalent crystals: structure of diamond	diffraction methods-Laue method	Synthesis of Graphene	manifestations of the energy gap	photovoltaic
S-11	SLO-1	structure of graphite	diffraction methods- the rotating crystal method.	Gas-Phase Methods-CVD, PVD and ALD	Josephson devices.	photoelectrochemical effects.
	SLO-2	Metallic Crystals and Molecular Crystals	diffraction methods- the powder method.	Sputtering, Evaporation and Aerosol Synthesis and Spray Pyrolysis	Josephson devices.	photoelectrochemical effects.
S-12	SLO-1	Practice: Structures of Wurtzite , Rutile Perovskit	Practice: problem solving related to Bragg's law diffraction methods	Practice: Synthesis of Graphene Pyrolysis method , Gas-Phase Methods	Practice: BCS theory type I superconductors , Josephson devices	Practice: photoluminescence, electroluminescence, photoelectrochemical reactions
	SLO-2					

Learning Resources	1. R. West, Solid State Chemistry and Its Application, 2ed, Wiley, 2014. 2. P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, Shriver & Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press 2011-2012 4. C. N. R. Rao and J. Gopalakrishnan, New Directions in Solid State Chemistry, 2ed, Cambridge University Press, 2010. 5. P. A. Cox, The Electronic Structure and Chemistry of Solids, Oxford Science Publications, 1987. 6. G. Gottstein, Physical Foundation of Material Science, Springer, 2004. 7. D. M. Adam, Inorganic Solids: An introduction to concepts in solid-state structural chemistry, John Wiley and Sons, London, New York, Sydney, Toronto, 1974

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: Pgsekar@iitm.ac.in	Dr. S. Shanmugan, SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	Prof. M. Arthanareeswari, SRMIST

Course Code	UCY23D06T	Course Name	Chemical Technology and Society	Course Category	D	Discipline Specific Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Gain knowledge of the basic concepts of chemical engineering	
CLR-2 :	Learn different types of equipment in chemical technology	
CLR-3 :	Employ various chemical technology to industries	
CLR-4 :	Gain knowledge on chemical technology for societal benefits	
CLR-5 :	Learn natural sources used in various chemical technology	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Use of basic chemistry to chemical engineering	4	H	-	L	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Familiar with different types of equipment in chemical technology	4	H	-	-	M	-	-	-	-	-	-	-	-	-	H	-
CLO-3 :	Provide required knowledge on various chemical technology used in industries	4	-	H	-		-	-	-	-	-	H	-	-		M	-
CLO-4 :	Connect chemical technology for societal benefits	4	H	-	-	L	-	H	-	-	-	-	-	-	-	-	-
CLO-5 :	Utilize the natural sources for various chemical technology	4	-	H	-	-	H	-	-	-	-	-	-	-	-	H	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Basic Principles of Chemical Technology	Manufacture of Formaldehyde	Manufacture of Phenol from cumene and toluene	storage and transportation.	Manufacture of glycerin
	SLO-2	Basic principles of distillation	Manufacture of Formaldehyde	Manufacture of Phenol from benzene	Techniques for pressureless processing-Casting and dipping.	Manufacture of glycerin
S-2	SLO-1	solvent extraction	Manufacture of Chloromethanes	Manufacture of Phenol from chlorobenzene	coating and foaming	Manufacture of Detergents
	SLO-2	solid-liquid leaching	Manufacture of Chloromethanes	Manufacture of Styrene and pthalic anhydride	Polymer processing under pressure-Compression molding, rolling.	Manufacture of Detergents
S-3	SLO-1	liquid-liquid extraction	Manufacture of Hydrocarbon steam cracking for petrochemicals	Manufacture of Maleic anhydride	calendering, extrusion	Edible and essential oils
	SLO-2	separation by absorption and adsorption	Manufacture of Ethylene dichloride from ethylene	Manufacture of Dichloro diphenyl trichloroethane	blow molding and injection molding	vegetable oil extraction, hydrogenation of oil
S-4	SLO-1	Practice: distillation extraction absorption and adsorption	Practice: flow sheet of Formaldehyde synthesis flow sheet of Chloromethanes synthesis : flow sheet of Ethylene dichloride synthesis	Practice: flow sheet of Phenol synthesis : flow sheet of Styrene synthesis : flow sheet of Maleic anhydride synthesis	Practice: pressureless processing, pressure processing	Practice: flow sheet of glycerin synthesis flow sheet of Detergents synthesis, flow sheet of vegetable oil extraction
	SLO-2					
S-5	SLO-1	An introduction into the scope of different types of equipment needed in chemical technology	Manufacture of Vinyl chloride from ethylene	Polymer Process Technology	Polymer manufacturing processes with flow sheet for polythene, polyvinyl chloride	Society: Exploration of societal and technological issues from a chemical perspective

Duration (hour)		12	12	12	12	12
	SLO-2	including reactors	Manufacture of Vinyl chloride from ethylene	Classification according to physical and chemical structures	styrene butadiene rubber, phenol formaldehyde	Chemical and scientific literacy
S-5	SLO-1	distillation columns,	Manufacture of Ethylene oxide	Preparation Methods: Condensation and addition polymerization	viscose rayon and nylon	understand topics like air and water and the trace materials found in them that are referred to as pollutants
	SLO-2	Extruders, pumps	Manufacture of Ethylene oxide	methods-bulk, solution, Suspension, Emulsion	Natural Product Process Technology: Introduction	energy from natural sources
S-6	SLO-1	Mills, emulgators	Manufacture of Ethanolamines	homogeneous and heterogeneous polymerization	Preparation of wood pulp by sulfate (kraft) process with flow sheet	solar and renewable forms
	SLO-2	Scaling up operations in chemical industry.	Manufacture of Isopropanol from propylene	Physical properties and applications	Chemical recovery from black liquor and production of paper	energy from fossil fuels
S-7	SLO-1	Practice: different types of equipment Scaling up operations	Practice: flow sheet of Vinyl chloride synthesis flow sheet of Ethylene oxide synthesis flow sheet of Isopropanol synthesis	Practice: Polymer Process: \polymerization Methods, applications	Practice: manufacturing processes, flow sheet of polymers synthesis : flow sheet of polymers synthesis	Practice: technological issues pollution issuesnatural sources energy
	SLO-2					
S-8	SLO-1	Introduction to clean technology	Manufacture of Acetone from isopropanol	Thermoplastic and thermosetting	Manufacture of sugar	energy from nuclear fission
	SLO-2	Petrochemical Process Technology: Introduction	Manufacture of Cumene and acrylonitrile from propylene	elastomers and fibres	Manufacture of starch	materials like plastics and polymers and their natural analogues
S-9	SLO-1	Petrochemicals: overview	Manufacture of Isoprene and oxoprocessing of olefins	Adhesives and coatings films and fibres	Manufacture of Ethanol from Molasses	proteins and nucleic acids
	SLO-2	Classification of petrochemicals and process topology.	Manufacture of Isoprene and oxoprocessing of olefins	Processing technologies-mixing, rolling	Manufacture of Soaps	interconversions from simple to complex molecules
S-10	SLO-1	Process technology with flow sheet	Manufacture of Butadiene and benzene production using hydrodealkylation route	Kneading, pelletizing	Manufacture of fatty acids	molecular reactivity
	SLO-2	Manufacture of Methanol from Synthesis gas	Manufacture of Butadiene and benzene production using hydrodealkylation route	shredding and grinding	Manufacture of fatty acids	manufacture of drugs
S-11	SLO-1	Process technology flow sheet of Methanol synthesis from Syn gas	flow sheet of Acetone synthesis flow sheet of Cumene and acrylonitrile synthesis	Processing technologies	flow sheet of sugar synthesis flow sheet of starch synthesis	nuclear fission process, molecular reactivity
	SLO-2					
S-12	SLO-1	Practice: flow sheet of Methanol synthesis from Syn gas	Practice: flow sheet of Butadiene and benzene synthesis	Practice: elastomers and fibres	Practice: flow sheet of fatty acids synthesis	Practice: flow sheet of drugs synthesis
	SLO-2					

Learning Resources	
	1. J. W. Hill, T. W. McCreary, D. K. Kolb, Chemistry for changing times 13th Ed Pearson, 2011.
	2. C. E. Dryden, Outlines of Chemical Technology, East-West Press, 2008
	3. R. N. Shreve, G. T. Austin, Shreve's Chemical process industries, McGraw – Hill, 1984
	4. R. E. Kirk, D. F. Othmer, Encyclopedia of Chemical Technology, John Wiley and Sons, 1999-2012
	5. F. Ullmann, Encyclopedia of Industrial Chemistry, Wiley – VCH, 1999-2012.

Learning Assessment						
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)				Final Examination (50% weightage)
		CLA – 1 (10%)	CLA – 2 (10%)	CLA – 3 (20%)	CLA – 4 (10%)#	

		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	30%	-	20%	-	20%	-	30%	-
	Understand										
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-
	Analyze										
Level 3	Evaluate	30%	-	20%	-	30%	-	30%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	1. Dr. S. Shanmugan, SRMIST
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	2. *Prof. M. Arthanareeswari, SRMIST*

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Course Code	UCY23G04T	Course Name	Pharmaceutical Chemistry	Course Category	G	Generic Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Develop basic understanding of drug, their nomenclature and classifications, development and their side effects.	
CLR-2 :	Comprehend the mode of action of antiinflammatory agents, antibacterial, antifungal agents ans antiviral agents	
CLR-3 :	Give the knowledge of synthesis of major drug classes including-analgesics, antipyretics, antiinflammatory agents, antibacterial and antifungal agents antiviral agents, Central Nervous System agents and drugs for HIV--AIDS	
CLR-4 :	Gain knowledge about enzyme reactions and influence of cofactors on the reactions	
CLR-5 :	Gain an overview of fermentation process and production of certain dietary supplements and certain common antibiotics will be discussed.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand the importance of drugs, mode of action and difference from poison	4	H			-		-	M	-	-	-	-	H	-	-	-
CLO-2 :	correlate various features of the drug to its biological action	4		H	-	-	-	-	H	-	-	L	-	-	-	-	-
CLO-3 :	differentiate between drug and poison	4		H	-	-		-			-	-	-	H	-	-	-
CLO-4 :	Utilize the knowledge gained in the course to synthesize of molecules.	4	-	H	-	H		-	H	-	-	-	-	-	-	-	-
CLO-5 :	Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins	4	-	H	-	-	-	-	H	-	-	-	L		-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction of drugs	Medicinally important inorganic compounds	Definition and actions of representative antibacterial agent	Storage of drugs: Importance, and different conditions	Fermentation - Aerobic and anaerobic fermentation
	SLO-2	Nature and sources of drugs		Synthesis of the representative drugs (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim)		
S-2	SLO-1	Classifications of drugs: Biological	Role of inorganic compounds	Synthesis of the representative drugs of the following classes: antibacterial agent (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim	Encapsulation of drugs	Production of Ethyl alcohol
	SLO-2	Classifications of drugs: Chemical				
S-3	SLO-1	Nomenclature of drugs	Therapeutic uses of inorganic compounds	Synthesis of the representative drugs of the following classes: antibacterial agent (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim	Brief introduction to drug delivery	Production of citric acid
	SLO-2					

Duration (hour)		12	12	12	12	12
S-4	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-5	SLO-1	Drug receptor interaction	Drugs and Pharmaceuticals – I: Study of pharmaceutical aids - talc, diatomite and kaolin	Definition and actions of representative antifungal agent	Introduction - Enzymes	Production of Antibiotics - Penicillin
	SLO-2			Synthesis of the representative drugs		
S-6	SLO-1	Mechanism of drug interaction	Study of pharmaceutical aids - bentomite, gelatin and natural colours	Drugs and Pharmaceuticals – II Definition and actions of Antiviral agents	Classification of enzymes	Production of Antibiotics - Cephalosporin
	SLO-2			Synthesis of the representative drugs Antiviral agents (Acyclovir)	Enzyme specificity	Production of Antibiotics - Chloromycetin
S-7	SLO-1	Metabolism of drugs	Definition and actions of antipyretic drug	Definition and actions of Central Nervous System agents	Mechanism of enzyme action	Production of Antibiotics - Streptomycin
	SLO-2		Examles	Synthesis of the representative drugs Central Nervous System agents (Phenobarbital, Diazepam)		
S-8	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					
S-9	SLO-1	Definition of the following terms: pharmacophore-pharmacology, pharmacopeia, bacteria, virus, chemotherapy and vaccine	Basic Retro-synthetic approach for development of drug.	Definition and actions of Cardiovascular drug	Enzyme cofactor	Production of - Lysine, Glutamic acid
	SLO-2			Synthesis of the representative Cardiovascular drug (Glyceryl trinitrate)	Role of enzyme cofactor in reactions	
S-10	SLO-1	Causes and symptoms for common disease and their treatment	Definition and actions of antipyretic drug	Definition and actions of antilaprosy drug	coenzyme - – its role in enzyme reactions	Production of - Vitamin B2
	SLO-2		Synthesis of the representative drugs	Synthesis of the representative antilaprosy drugs (Dapsone)		
S-11	SLO-1	Difference between drug and poison.	Definition and actions of anti-inflammatory drug	Definition and actions of HIV-AIDS related drugs	Immobilization of enzymes	Production of - Vitamin C
	SLO-2		Synthesis of the representative drugs (Aspirin)	Synthesis of the representative HIV-AIDS related drugs (AZTZ idovudine)		
S-12	SLO-1	Tutorial session	Tutorial session	Tutorial session	Tutorial session	Tutorial session
	SLO-2					

Learning Resources	Theory: 1. G. L. Patrick, Introduction to Medicinal Chemistry, Oxford University Press, UK 2013. 2. H. V. K. Kapoor, Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi 2008. 3. W. O. Foye, L. Thomas, D. A. William, Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi 2012. 4. 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. 5. 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.

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	***2.****Prof. Dr. M. Arthanareeswari, SRM IST*

Course Code	UPY23G06T	Course Name	Thin Films	Course Category	G	Generic Elective Course	L	T	P	O	C
							4	0	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	impart a sound basis for an understanding of vacuum technology.			
CLR-2:	provide a fundamental knowledge on various principles and methods used in the synthesis of materials in thin film form.			
CLR-3:	introduce nucleation and growth mechanisms of thin films based on thermodynamics and molecular theory.			
CLR-4:	provide understanding of optical techniques for thickness measurements			
CLR-5:	familiarize with physics and techniques involved in the measurement and characterization of thin films			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	understand the concept of vacuum technique	2	75	60
CLO-2:	explore evaporation and sputtering systems for fabrication of films	2	80	70
CLO-3:	know about the concept of various CVD techniques and their applications	2	70	65
CLO-4:	understand the possible growth modes and techniques to measure thickness of films	2	70	70
CLO-5:	explore various advanced experimental techniques to search for crystal structures, morphology, elemental and surface analysis	2	80	70

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1:	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-2:	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-3:	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-4:	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-
CLO-5:	H	H	-	-	-	-	-	H	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Fundamentals of vacuum	Substrate deposition technology	Chemical bath deposition : ionic and solubility products	Introduction to elasticity	X-ray diffraction (XRD)
	SLO-2	Basic definition and pressure regions of vacuum	Substrate materials,	Preparation of binary semiconductors	Plasticity and mechanical behavior	Experimental investigation of X-ray diffraction (XRD
S-2	SLO-1	Kinetic theory of gases, mean free path	Substrate cleaning	Deposition mechanism	Electrical and magnetic properties of thin films	Scanning electron microscopy
	SLO-2	Kinetic theory of gases, mean free path	Masks and connections	Preparation of compound thin films	Introduction to electrical properties of thin films,	Morphology analysis using scanning electron microscopy
S-3	SLO-1	Understanding concepts and types of gas flow	Thermal evaporation	Electrodeposition	Optical properties of thin films	Transmission electron microscopy
	SLO-2	Types of flow	Thermal evaporation	Electrolytic deposition	Optical constant in thin films	Transmission electron microscopy
S-4	SLO-1	Conductance	Resistive heating	Electro less deposition	Theory of nucleation and growth process	Investigation of nanostructures using transmission electron microscopy
	SLO-2	Vacuum pumps	Flash evaporation	Anodic oxidation	Early stages of film growth	Investigation of nanostructures using transmission electron microscopy

S-5	**SLO-1**	*Vacuum pumps and systems*	*Rf-heating*	*Spray pyrolysis*	*Thermodynamic aspects of nucleation*	*Energy dispersive analysis*
	SLO-2	*Rotary mechanical pump*	*Co-evaporation*	*Spin coating*	*Capillary theory*	*Elemental analysis using energy dispersive analysis*
S-6	**SLO-1**	*Rotary mechanical pump*	*Co-evaporation*	*Dip coating*	*Thin film growth modes*	*Auger electron spectroscopy*
	SLO-2	*Roots pump*	*Electron bombardment heating*	*Chemical vapor deposition (cvd)*	*Volmert, weber (vw) growth*	*Auger electron spectroscopy*
S-7	**SLO-1**	*Diffusion pump*	*Sputtering plasma*	*Homogenous process*	*Frank-van der merwe (fm) growth*	*Study of surface using auger electron spectroscopy*
	SLO-2	*Diffusion pump*	*Discharges and arc*	*Heterogeneous process,*	*Stranski-krastanov growth*	*Study of surface using auger electron spectroscopy*
S-8	**SLO-1**	*Turbo molecular pump*	*Sputtering yield low pressure sputtering*	*Cvd reactions*	*Thickness measurement*	*Basic principle of x-ray photoelectron spectroscopy*
	SLO-2	*Turbo molecular pump*	*Rf-sputtering*	*Pyrolysis*	*Electrical methods*	*Experimental details of x-ray photoelectron spectroscopy*
S-9	**SLO-1**	*Measurement of vacuum*	*Reactive sputtering*	*Hydrogen reduction, halide disproportionation,*	*Microbalance monitors*	*Identify elements within materials from x-ray photoelectron spectroscopy study*
	SLO-2	*Concept of different gauges*	*Basic principle of magnetron sputtering*	*Transfer reactions*	*Quartz crystal monitor*	*Uv-vis spectroscopy, theory and applications*
S-10	**SLO-1**	*Capacitance gauges*	*Details study of magnetron sputtering*	*Cvd processes and systems*	*Basic of mechanical method (stylus)*	*Uv-vis spectroscopy, theory and applications*
	SLO-2	*Pirani gauge*	*Magnetron configurations*	*Low pressure CVD*	*Mechanical method (stylus)*	*Introduction of secondary ion mass spectrometry*
S-11	**SLO-1**	*Ionization gauge and penning gauge*	*Evaporation versus sputtering*	*Laser enhanced cvd*	*Ellipsometry*	*Experimental study of secondary ion mass spectrometry*
	SLO-2	*Vacuum system components*	*Evaporation versus sputtering*	*Metal organic cvd (mocvd)*	*Interference fringes*	*Use of secondary ion mass spectrometry*
S-12	**SLO-1**	*Problems/Demos/ Simulations/Seminars on mean free path from kinetic theory of gases, and different gauges*	*Problems/Demos/ Simulations/Seminars on rf and resistive heating*	*Problems/Demos/ Simulations/Seminars on electrodeposition and MOCVD*	*Problems/Demos/ Simulations/Seminars on nucleation*	*Problems/Demos/ Simulations/Seminars on crystallite size, strain analysis using XRD*
	SLO-2	*Problems/Demos/ Simulations/Seminars on vacuum operation*	*Problems/Demos/ Simulations/Seminars on evaporation versus sputtering*	*Problems/Demos/ Simulations/Seminars on low pressure CVD and CVD reactions*	*Problems/Demos/ Simulations/Seminars on thickness analysis and crystal monitor*	*Problems/Demos/ Simulations/Seminars on morphology study from SEM and TEM data*

Learning Resources

1. D.M. Hoffman, B. Singh and J.H. Thomas, Handbook of Vacuum Science & Technology, Academic Press, 1998.
2. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed., Academic Press (An Imprint of Elsevier), 2002.
3. Properties of Thin Films by Joy George, Marcel and Decker, (1992).
4. Kaufmann, Characterization of Materials, 2nd Ed., Wiley, 2003.
5. K.L. Chopra, Thin Film Phenomena, Robert E. Krieger Publishing Company, 1979.
6. Z.L. Wang, Characterization of Nanophase Materials, Wiley, 2000.
7. Thin Film Technology by O S Heavens, Methuen young books (1970).
8. N. Yoshimura, Vacuum Technology: Practice for Scientific Instruments, Springer Publications, 2007.
9. The Vacuum Technology Book Volume II, Pfeiffer Vacuum [Online Book]
10. E. Ahmed, et al. "Significance of substrate temperature on the properties of flash evaporated CuIn 0.75 Ga 0.25 Se 2 thin films." Thin Solid Films 335.1 (1998): 54-58.
11. Physics of Thin Films by Ludmila Eckertová, Springer (1986).
12. J.B. Mooney, and S.B. Radding. "Spray pyrolysis processing." Annual Review of Materials Science 12.1 (1982): 81-101.
13. R.F. Bunshah, Handbook of Deposition Technologies for Films and Coatings, Science,

		Technology and Applications, Noyes Publications, 1994.

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. N. VIJAYAN, CSIR-NPL, nvijayan@nplindia.org Experts from Higher Technical Institutions	Prof. V. Subramanian, IIT Madras, manianvs@iitm.ac.in	*Dr. Bhaskar Behera, SRMIST*

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Course Code	UCY23G05T	Course Name	Chemistry in Everyday life	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	To familiarize the students on chemistry in everyday life	
CLR-2 :	To gain necessary details and information related to preparation of cosmetic items	
CLR-3 :	To know about the health hazards of the cosmetic items and food colors	
CLR-4 :	To understand the properties of food composition and adulterants in food	
CLR-5 :	To understand the concept of types of fibre biodegradable polymers	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Apply the knowledge gained to generate home made products like soap and camphor tablets	4	H	-	-	-	-	-	L	-	-	-	-	H	-	-	-
CLO-2 :	Ability to identify the adulterants present in regular food items	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the hazards of food colors and its real-life implications	4	H	-	-	-	M	H	-	-	-	-	-	-	-	-	-
CLO-4 :	Application of various food preservation techniques	4	H	-	-	H	-	-	H	-	-	-	-	-	-	-	-
CLO-5 :	The students will be able to understand the importance and benefits of antioxidants to the living system	4	-	H	-	-	H	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Cosmetics: Introduction	Definitions and sources – Carbohydrates	Food preservatives-Definition examples	Significance of Radical chemistry in living system	Fibers: natural fibers
	SLO-2	Preparation of Talcum Powder	Definitions and sources - proteins -fats	Methods of preservation-Low and high temperature methods	Radical production in environment	Fibers: Artificial fibers
S-2	SLO-1	Preparation of shampoo	Definitions and sources - minerals	Methods of preservation-dehydration osmotic pressure	Superoxide and peroxide radicals	Artificial fibers - polyamides
	SLO-2	Preparation of tooth paste	Definitions and sources – vitamins	Methods of preservation- food irradiation	Quantification of radicals by EPR	Acrylic and polyesters
	SLO-2	Preparation of Nail Polish	Definition and source of sports supplements	Food colour chemicals used in food -soft drinks and its health hazards	Health impacts Action of radicals	PET
S-3	SLO-1	Preparation of skin creams	Physiological importance-balanced diet	Chemicals in food production	Diseases caused by free radicals	PET recycling process
	SLO-2					
S-4	SLO-1	Practice: Quiz about cosmetic materials	Practice: Quiz about sources of carbohydrates	Practice: Quiz about food preservative chemicals	Practice: Quiz about radicals' detection	Practice: Quiz about natural fibers
	SLO-2	Practice: Quiz about shampoo and nail polish	Practice: Quiz about proteins and minerals	Practice: Quiz about food preservatives methods	Practice: Quiz about EPR analysis	Practice: Quiz about synthetic fibers
S-5	SLO-1	Preparation of Perfumes	Adulterants in milk - ghee - oil- identification.	Food poisoning-Reasons	Cancer Radical quencher	Biodegradable Polymers-examples
	SLO-2					

Duration (hour)		12	12	12	12	12
S-6	SLO-1	Cottage industries: agarbatti	Adulterants in coffee and tea powders and its identification	Introduction to Fertilizers	Anti-oxidants- Introductions	Non-biodegradable polymers examples
	SLO-2	Preparation of bath salts	Adulterants in asafoetida - identification	Fertilizers used in natural sources	Advantages and role of antioxidants in human health	Use of polymeric materials in daily life
S-7	SLO-1	Soaps and detergents - General formulations and preparation	Adulterants in chilli powder- identification	Fertilizers-Urea- NPK need -Uses and hazards	Natural anti-oxidants like vegetables, beverages like tea and coffee, fruits	Polystyrene materials for food storage and serving
	SLO-2	Cosmetics for nail care	Adulterants in pulses and turmeric powder – identification	Fertilizers super phosphates- Uses and hazards	Water soluble antioxidants	PTFE in cookware
S-8	SLO-1	Practice: Oral Presentations	Practice: Oral Presentations	Practice: Oral Presentations	Practice: Oral Presentations	Practice: Oral Presentations
	SLO-2					
S-9	SLO-1	Sun screens formulation and working mechanism	Role of voluntary agencies such as, Agmark, I.S.I.	Pesticides –definition and examples	Antioxidants/Polyphenols and skin aging	Polymers in sports
	SLO-2					
S-10	SLO-1	Cosmetics used for eye care	Highlights of Food Safety and Standards Act 2006	Pesticides for public health pest control- mosquitoes, houseflies	Radical destroying enzymes: superoxide dismutase	Uses of Vinyl polymers and Bakelite
	SLO-2					
S-11	SLO-1	Possible Hazards of cosmetic use	Food Safety and Standards Authority of India (FSSAI)- Rules and Procedures	Pesticides for domestic pests - Bed bugs, cockroaches etc.	Radical destroying enzymes: catalase, peroxidase	hazards of polymers
	SLO-2					
S-12	SLO-1	Practice: Participative debates	Practice: Participative debates	Practice: Participative debates	Practice: Participative debates	Practice: Participative debates
	SLO-1	Practice: Summarizing all concepts	Practice: Summarizing all concepts	Practice: Summarizing all concepts	Practice: Summarizing all concepts	Practice: Summarizing all concepts

Learning Resources

Theory:

1. W. A. Poucher, Perfumes, Cosmetic and Soaps (Vol 3),10th edition Kluwer academic publishers 2000.
2. O. P. Vermani, A. K. Narula Industrial Chemistry Galgotia Publications Pvt. Ltd., New Delhi 2006.
3. J. M. Berg, J. L. Tymoczeko, I. Stryer, Biochemistry, W. H. Freeman Publishers, 2008.
4. B. K. Sundari. Applied chemistry - MJP Publishers, New Delhi. 2006.
5. L. H. Meyer., Food Chemistry, CBS publishes & distributors. 2004.
6. V. R. Gowariker, N. V.Viswanathan, J. Sreedhar, Polymer science, New Age, International 2005

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	30%	-	30%	-	20%	-	20%	-	30%	-
Level 2	Apply / Analyze	40%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate / Create	30%	-	20%	-	30%	-	30%	-	20%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combinatin of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers

Expert from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	UPY23G07T	Course Name	Group Theory	Course Category	G	General Elective Course	L	T	P	O	C
							3	1	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1:	Learn and evaluate the symmetry	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2:	Understand role of symmetry in physics			
CLR-3:	Able to evaluate the groups of a system			
CLR-4:	Able to understand the group theory in quantum mechanics			
CLR-5:	Apply group theory in solid state physics			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1:	To able to define symmetry in mathematical formalism	2	75	60
CLO-2:	Able to represent the symmetry and symmetric operations	2	80	70
CLO-3:	Acquire the knowledge of space groups in real space	2	70	65
CLO-4:	Acquire the knowledge of space groups in reciprocal space	2	70	70
CLO-5:	Application of character table in simple molecule	2	80	70

Program Learning Outcomes (PLO)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
CLO-2:	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
CLO-3:	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
CLO-4:	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-
CLO-5:	H	-	-	-	-	-	-	-	-	H	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Definition of a Group	Reducible and Irreducible representation	Symmetry Relations and Point Group Classifications	Reciprocal Space	Character Table
	SLO-2	Definition of a Group	Reducible and Irreducible representation	Symmetry Relations and Point Group (PG) Classifications	Reciprocal Space	Character Table
S-2	SLO-1	Example of a Group Basic Definitions	Schur's Lemma and Great Orthogonality Theorem	Symmetry Relations and Point Group Classifications	Translational Group and Bloch's Theorem	Character Table
	SLO-2	Example of a Group Basic Definitions	Schur's Lemma and Great Orthogonality Theorem	Symmetry Relations and Point Group Classifications	Translational Group and Bloch's Theorem	Character Table
S-3	SLO-1	***Rearrangement Theorem***	Character Table	Mathematical Background for Space Groups	PG in r and k space	Space group analysis of CH_4
	SLO-2	***Rearrangement Theorem***	Character Table	Mathematical Background for Space Groups	PG in r and k space	Space group analysis of CH_4
S-4	SLO-1	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars	Problems/Demos/ Simulations/Seminars
	SLO-2					
S-5	SLO-1	Cosets , Conjugation and Class	Character Table	Mathematical Background for Space Groups	SG-representation	Space group analysis of CH_4
	SLO-2	Cosets , Conjugation and Class	Character Table	Mathematical Background for Space Groups (SG)	SG-representation	Space group analysis of CH_4
S-6	SLO-1	Symmetry Planes	Character Table	Symmetry operations	SG-representation	Space group analysis of CH_4
	SLO-2	Symmetry Planes	Character Table	Symmetry operations	SG-representation	Space group analysis of CH_4
S-7	SLO-1	Inversion centre	Definition of Character	Symmorphic and Nonsymmorphic	Common Cubic-Lattices	Space group analysis of NH_3
	SLO-2	Inversion centre	Definition of Character	Symmorphic and Nonsymmorphic	Γ-point	Space group analysis of NH_3
S-8	SLO-	Problems/Demos/	Problems/Demos/	Problems/Demos/	Problems/Demos/	Problems/Demos/

	1	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*	*Simulations/Seminars*
	SLO-2					
S-9	SLO-1	*Proper and Improper axis & rotations*	*Characters and Class, Matrices*	*Bravis Lattice and SG*	*points with k ≠ 0*	*Space group analysis of NH_3*
	SLO-2	*Proper and Improper axis & rotations*	*Characters and Class, Matrices*	*Bravis Lattice and SG*	*points with k ≠ 0*	*Space group analysis of NH_3*
S-10	SLO-1	*Products of Symmetry operations*	*Schoenflies Symmetry Notation*	*Examples of Symmorphic SG*	*Nonsymmorphic Space Group*	*Space group analysis of NH_3*
	SLO-2	*Products of Symmetry operations*	*Schoenflies Symmetry Notation*	*Cubic SG and the Equivalence Transformation*	*Factor Group and Γ-point*	*Space group analysis of NH_3*
S-11	SLO-1	*Optical Isomerism*	*The Hermann–Mauguin Symmetry Notation*	*2D Space Group*	*Factor Group and Γ-point*	*Space group analysis of NH_3*
	SLO-2	*Optical Isomerism*	*The Hermann–Mauguin Symmetry Notation*	*Oblique, Square, Rectangular and Hexagonal SG*	*Factor Group and Γ-point*	*Space group analysis of NH_3*
S-12	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					

Learning Resources	1. *M.S. Dresselhaus, G. Dresselhaus, A. Jorio, Group Theory: Application to the Physics of Condensed Matter, Springer, 2008* 2. F.A. Cotton, Chemical Applications of Group Theory, 3rd ed, Wiley, 2008	3. A. W. Joshi, Elements Of Group Theory For Physicists, New Age International, 2018 4. Rakshit Ameta, Suresh C. Ameta, Chemical Applications of Symmetry and Group Theory, AAP, 2016

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
-	Dr. Amrita Bhattacharjee, IIT Bombay, Mumbai, b_amrita@iitb.ac.in	Dr Rudra Banerjee
-	Prof. Subhradip Ghosh, IIT Guwahati, subhra@iitg.ac.in	Dr. Triparno Banerjee

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Course Code	UCY23P03L	Course Name	Internship-III	Course Category	*P*	***Internship/Apprenticeship / Project/ Community Outreach***	L	T	P	O	C
							0	0	0	0	2

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
10Course Offering Department	Department of English	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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.*																		

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	ICT Skills	Professional Behavior	Life Long Learning
CLO-1 :	*Identify areas for future knowledge and skill development*	*3*	*80*	*70*	*H*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*L*	*-*	*M*	*-*	*-*	*-*	*-*
CLO-2 :	*understanding of what is expected in the job market and what their standard of performance should be*	*3*	*85*	*75*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*M*	*-*	*L*	*-*	*-*	*-*	*-*
CLO-3 :	*Build professional, as well as academic, contacts and begin the process of networking and support for your future careers.*	*3*	*75*	*70*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*M*	*-*	*-*	*H*	*-*
CLO-4 :	*Acquire knowledge of the industry in which the internship is done.*	*3*	*85*	*80*	*H*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*L*	*-*	*-*	*-*	*-*	*-*	*M*
CLO-5 :	*practical experience within the business environment*	*3*	*85*	*75*	*-*	*-*	*-*	*-*	*-*	*H*	*-*	*-*	*-*	*-*	*M*	*-*	*-*	*-*	*H*

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 %*

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. T, Pushpa Malini SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	***2.*** *Prof. M. Arthanareeswari, SRMIST*

Course Code	*UCY23P05L*	*Course Name*	*Project Phase-I*	*Course Category*	*P*	*Internship/ Project/ Community Outreach*	*L*	*T*	*P*	*O*	*C*
							0	*0*	*9*	*2*	*4*

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**	**Program Learning Outcomes (PLO)**														
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	13	14	15
CLR-1:	*Produce competent, creative and imaginative graduates with a strong scientific acumen*																
CLR-2	*Apply of the acquired knowledge, skills, and tools pertinent to the field of Chemistry*																
CLR-3	*Promote independent and collaborative research work in the domain of chemistry*																
CLR-4	*Inculcate the ethical responsibility of the graduate in the scientific society*																
CLR-5	*Identify the challenges and solutions pertinent to the field of Chemistry*																

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1	*demonstrate the key areas of research*	*4*	*H*	-	-	-	*H*	-	-	-	*L*	-	-	-	-	-	-
CLO-2	*develop laboratory and experiment related skills*	*4*	-	*H*			*H*	*H*	-	-	-	-	-	-	-	-	-
CLO-3	*posses' competence on data collection and process of scientific documentation*	*4*	-	*M*	-	-	*M*	-	-	-	-	-	*M*	-	-	-	-
CLO-4	*gain the knowledge of research ethics*	*4*	-	-	-	-	*M*	*M*	-	*H*	-	-	-	-	-	-	-
CLO-5	*solve problems in their area of research*	*4*	-	-	*H*	-	-	-	*H*	-	-	-	-	*M*	-	-	-

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

Semester - VIII

Course Code	UCY23801T	Course Name	Organometallic & Bioinorganic Chemistry	Course Category	C	Discipline Specific Core	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning	Program Learning Outcomes (PLO)

CLR-1:	Gain knowledge of the basic concepts of organometallic chemistry	1
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:	Level of Thinking (Bloom)	1 Fundamental Knowledge	2 Application of Concepts	3 Link with Related Disciplines	4 Procedural Knowledge	5 Skills in Specialization	6 Ability to Utilize Knowledge	7 Skills in Modeling	8 Analyze, Interpret Data	9 Investigative Skills	10 Problem Solving Skills	11 Communication Skills	12 Analytical Skills	13 PSO -1	14 PSO -2	15 PSO-3
CLO-1:	Employ 18-electron rule to rationalize the stability of organometallic compounds	4	H	-	-	H	-	-	M	-	-	-	-	-	-	-	-
CLO-2:	Apply concepts of organometallic chemistry in fine chemical for industry	4	H	-	-	-	H	-	-	-	M	-	-	-	-	-	-
CLO-3:	Develop a general idea of catalysis and describe the mechanism in detail	4	-	H	-		-	-	M	-	-	-	-	-	H	-	-
CLO-4:	Solve periodically by incorporation of organometallic compounds into organic synthesis problems	4	L	-	-	H	-	-	-	-	-	-	-	-	-	M	-
CLO-5:	Explain the sources and consequences of excess and deficiency of trace metals and learn about the toxicity of certain metal ions	4	-	-	H	-	-	-	L	-	-	-	-	-	-	H	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to organometallic chemistry	Introduction of Organometallic compounds containing π systems, synthesis and properties	Introduction: Catalytic reactions and their applications	Introduction to Bioinorganic Chemistry: Porphyrin systems and their functions	Introduction of Non-Porphyrin systems and their functions
	SLO-2					
S-2	SLO-1	Type of ligands and coordination-hapticity	Organometallic compound Synthesis, structure, bonding	Homogeneous catalysis	Essential and non–essential metals Toxicity of metals – Cd, Hg and Cr toxic effects with specific examples	Non-heme proteins-hemocyanin and hemerythrin
	SLO-2					
S-3	SLO-1	Eighteen electron rule-Electron counting and limitations	Reactivity of transitional metal complexes with alkenes	Feedstocks for chemical industry Metathesis and hydrogenation	Ion (Na+ and K+) transport-ion channel ion carrier and ion pump	Their coordination geometry
	SLO-2					
	SLO-2					
S-4	SLO-1	Transition metal carbonyl complexes-synthesis and reactivity	Reactivity of transitional metal complexes with alkynes	Hydroformylation and acetic acid synthesis	Porphyrins, in photosynthesis Photosystems I and II	Electronic structure and oxygen bindings,
	SLO-2					
S-5	SLO-1	Nitrosyl containing complexes. Ligand substitution reactions	Π-allyl, Enyl, butadiene, pentadienyl, Cyclobutadiene and cyclopentadienyl complexes	Heterogeneous catalysis: Fischer-tropsch reaction	Chlorophylls and their coordination geometry	Electron transfer proteins: Active site structure and functions of ferredoxin and Rubredoxin
	SLO-2					
S-6	SLO-1					

Duration (hour)		12	12	12	12	12
	SLO-2	and Ligand insertion reactions Structure of mononuclear and polynuclear metal carbonyl	Metallocenes complexes and Benzenoid complexes	Ziegler-natta polymerization and Polymer-bound catalysts	Hemoglobin and their coordination geometry. Electronic structure and co-operativity effect	Nitrogen fixation. Metalloenzymes containing molybdenum and iron
S-7	SLO-1	Practice: Structure of metal carbonyl	Practice: Reactivity of metal alkene complexes	Practice: Heterogeneous Catalytic reactions	Practice: structure of Chlorophylls	Practice: structure of Fe-S proteins
	SLO-2					
S-8	SLO-1	Practice: Structure of metal Nitrosyl	Practice: Reactivity of metal arene complexes	Practice: Mechanisms	Practice: structure of Hemoglobin	Practice: structure of Fe-S proteins
	SLO-2					
S-9	SLO-1	Metal dinitrogen and dioxygen complexes	Migratory insertion reaction with alkenes, alkynes	Olefinic oxidation and Addition of hx to olefins	Oxygen binding, transport and utilization of hemoglobin	Cobalt: cobalamine based enzymes and nickel: urease
	SLO-2					
S-10	SLO-1	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-2					
S-11	SLO-1	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-2					
S-12	SLO-1	Practice: Structure of metal dinitrogen Structure of Vaska's complex	Practice: Migratory insertion reaction Oxidative addition and Reductive elimination	Practice: various types of reactions	Practice: structure of Cytochromes	Practice: structure of zinc enzymes, structure of Cobalt enzymes
	SLO-2					

Learning 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. 2. F. A. Cotton, G. Wilkinson, P. L. Gaus, Basic Inorganic Chemistry 3rd Ed. Wiley India 1998 3. N. N. Greenwood, A. Earnshaw, Chemistry of the Elements 2nd Ed, Elsevier, (Ziegler Natta Catalyst and Equilibria in Grignard Solution), 1997. 4. G. O. Spessard, G. L. Miessler, Organometallic Chemistry, Prentice Hall, 1997. 5. B. E. Douglas, D. H. McDaniel, J. J. Alexander, Concepts and Models in Inorganic Chemistry 3rd Ed., John Wiley and Sons, NY, 1994. 6. K. F. Purcell, J. C. Kotz, Inorganic Chemistry, W.B. Saunders Co. 1977 7. 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. 9. J. A. Cowan, Inorganic Biochemistry: An Introduction, VCH Publishing, 1993. 10. W. Kaim, B. Schwederski, B. Bioinorganic chemistry: Inorganic Elements in the Chemistry of Life, Wiley, 2006.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	*Experts from Higher Technical Institutions*	*Internal Experts*
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*Dr. Mihir. Ghosh, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: sukhendu@iisertvm.ac.in	*Prof. M. Arthanareeswari, SRMIST*

Course Code	*UCY23D07T*	*Course Name*	*Organic Spectroscopy*	*Course Category*	*D*	*Discipline Specific Elective Courses*	*L*	*T*	*P*	*O*	*C*
							4	*0*	*0*	*2*	*4*

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Gain information regarding NMR spectroscopy and analysis*
CLR-2 :	*Enable the students to acquire knowledge on infrared spectroscopy*
CLR-3 :	*Gain knowledge on the basic principle of UV spectroscopy*
CLR-4 :	*Acquire knowledge in the fundamentals of mass spectroscopy*
CLR-5 :	*Promote the importance of ESR, XPS and CD to characterize organic compounds*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning Level of Thinking (Bloom)	Program Learning Outcomes (PLO) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*Apply the concepts of NMR spectroscopy to apply on unknown organic compounds.*	*4*	*H*	-	-	-	-	-	*M*	-	-	-	-	*H*	-	-	-
CLO-2 :	*Gain knowledge and practical skill in the quantitative analysis of wide range of compounds by IR spectroscopy*	*4*	*H*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Understand the basic concepts of Ultraviolet spectroscopy*	*4*	*H*	-	-	-	*M*	-	-	*H*	-	-	-	-	-	-	-
CLO-4 :	*Acquaint the fundamental concepts of mass spectroscopy to analyze organic compounds*	*4*	*H*	-	-	*H*	-	-	-	-	*L*	-	-	-	-	-	-
CLO-5 :	*Utilize their chemistry knowledge of ESR/CD to get in depth knowledge about the prepared compounds.*	*4*	-	*H*	-	-	-	-	*H*	-	*M*	-	-	-	-	-	-

-

Duration (hour)		12	12	12	12	12
S-1	**SLO-1**	Introduction to NMR	Introduce DEPT	Ultraviolet spectroscopy	Mass spectrometry: Basic principles	ESR spectroscopy
	SLO-2	Origin of NMR spectrum	Use in characterizing molecules	Basic principles	Mass spectrometer	Basic principles and applications
S-2	**SLO-1**	NMR active nuclei and sensitivity	Introduce IR	Absorption laws: The Lambert-Beer's Law	The molecular ions and Metastable ions	Free radicals
	SLO-2	Basic principle of NMR spectroscopy, spin states and population of nuclei	Use of IR spectra	Oxochromes	Reactions of ions in gas phase	Organic compounds
S-3	**SLO-1**	Effect of external magnetic field on the population and correlation with field strength	Absorption of light and spectral properties	Chromophores, standard works of reference	Effect of isotope	X-ray photoelectron spectroscopy
	SLO-2	Introduce polyatomic molecules and relaxation of nuclei	IR active/inactive bonds, selection rules	Selection rules	Isotope abundances	elemental composition
S-4	**SLO-1**	continuous-wave method	Modes of stretching and bending	Electronic transitions in organic compounds	Nitrogen rule, Determination of molecular formula	empirical formula
	SLO-2	Fixed B_0	Modes of stretching and bending	Mixtures of absorbing species	Fragmentations	chemical state of elements
S-5	**SLO-1**	^{1}H NMR: Chemical shifts, dependency on external field	Stretching/bending frequency of: alkanes, alkenes, alkynes	calibration curve for calculation of unknown	McLafferty rearrangements	electronic state of the elements
	SLO-2	and Hz scales	aromatic rings	Extinction coefficient	Fragmentation of organic compounds	Examples
S-6	**SLO-1**	Shielding, deshielding	alcohols and ethers (cyclic and acyclic)	Applications: conjugated dines	Instrumentation: Various methods of ionization	Optical rotatory dispersion (ORD)
	SLO-2	Magnetic anisotropy	aldehyde and ketone	trienes	Field ionization	Circular dichroism (CD)

Duration (hour)		12	12	12	12	12
S-7	SLO-1	Chemical shifts of protons attached to functional groups	Carboxylic acids	unsaturated carbonyl compounds	Field desorption	Phenomena of ORD and CD
	SLO-2	Chemical shifts of protons attached to functional groups	ester and amine (cyclic and acyclic)	aromatic compounds	Fast atom bombardment (FAB)	Classification of ORD, and CD Curves
S-8	SLO-1	Multiplicity of signals	anhydride	Woodward -Fieser rules	Matrix-assisted laser desorption/ ionization (MALDI)	Cotton effect curves
	SLO-2	Calculation of coupling constants	acid chloride acid alkyl/aryl halides	calculation of absorption maxima (λmax)	Different detectors	Application to stereochemical problems
S-9	SLO-1	NMR spectrum of compounds with symmetry	Amine, nitro	dienes and carbonyl compounds	Magnetic analyser	The Octant rule
	SLO-2	NMR spectrum of compounds with symmetry	cyano, isocyanate	Fieser and Kuhn rules	Ion cyclotron analyzer	application to alicyclic ketones
S-10	SLO-1	Introduce COSY	Introduction to Raman spectroscopy	Effects of auxochromes and conjugation on the absorption maxima	Quadrupoule mass filter	axial haloketone rule
	SLO-2	Basic principle and spectrum analysis	Selection rules	Different shifts of absorption peaks	Time of flight (TOF),	assignment of configuration of chiral molecules
S-11	SLO-1	Introduce nOe	Compare IR and Raman	Bathochromic, hypsochromic, hypochromic shifts	Rules of fragmentation of different functional	Structural elucidation of organic molecules using spectroscopic techniques
	SLO-2	Basic principle and spectrum analysis	Optical Transitions: Absorption, Scattering, and Fluorescence	Absorption spectra of organic compounds	factors controlling fragmentation	Structural elucidation of organic molecules using spectroscopic techniques
S-12	SLO-1	Introduce ^{13}C NMR	Elastic Scattering (Raleigh	Applications in organic molecule analysis	HRMS	Structural elucidation of organic molecules using spectroscopic techniques
	SLO-2	Multiplicity of signals, chemical shifts	Stokes and anti-Stokes shifts	Applications in organic molecule analysis	Applications	Structural elucidation of organic molecules using spectroscopic techniques

Learning Resources	**Theory:** 1. R. M. Silverstein, G. C. Bassler and T. C. Morril, Spectroscopic Identification of Organic Compounds,3rd Ed., John Wiley & Sons Inc., 1974. 2. W. Kemp, Organic Spectroscopy, Palgrave Macmillan, 1991. 3. C. N. Banwell and E. M. McCash, Fundamentals of Molecular spectroscopy, 4th Ed., McGraw-Hill, 1972. 4. M-M. Cid, J. Bravo, Structure Elucidation in Organic Chemistry: The search for the right tools, Wiley-VCH, 2015. 5. N. E. Jacobsen, NMR Data Interpretation Explained: Understanding 1D and 2D NMR Spectra of Organic Compounds and Natural Products, Wiley, 2016.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	30%	-	30%	-	20%	-	20%	-	30%	-
Level 2	Apply Analyze	40%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate Create	30%	-	20%	-	30%	-	30%	-	20%	-

	Total	100 %	100 %	100 %	100 %	100 %

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Susnata Pramanik, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. M. Arthanareeswari, SRM IST*

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Course Code	UCY23D08T	Course Name	Materials chemistry and their use in everyday life	Course Category	D	Discipline Specific Elective	L	T	P	O	C
							4	0	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Introduce the science of materials chemistry	Level of Thinking (Bloom)
CLR-2 :	Deepen the knowledge on crystalline materials with a focus on their synthesis methods	
CLR-3 :	Improve the understanding of amorphous, electronic materials and their applications	
CLR-4 :	Gain knowledge about mechanical, magnetic and electrical properties of materials along with their technological relevance	
CLR-5 :	Enlighten with basic principles of various analytical techniques for characterization of materials	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:		Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Understand different types of materials, their properties, characterization and applications	4	H	-	-	-	M	-	-	-	-	-	-	H	-	-	-
CLO-2 :	Well aware of various chemical, physical methods of materials synthesis	4	L	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Gain knowledge about polymer materials and their use	4	H	-	-	-	H	-	H	-	-	-	-	-	-	-	-
CLO-4 :	Familiar with the mechanical, magnetic and electrical properties	4	H	-	-	M	-	-	-	H	-	-	-	-	-	-	-
CLO-5 :	Identify the suitable analytical techniques and perform the characterization of materials	4	-	H	-	-	H	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Crystalline materials: introduction	Amorphous solids: Introduction	Introduction to nanomaterials	Introduction to magnetic materials	Characterization of biomaterials (physical)
	SLO-2	Crystalline materials: introduction	A comparison of crystalline and amorphous materials in terms of properties and applications	Examples of a variety of nanomaterials	Examples of magnetic materials	Characterization of biomaterials (chemical)
S-2	SLO-1	Fundamentals of lattice	Oxides (examples)	Fabrication methods of nanomaterials	magnetic properties of materials: Applications	Spectroscopic methods: Introduction
	SLO-2	Unit cell	Oxides (applications)	Fabrication methods of nanomaterials	magnetic properties of materials: biological applications	Classification and their use
S-3	SLO-1	Bravias lattices	Carbons (examples)	Classification of nanomaterials: 0D,1D nanomaterials	Classification of magnetic materials: Ferro magnetic	UV-Vis Instrumentation (set up)
	SLO-2	Atomic coordinates	Carbons (applications)	Classification of nanomaterials: 2D nanomaterials	anti-ferro magnetic, Ferri magnetic	basic working principles
S-4	SLO-1	Assignment-1	Assignment-1	Assignment-1	Assignment-1	Assignment-1
	SLO-2	Assignment-2	Assignment-2	Assignment-2	Assignment-2	Assignment-2

Duration (hour)		12	12	12	12	12
S-5	SLO-1	Point defects	Introduction to polymer	Examples of 0D nanomaterials	Piezoelectric property and its use	IR: Instrumentation (set up)
	SLO-2	Line defects	Examples	Applications of 0D nanomaterials	Dielectric property and its use	basic working Principles
S-6	SLO-1	Surface defects	Synthesis of polymer (chemical)	Examples of 1D nanomaterials	Pyroelectric property and its use	X-ray diffraction: Instrumentation
	SLO-2	Bulk defects	Synthesis of polymer (radical)	Applications of 1D nanomaterials	Ferroelectric property and its use	basic working principles
S-7	SLO-1	synthetic approaches for crystalline functional materials: Chemical methods (example 1)	Use of polymer in daily life	Examples of 2D nanomaterials	Introduction to biomaterials	SEM, Instrumentation
	SLO-2	synthetic approaches for crystalline functional materials: Chemical methods (example 2)	Use of polymer in health/medical science	Applications of 2D nanomaterials	Classifications	basic working principles
S-8	SLO-1	Assignment-1	Assignment-1	Assignment-1	Assignment-1	Assignment-1
	SLO-2	Assignment-2	Assignment-2	Assignment-2	Assignment-2	Assignment-2
S-9	SLO-1	synthetic approaches for crystalline functional materials: chemical methods (example 3)	Band theory of solids: Introduction	Porous materials (Definition and examples)	Examples of a variety of biomaterials (hydrogel)	TEM, Instrumentation
	SLO-2	synthetic approaches for crystalline functional materials: chemical methods (example 4)	Importance and use	Porous materials (uses)	Examples of a variety of biomaterials (composite)	basic working principles
S-10	SLO-1	synthetic approaches for crystalline functional materials: Physical methods (Example 1)	Insulators	Soft materials (Definition and examples)	Synthesis of different kinds of biomaterials (hydrogel)	XPS: Instrumentation
	SLO-2	synthetic approaches for crystalline functional materials: Physical methods (Example 2)	semiconductors	Soft materials (uses)	Synthesis of different kinds of biomaterials (composite)	basic working principles
S-11	SLO-1	synthetic approaches for crystalline functional materials: Physical methods (Example 3)	Concept of doping	luminescent materials (Definition and examples)	Use of biomaterials (hydrogel)	AFM: Instrumentation
	SLO-2	synthetic approaches for crystalline functional materials: Physical methods (Example 4)	different types of dopant materials	luminescent materials (uses)	Use of biomaterials (composite)	basic working principles
S-12	SLO-1	Assignment-1	Assignment-1	Assignment-1	Assignment-1	Assignment-1
	SLO-2	Assignment-2	Assignment-2	Assignment-2	Assignment-2	Assignment-2

Learning Resources	Theory: 1. A. R. West, Basic Solid State Chemistry, 2nd Ed., John Wiley &Sons Ltd., 1999 2. K. J. Klabunde, Nanoscale materials in Chemistry, Wiley Interscience, New York, 2001 3. C. Giacovazzo, Fundamentals of Crystallography, Oxford University Press, 2002. 4. W. D. Callister and D. G. Rethwisch, Materials Science and Engineering: An Introduction,9th Ed., Wiley, 2013. 5. 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.

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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Course Code	UCY23D09T	Course Name	Medicinal Chemistry and Drug Design	Course Category	D	Discipline Specific Elective Courses	L	T	P	O	C
							4	0	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
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	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Gain exposure to the field of medicinal chemistry	4	H	-	-	-	-	-	M	-	-	-	-	H	-	-	-
CLO-2 :	Gain insight about the drug molecules, their action, how to design a drug molecule	4	H	H	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-3 :	Gain knowledge about the structural importance in activity and how to improve their water solubility	4	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Know how drug molecules passes through the membrane, their metabolism, production and formulation	4	H	-	-	-	-	-	H	-	L	-	-	-	-	-	-
CLO-5 :	Learn about the use of computational simulation for drug design	4	-	H	-	-	-	-	H	-	-	-	H	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	introduction and definition of medicinal chemistry	drug discovery: history	Theories for Drug–Receptor Interactions	pharmacological testing	Macromolecular Drug Carrier Systems
	SLO-2	general terminologies	general stages in drug discovery	Occupancy, rate, induced-fit Theory	toxicological testing (IC_{50})	Continued
S-2	SLO-1	structure and functions of proteins	Identification and Validation of Targets for Drug Discovery	Potency	formulation development	Bioprecursor Prodrugs
	SLO-2	continued	Alternatives to Target-Based Drug Discovery	Selectivity	Continued	Proton Activation
S-3	SLO-1	structure and functions of nucleic acid	desirable properties of a drug	structure–activity relationship of drugs	Production	Hydrolytic Activation, Elimination Activation,
	SLO-2	continued	stereochemistry and drug design	Drug Synthesis: the design of combinatorial syntheses	quality control	Oxidative Activation
S-4	SLO-1	enzyme structure Binding pocket	importance of water solubility, and structure of the solute	Techniques of it	Continued	continued
	SLO-2	Catalytic active site	methods of improving water solubility	solid support method	Continued	Reductive Activation
S-5	SLO-1	Amino acid residues involve in catalysis	salt formation, formulation, effect of pH	encoding methods	Drug Resistance	continued
	SLO-2	Examples of biologically important reactions	Surfactants, amphiphiles	combinatorial synthesis in solution	Mechanisms of Drug Resistance	Nucleotide Activation, Phosphorylation Activation
S-6	SLO-1	inhibition in drug discovery	methods and routes of administration	library generation and analysis	Altered Target Enzyme or Receptor	Sulfation Activation
	SLO-2	reversible inhibitors	Drug metabolism	high-throughput screening	Increased Drug-Destroying	Decarboxylation Activation

Duration (hour)		12	12	12	12	12
					Mechanisms	
S-7	SLO-1	irreversible inhibitors	secondary pharmacological implications of metabolism	Random Screening, Targeted (or Focused) Screening	Activation of New Pathways Circumventing the Drug Effect	Computer-based drug design
	SLO-2	continued	phase I metabolic reactions, and examples	introduction and bioassay	Reversal of Drug Action	Benefits over the traditional method
S-8	SLO-1	transition-state inhibitors	phase II metabolic reactions, and examples	continued	Drug Synergism (Drug Combination)	molecular modeling methods
	SLO-2	case studies	drug action	Screening of Compounds, sources of leads and drugs	Mechanisms of Drug Synergism	molecular mechanics
S-9	SLO-1	Structure of DNA	pharmacodynamics and pharmacokinetics	lead discovery, Lead Modification (Lead Optimization)	Inhibition of a Drug-Destroying Enzyme, Sequential Blocking	molecular dynamics
	SLO-2	Binding sites (major and minor groves)	drug targets: action sites	Identification of the Active Part, Functional Group Modification	Inhibition of Targets in Different Pathways, Use of Multiple Drugs for the Same Target	Docking: de novo design
S-10	SLO-1	DNA Interactive agents and chemotherapy	receptors proteins	Structure Modifications, Homologation, Chain Branching	Enzyme Activation of Drugs	comparing 3D structures and use
	SLO-2	DNA binding agents	continued	Conformational Constraints and Ring-Chain Transformations	Utility of Prodrugs	pharmacophores
S-11	SLO-1	intercalation and alkylation	carrier proteins	Lipophilicity Effects, Balancing Potency	Mechanisms of Drug Inactivation	use of pharmacophore
	SLO-2	DNA strand breakers	Drug–Receptor Interactions	quantitative structure–activity relationship (QSAR)	Carrier-Linked Prodrugs	modeling protein structures
S-12	SLO-1	working principle	noncovalent interactions	Scaffold Hopping	Examples of Carrier-Linked Bipartite Prodrugs	three-dimensional QSAR
	SLO-2	case studies	continued	Molecular Graphics-Based Lead Modification	Prodrugs for Stability	other uses of computers in drug discovery

Learning Resources	**Theory:** 1. G. Thomas, Medicinal Chemistry: An Introduction, 2nd Ed., John Wiley and Sons, Ltd 2007. 2. R. B. Silverman and Mark W. Holladay, The Organic Chemistry of Drug Design and Drug Action, 3rd Ed., Elsevier 2014. 3. T. Nogrady, D. F. Weaver, Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd Ed., Oxford University Press, Inc 2005.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Ravikiran Allada, Director, *Analytical Sciences and Technology Transfer,* *Novugen Pharma, Malaysia* *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry,* *IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Susnata Pramanik, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. Dr. M. Arthanareeswari, SRMIST*

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Course Code	UCY23D10T	Course Name	Green Chemistry	Course Category	C	Discipline Specific Elective Courses	L	T	P	O	C
							4	0	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Know the basics of Green Chemistry and its developments.	
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	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	Gain knowledge about the principles of green chemistry	4	H	-	-	-	H	-	M	-	-	-	-	-	-	-	-
CLO-2 :	Employ a green chemistry approach to the existing synthetic reactions	4	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Employ nonconventional reaction methods to existing conventional synthetic methods	4	H	L	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Utilize the knowledge gained in the course for experimenting with solvent less reactions	4	H	-	-	H	-	-	-	-	-	-	-	H	-	-	-
CLO-5 :	Identify reactions wherein sustainable synthetic methods can be employed	4	M	H	-	-	-	-	H	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction: Green Chemistry	Acetylation of primary amine,	Ionic liquids: Introduction	Supported metal catalysts: Introduction	Photo reduction of benzophenone to benzopinacol using sunlight.
	SLO-2	Introduction: Green Chemistry	Acetylation of primary amine,	Ionic liquids: Introduction	Supported metal catalysts: Introduction	Photo reduction of benzophenone to benzopinacol using sunlight.
S-2	SLO-1	Need for Green Chemistry	base catalyzed aldol condensation (synthesis of dibenzalpropanone),	classification of ionic liquids-	Supported metal catalysts – mesoporous silica.	Photochemical alternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylating agent.
	SLO-2	Need for Green Chemistry	base catalyzed aldol condensation (synthesis of dibenzalpropanone),	Classification of ionic liquids-	Supported metal catalysts – mesoporous silica.	Photochemical alternative to Friedel-Crafts reaction and use of dimethyl carbonate as a methylating agent.
S-3	SLO-1	Anastas' twelve principles of green chemistry	halogen addition to C=C bond (bromination of trans-stilbene)	Synthesis of ionic liquids – Ionic liquids	Supported metal catalysts – mesoporous silica.	Reaction in water - furan
	SLO-2	Anastas' twelve principles of green chemistry	halogen addition to C=C bond (bromination of trans-stilbene)	Synthesis of ionic liquids – Ionic liquids	Phase transfer catalyst - Synthesis	Reaction in water - furan

Duration (hour)		12	12	12	12	12
S-4	SLO-1	Anastas' twelve principles of green chemistry	[4+2] cycloaddition reaction (Diels Alder reaction between furan and maleic acid).	Ionic liquids: simple preparation – types – properties and application	Phase transfer catalyst - Synthesis	Reaction in water - maleic acid.
	SLO-2	Anastas' twelve principles of green chemistry	[4+2] cycloaddition reaction (Diels Alder reaction between furan and maleic acid).	Ionic liquids: simple preparation – types – properties and application	Phase transfer catalyst - Synthesis	Reaction in water - maleic acid.
S-5	SLO-1	Atom economy-Principle	Rearrangement reaction (benzyl-benzilic acid rearrangement),	Ionic liquids in organic reactions (Heck reaction)	Phase transfer catalyst - Synthesis	Extraction of D-limonene from orange peel.
	SLO-2	Atom economy-Principle	Rearrangement reaction (benzyl-benzilic acid rearrangement),	Ionic liquids in organic reactions (Heck reaction)	Phase transfer catalyst - Synthesis	Extraction of D-limonene from orange peel.
S-6	SLO-1	Definition with example (ibuprofen synthesis	Rearrangement reaction (benzyl-benzilic acid rearrangement),	Ionic liquids in organic reactions (Suzuki reactions)	Phase transfer catalyst - applications	Mechanochemistry principles in green chemistry
	SLO-2	Definition with example (ibuprofen synthesis	coenzyme catalyzed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin)	Ionic liquids in organic reactions (Suzuki reactions)	Phase transfer catalyst - applications	Mechanochemistry principles in green chemistry
S-7	SLO-1	Microwave assisted organic synthesis (MAOS)	coenzyme catalyzed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin)	Ionic liquids in organic reactions (epoxidation)	Phase transfer catalyst - applications	Mechanochemistry principles in green chemistry
	SLO-2	Microwave assisted organic synthesis (MAOS)	coenzyme catalyzed benzoin condensation (thiamine hydrochloride catalyzed synthesis of benzoin)	Ionic liquids in organic reactions (epoxidation)	Phase transfer catalyst - applications	Photochemical principles in green chemistry
S-8	SLO-1	Microwave assisted organic synthesis (MAOS)	Electrophilic aromatic substitution reactions (nitration of phenol)	Ionic liquids in analytical chemistry (gas chromatography stationary phases)	Phase transfer catalyst - applications	Photochemical principles in green chemistry
	SLO-2	Examples of MAOS (synthesis of fused anthroquinones	Electrophilic aromatic substitution reactions (nitration of phenol)	Ionic liquids in analytical chemistry (gas chromatography stationary phases)	Phase transfer catalyst - applications	Photochemical principles in green chemistry
S-9	SLO-1	Examples of MAOS (synthesis of fused anthroquinones	Electrophilic aromatic substitution reactions (bromination of acetanilide)	Ionic liquids in analytical chemistry (matrices for MALDI-TOF MS)	Magnetically recoverable catalysts.	Green chemistry in sustainable development.
	SLO-2	Examples of MAOS (synthesis of fused anthroquinones	Electrophilic aromatic substitution reactions (bromination of acetanilide)	Ionic liquids in analytical chemistry (matrices for MALDI-TOF MS)	Magnetically recoverable catalysts.	Green chemistry in sustainable development.
S-10	SLO-1	Advantages and disadvantages of MAOS.	green oxidation reactions (synthesis of adipic acid)	Advantages and Disadvantages	Magnetically recoverable catalysts.	Green chemistry in sustainable development.
	SLO-2	Advantages and disadvantages of MAOS.	green oxidation reactions (synthesis of adipic acid)	Advantages and Disadvantages	Magnetically recoverable catalysts.	Green chemistry in sustainable development.
S-11	SLO-1	Organic reactions by sonication method	zeolite catalyzed Friedel-Crafts acylation	Super critical CO2 – preparation, properties and applications	Magnetically recoverable catalysts.	Green chemistry in sustainable development.

Duration (hour)		12	12	12	12	12
	SLO-2	Organic reactions by sonication method	zeolite catalyzed Friedel-Crafts acylation	Super critical CO2 – preparation, properties and applications	Magnetically recoverable catalysts.	Green chemistry in sustainable development.
S-12	SLO-1	Examples of sonochemical Reactions (Wittig reaction)	zeolite catalyzed Friedel-Crafts acylation	Super critical CO2 – preparation, properties and applications	Magnetically recoverable catalysts.	Green chemistry in sustainable development.
	SLO-2	Examples of sonochemical Reactions (Wittig reaction)	zeolite catalyzed Friedel-Crafts acylation	Super critical CO2 – preparation, properties and applications	Magnetically recoverable catalysts.	Green chemistry in sustainable development.

Learning Resources	**Theory:** 1. V. K. Ahluwalia, M. R. Kidwai, New Trends in Green Chemistry, Anamalaya Publishers, 2005. 2. V. K. Ahluwalia, Green Chemistry Narosa, New Delhi, 2011. 3. P. T. Anastas, J. K. Warner, Green Chemistry- Theory and Practical, Oxford University Press, 1998. 4. A. S. Matlack, Introduction to Green Chemistry, Marcel Dekker, 2001. 5. M. C. Cann, M. E. Connely, Real-World cases in Green Chemistry, ACS 2000. 6. M. A. Ryan, M. Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, 2002. **7.** M. Lancaster, Green Chemistry: An Introductory Text RSC Publishing, Second Edition, 2010.

Learning Assessment

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

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia *Email: ravianalytical@gmail.com*	*Prof. G. Sekar, Department of Chemistry, IIT Madras* *Email: gsekar@iitm.ac.in*	*1. Dr. Samarendra Maji, SRMIST*
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	*2. Prof. Dr. M. Arthanareeswari, SRM IST*

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Course Code	UCY23G06T	Course Name	Computational Modelling in Chemistry	Course Category	C	Generic Elective	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	To make the students aware about the basic concepts in computational chemistry and force-field based methods	
CLR-2 :	To make the students aware about the HF method and its applications to solve different problems	
CLR-3 :	To make the students aware about the different types of electronic structure methods in computational chemistry	
CLR-4 :	To make the students aware about the different properties that can be computed using computational chemistry.	
CLR-5 :	To introduce the students to some of the advanced methods and their applications in computational chemistry.	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*Explain the concept of methods like MM, MD and their applications and limitations.*	4	H	-	-	-	-	-	L	-	-	-	-	H	-	-	-
CLO-2 :	*Explain the concept of HF method and its applications.*	4	M	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Explain the concept of semi-empirical methods and calculations of different properties.*	4	H	-	-	-	M	-	-	-	L	-	-	-	-	-	-
CLO-4 :	*Elaborate of comparative study of different properties using different methods*	4	H	-	-	H	-	-	M	-	-	-	-	-	-	-	-
CLO-5 :	*Develop concepts and application of advanced computational methods and their application.*	4	-	H	-	-	-	-	H	-	M	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to the subject of computational chemistry	Review of the variational method: definition and theorems	Electronic spin: S2 operator, degeneracy,	Introduction to analytic gradient: theory	Introduction to excited state theories used in computational chemistry: concept
	SLO-2	Scope of computational chemistry	Review of the variational method: derivation	evaluating the spin of Slater determinants	Applications of analytic gradient	Introduction to excited state theories used in computational chemistry: theory
S-2	SLO-1	The tools of computational chemistry: GUI	Hartree-Fock molecular orbital theory	Group theory: Molecular point groups	Electrostatics	Excited states: methods
	SLO-2	The tools of computational chemistry: Simulation packages	Slater determinants, anti-symmetry principle	Group theory: term symbols	Applications of electrostatics	Excited states: applications
S-3	SLO-1	Introduction to molecular mechan-ics (MM)	Basis sets	Group theory: computational simplifications	Introduction to charge analysis	Introduction to solvation in computational chemistry: definitions
	SLO-2	comparison of popular force fields (MM)	EMSL basis set exchange	Group theory: application	different types of charges	Introduction to solvation in computational chemistry: theory
S-4	SLO-1	Practical session on GUI	Practical session on applying HF theory to evaluate single point energy of water	Practical session on applying group theory to small molecules	Practical session on charge analysis of molecules: Mullikan charge	Practical session on energy evaluation in gas phase

Duration (hour)		12	12	12	12	12
	SLO-2	Practical session on simulation packages	Practical session on applying HF theory to evaluate single point energy of ammonia	Practical session on applying group theory to cyclic structures	Practical session on charge analysis of molecules: Löwdin charge	Practical session on energy evaluation in solvent phase
S-5	SLO-1	Performance of molecular mechanics on biomolecules	Derivation of HF equations	Semiempirical methods	Transition state theory	Models of Solvation: PCM
	SLO-2	Performance of molecular mechanics on materials	Hartree-Fock energy expressions for arbi-trary spin-orbital configurations	Applications of Semiempirical methods	statistical mechanics, and thermodynamic properties	Models of Solvation: SMD
S-6	SLO-1	Moleculat Dynamics-concept and defination	Application of HF to IP and EA calculation	Geometry optimization:Methods	Introduction to electron correlation: static correlation	Introduction to Coupled-cluster (CC) theory
	SLO-2	Molecular Dynamics: theory	spin integration	Geometry optimization: analysis	Dynamic correlation	Application of Coupled-cluster theory
S-7	SLO-1	Applications of MD on biomolecules	restricted and unrestricted references	Vibrational frequency analysis: symmetry analysis	Configuration interaction (CI): theory	Introduction to Density-functional theory: theorems and functionals
	SLO-2	Application of MD on materials	Self-consistent-field (SCF) procedure	harmonic vs. fundamental frequencies	Configuration interaction (CI): application	Time-dependent DFT (TD-DFT)
S-8	SLO-1	Practical Session on MM of transition metal complex	Practical session on applying HF theory: Building the molecules in GUI for evaluation of reaction energy	, Practical session on applying semi-empirical methods to small system	Practical session on study of molecule structure evaluation using HF	Practical session on applying couple cluster theory to small molecules to evaluate energy
	SLO-2	Practical Session on MM of materials	Practical session on applying HF theory: calculating the reaction energy	Practical session on applying semi-empirical methods to large system	Practical session on of molecule structure evaluation using CI	Practical session on applying couple cluster theory to medium sized molecules to evaluate energy
S-9	SLO-1	Postulates of quantum mechanics	Molecular integrals	Zero-point vibrational energies (ZPVE's), Hessian index	Comparative study of HF and CI to small systems	Applications of DFT
	SLO-2	Variables and functions	types of integrals	distinguishing minima from transition states	Comparative study of HF and CI to big systems	Applications of TD-DFT
S-10	SLO-1	The Born-Oppenheimer approximation	Gaussian product theorem	Intrinsic reaction coordinate (IRC) analysis: background	Many-body perturbation theory	Multiconfigurational self-consistent field (MCSCF): theory
	SLO-2	Introduction to potential energy surfaces	Permutational symmetry of integrals	Intrinsic reaction coordinate (IRC) analysis: definition	Applications of Many-body perturbation theory	Multiconfigurational self-consistent field (MCSCF): application
S-11	SLO-1	PES: local and global minima	The HF algorithm for closed shell system	Intrinsic reaction coordinate (IRC) analysis: theory	Useful approximations: resolution of the identity (density fitting)	Comparing the performance of DFT and HF
	SLO-2	PES: transition states	The HF algorithm for open shell system	Intrinsic reaction coordinate (IRC) analysis: analysis	local correlation	Comparing the performance of CI and CC
S-12	SLO-1	Practical session on MD of transition metal complex	Practical session on applying HF method to evaluate the potential energy surface of n-Butane: Building the system	Practical session on evaluating optimized energies	Practical session on study of HF to find the stable geometric isomer of a molecule	Practical session on evaluating excited state energies of a molecule using TD-DFT
	SLO-2	Practical session on MD of slab of material	Practical session on applying HF method to evaluate the potential energy surface of n-	Practical session on evaluating ZPEs	Practical session on study of CI to find the stable	Practical session on evaluating excited state energies of a molecule using CI and CC

Duration (hour)		12	12	12	12	12
			Butane: calculating the energy		geometric isomer of a molecule	

Learning Resources	Theory: 1. F. Jensen, Introduction to Computational Chemistry, (Wiley, New York, 1999). Good introductory textbook covering a variety of topics. 2. A. Szabo, N. S. Ostlund, Modern Quantum Chemistry, Introduction to Advanced Electronic Structure Theory, 1st ed., revised. More mathematical detail for many of the ab initio electronic structure methods. 1998. **3.** M. A. Ratner, G. C. Schatz, Introduction to Quantum Mechanics in Chemistry, Prentice Hall, Upper Saddle River, NJ 2001.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	30%	-	30%	-	20%	-	20%	-	30%	-
Level 2	Apply Analyze	40%	-	50%	-	50%	-	50%	-	50%	-
Level 3	Evaluate Create	30%	-	20%	-	30%	-	30%	-	20%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
Dr. Ravikiran Allada, Director, Analytical Sciences and Technology Transfer, Novugen Pharma, Malaysia Email: ravianalytical@gmail.com	Prof. G. Sekar, Department of Chemistry, IIT Madras Email: gsekar@iitm.ac.in	**1.Dr. Tumpa Sadhukhan, SRMIST**
	Prof. Sukhendu Mandal, Department of Chemistry, IIISER, Thiruvananthapuram Email: *sukhendu@iisertvm.ac.in*	***2.Prof. Dr. M. Arthanareeswari, SRM IST***

Course Code	UPY23G08T	Course Name	*Applications of Nanotechnology*	Course Category	*G*	Generic Elective Course	L	T	P	O	C
							3	1	0	2	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*comprehend the principles of nanotechnology.*			
CLR-2 :	*make the students understand the basic concepts in nanoscience.*			
CLR-3 :	*develop understanding on the exotic properties of nanostructured materials.*			
CLR-4 :	*introduce various techniques available for the processing of nanostructured materials.*			
CLR-5 :	*emphasize the importance and development of nanotechnology in various fields*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*determine the nanotechnology and actual working areas and applications.*	*2*	*75*	*60*
CLO-2 :	*classify different techniques for synthesis of nanomaterials*	*2*	*80*	*70*
CLO-3 :	*classify different techniques depending on the application areas*	*2*	*70*	*65*
CLO-4 :	*determine the characterization techniques for nanomaterials*	*2*	*70*	*70*
CLO-5 :	*discuss and evaluate state-of-the-art characterization methods for nanomaterials*	*2*	*80*	*70*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	*H*	*H*								*H*					
CLO-2 :	*H*	*H*								*H*					
CLO-3 :	*H*	*H*								*H*					
CLO-4 :	*H*	*H*								*H*					
CLO-5 :	*H*	*H*								*H*					

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Nanotechnology*	*Classification of nanostructures*	*Top-down approach*	*Characterization techniques*	*Application od nanotechnology*
	SLO-2	*History and importance*	*zero, one, two and three dimensional nanostructures,*	*overview*	*General Introduction*	*Nanotechnology in food, FDA regulation*
S-2	SLO-1	*opportunity at the nanoscale,*	*What is density of states (DOS)? How DOS changes with dimensional nanostructures*	*bottom-up approach*	*Scanning electron microscope (SEM), transmission electron microscope (TEM), comparing SEM, TEM and SPM for different classes of nanomaterials.*	*Nanoemulsions, Methods of producing nanoemulsions*
	SLO-2	*Examples*	*Quantum confinement effect*	*Overview with examples*	*scanning electron microscope (SEM) Qualitative Overview*	*Nanotechnology to enhance food safety and quality*
S-3	SLO-1	*length and time scale in structures,*	*Confinement effect with different nanostrcture*	*method of nanomaterials preparation,*	*transmission electron microscope (TEM),*	*Intelligent materials for packaging*
	SLO-2	*Definitions and concepts*	*size dependency in nanostructures, Examples*	*Qualitative discussion*	*Qualitative Overview*	*Examples*
S-4	SLO-1	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-5	SLO-1	*length and time scale in structures,*	*Confinement effect with different nanostrcture*	*method of nanomaterials preparation,*	*transmission electron microscope (TEM),*	*Intelligent materials for packaging*

	SLO-2	*Definitions and concepts*	*size dependency in nanostructures, Examples*	*Qualitative discussion*	*Qualitative Overview*	*Examples*
S-6	**SLO-1**	*difference between bulk and nanoscale materials*	*quantum size*	*wet chemical routes of synthesis*	*scanning probe microscope (SPM),*	*Nanomedicine*
	SLO-2	*Examples*	*Concept*	*physical routes*	*Qualitative Overview*	*Interaction of nanoparticles with Biological barriers*
S-7	**SLO-1**	*Significance of Nano size*	*Quantum size effects in nanostructures,*	*physical vapor deposition (PVD)*	*comparing SEM, TEM and SPM*	*Respiratory path, Gastrointestinal absorption and Skin absorption of nanoparticles*
	SLO-2	*Examples*	*Examples*	*What is Plasma? Plasma Components and ionization, DC Plasma*	*Basic differences*	*Nanoparticle concentration determination: dose matters*
S-8	**SLO-1**	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*	*Problems/Demos/ Simulations/Seminars*
	SLO-2					
S-9	**SLO-1**	*properties at nanoscale*	*chemistry of tailored nano shapes*	*Mean free path of atom/molecule in a chamber*	*Application of Discussed techniques*	*Nanostructures for water and wastewater treatment*
	SLO-2	*optical,*	*Qualitative discussion*	*Sputtering, atoms sputter from target*	*Overview*	*Construction of membranes and characteristics*
S-10	**SLO-1**	*Electronic properties*	*quantum dots*	*DC and RF sputtering difference, why need AC plasma?*	*different classes of nanomaterials*	*Types of Adsorption, Surface area and pore size*
	SLO-2	*Magnetic Properties*	*nanowells*	*chemical vapor deposition (CVD) and Mass flow controlled regime*	*Choice of Characterization Technique*	*Membrane Filtration and reverse osmosis, Membrane configurations*
S-11	**SLO-1**	*Chemical Properties*	*nanoribbons*	*CVD reaction mechanism, homogenous process and heterogeneous process*	*SEM, TEM and SPM*	*Nanotechnology in storage devices*
	SLO-2	*Overview*	*nanowires*	*Growth rate dependence with gas flow rate and temperature*	*Using for different materials*	*Batteries and application*
S-12	**SLO-1**	*Assignment on Properties*	*Problems/Demos/ Simulations/Seminars on above-given topics*	*Seminar on Synthesis*	*Assignment on Characterization*	*Assignment on applications*
	SLO-2					

Learning Resources	1. T. Pradeep, *A Textbook of Nanoscience and Nanotechnology*, Tata McGraw Hill Education, 2012. 2. G. Cao, Y. Wang, *Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*, 2nd Ed., Imperial College Press, 2004.	3. T.K. Sau, A.L. Rogach, *Complex-shaped Metal Nanoparticles: Bottom-Up Syntheses and Applications*, 1st Ed., Wiley-VCH, 2012. 4. Chattopadhyay, Banerjee, Introduction to Nanoscience and Nanotechnology, PHI, 2009.

Learning Assessment												
	Bloom's Level of Thinking	**Continuous Learning Assessment (50% weightage)**								**Final Examination (50% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (20%)**		**CLA – 4 (10%)#**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
Level 1	Remember Understand	30%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply	40%	-	50%	-	50%	-	50%	-	50%	-

	Analyze										
Level 3	Evaluate	30%	-	20%	-	20%	-	20%	-	20%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. N. VIJAYAN, CSIR-NPL, nvijayan@nplindia.org	Prof. S. Balakumar, University of Madras, balakumar@unom.ac.in	Dr. Mathimalar, SRMIST
Dr. Krishna SurendraMuvvala, Saint Gobain Research India, India, Krishna.muvvala@saintgobain.com	Prof. V. Subramaniyam, IIT Madras, vsubbu@iitm.ac.in	Dr. Debabrata Sarkar, SRMIST

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Course Code	UCY23P06L	Course Name	Project Phase-II	Course Category	P	Internship/ Apprenticeship/ Project/ Community Outreach	L	T	P	O	C
							0	0	12	2	6

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Produce competent, creative and imaginative graduates with a strong scientific acumen	
CLR-2	Apply of the acquired knowledge, skills, and tools pertinent to the field of Chemistry	
CLR-3	Promote independent and collaborative research work in the domain of chemistry	
CLR-4	Inculcate the ethical responsibility of the graduate in the scientific society	
CLR-5	Identify the challenges and solutions pertinent to the field of Chemistry	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Program Learning Outcomes (PLO)														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			Fundamental Knowledge	Application of Concepts	Link with Related Disciplines	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1	demonstrate the key areas of research	4	H	-	-	-	H	-	H	-	L	-	-	-	-	-	-
CLO-2	develop laboratory and experiment related skills	4	-	H			H	H	-	-	-	-	-	-	-	-	-
CLO-3	posses' competence on data collection and process of scientific documentation	4	-	M	-	-	M	-	-	-	-	-	M	-	-	-	-
CLO-4	gain the knowledge of research ethics	4	-	-	-	-	M	M	-	H	-	-	-	-	-	-	-
CLO-5	solve problems in their area of research	4	L	-	H	-	-	-	H	-	-	-	-	M	-	-	-

Learning Assessment

	Continuous Learning Assessment (50% weightage)		Final Evaluation (50% weightage)	
Project Phase-II	Review – 1	Review – 2	Project Report	Viva-Voce
	20%	30 %	30 %	20 %

Generic Elective course for other department

Course Code	UCY23G01J	Course Name	Basic Chemistry	Course Category	G	Generic Elective Course	L	T	P	O	C
							3	0	3	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
CLR-1:	Make students understand the nature of Chemical Bonding in compounds	
CLR-2 :	Provide basic knowledge about the chemistry of hydrogen, silicon and other metals	
CLR-3 :	Understand the basic principles of chemical kinetics	
CLR-4 :	Study the concepts in electrochemistry	
CLR-5 :	Make aware of the fuels, fertilizers and other detergents	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)
CLO-1 :	Gain knowledge on the basics in organic chemistry.	4
CLO-2 :	Promote the importance of silicon and metals.	4
CLO-3 :	Understand the facts in chemical kinetics	4
CLO-4 :	Acquire knowledge in the principles of electrochemistry	4
CLO-5 :	Understand the basic concepts in industrial chemistry	4

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Fundamental Knowledge	Application of Concepts	Link with Related	Procedural Knowledge	Skills in Specialization	Ability to Utilize Knowledge	Skills in Modeling	Analyze, Interpret Data	Investigative Skills	Problem Solving Skills	Communication Skills	Analytical Skills	PSO -1	PSO -2	PSO-3
CLO-1 :	H	-	-	-	-	-	-	-	-	-	-	H	-	-	-
CLO-2 :	-	-	-	-	H	-	H	-	-	-	-	-	-	-	-
CLO-3 :	-	-	-	-	M	-	H	-	-	-	-	-	-	-	-
CLO-4 :	-	-	-	H	-	-	H	-	-	-	-	-	-	-	-
CLO-5 :	-		H	-	-	H	-	-	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	**Introduction of Hybridisation and Isomerism: Hybridisation - sp, sp^2**	Addition reactions:	Coordination Chemistry: Nomenclature	Electrochemistry: Introduction	soaps. - structure and cleansing action
	SLO-2	sp^3 Hybridisation	Nucleophilic Addition reactions:	isomerism of coordination compounds	Faradays laws of electrolysis	Soap-examples
S-2	SLO-1	Bond length- bond angle- dipole moment	Electrophilic Addition reactions:	EAN rule	Specific conductance, equivalent conductance	Detergents - structure and cleansing action
	SLO-2	inductive effect- mesomeric effect and hyperconjucation	Free radical Addition reactions	VB Theory	Cell constant	Detergent - examples
S-3	SLO-1	Isomerism- geometrical and optical isomerism	Elimination rections	Crystal field theories of octahedral complexes	Arrhenius theory of electrolytic dissociation	Industrial Chemistry: Introduction-Fuel gas
	SLO-2	Structural isomers and stereoisomers	E1, E2, E1cb mechanism	tetrahedral and square planar complexes	Arrhenius theory of electrolytic dissociation-explanation	Water gas
S-4-6	SLO-1	Lab Introduction	Estimation of ascorbic acid	Estimation of $KMnO_4$using standard potassium dichromate	Determination of strength of an acid – Conductometric titration	Estimation of Nickel using decinormal solution of EDTA
	SLO-2					

Duration (hour)		18	18	18	18	18
S-7	SLO-1	Configurations, chirality	Chemistry of Hydrogen	Chemical Kinetics: Rate of reaction	Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes.	producer gas
	SLO-2	Elements of symmetry	Isotopes of hydrogen	order- molecularity	Molar conductivity at infinite dilution	LPG gas
S-8	SLO-1	Enantiomers	Occurrence- extraction of iron	first order rate law and simple problems	Ostwald"s dilution law	Gobar gas and
	SLO-2	diastereomers	Occurrence- extraction of cobalt	Half-life period of first order reaction	Activity- Ostwald"s dilution law	natural gas
S-9	SLO-1	Conformational analysis - ethane	Occurrence- extraction of nickel	pseudo first order reaction	Kohlrausch law of independent migration of ions	Fertilizers – Mixed fertilizer
	SLO-2	Conformational analysis – n-butane	Occurrence- extraction of copper	zero and second order reactions	Problems - Kohlrausch law of independent migration of ions	NPK fertilizer
S-10-12	SLO-1	Estimation of HCl using standard oxalic acid	Estimation of Copper using decinormal solution of Potassium dichromate solution	Determination of rate of the reaction – Ester hydrolysis	Determination of strength of mixture of acids – Conductometric titration	Estimation of $K_2Cr_2O_7$ using decinormal solution of Sodium thiosulphate solution
	SLO-2					
S-13	SLO-1	Nucleophilic substitution reactions	structure of borazole	Arrhenius theory-Postulates	Nernst equation -Derivation	Hardness of water – Temporary and permanent hardness
	SLO-2	SN1 mechanism	Preparation of borazole	Explanation and limitation	Problems – Nernst equation	disadvantages of hard water
S-14	SLO-1	SN2 mechanism	Chemistry of Silicon compounds	Collision theories-Postulates	Nernst equation applications	Boiler scales and sludges
	SLO-2	Free radical mechanism	Structure and Preparation of SiO_2	Explanation and limitation	Nernst equation application to different kinds of half-cells	Softening of hard water – Zeolite process
S-15	SLO-1	Electrophilic substitution reactions	Structure and Preparation of SiC	Problems/activities related to kinetics	Kohlrausch law of independent migration of ions	demineralization process - Principle
	SLO-2	Mechanism	Structure and Preparation of $SiCl_4$	Problems/activities related to kinetics	Ostwald"s dilution law	demineralization process - Procedure
S-16-18	SLO-1	Estimation of phenol / aniline	Estimation of NaOH using standard sodium carbonate	Estimation of FAS using standard oxalic acid	Redox titration by Potentiometric method	Estimation of hardness by EDTA method
	SLO-2					

Learning Resources	Theory:
	1. M. J. Sienko, R. A. Plane, Chemistry: Principles and Applications, 3rd ed., McGraw-Hill publishers, 1980. 2. P. W. Atkins, J. Paula, J. Keeler, Physical Chemistry, 11th ed., Oxford publishers, 2018. 3. K. P. C. Vollhardt, N. E. Schore, Organic Chemistry: Structure and Function 7thed., Freeman, 2014. 4. J. C. Kuriacose, J. Rajaram, Chemistry in Engineering and Technology, Tata McGraw-Hill Education, 1984. 5. A. Wieckowzki, J. Norskov, and Gottesfel, Fuel Cell Science: Theory, Fundamentals, and Biocatalysis, 2010 6. B. H. Mahan, R. J. Meyers, University Chemistry, 4th ed., Pearson publishers, 2009.

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (20%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice

Level 1	Remember Understand	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Level 2	Apply Analyze	40%	40%	50%	40%	50%	40%	50%	40%	50%	40%
Level 3	Evaluate Create	30%	30%	20%	30%	20%	30%	20%	30%	20%	30%
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Scientific Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications etc.,

Course Designers		
Expert from Industry	***Experts from Higher Technical Institutions***	***Internal Experts***
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Courses for earning Additional Credits

SEMESTER – II

Course Code	UCD23P01L	Course Name	Internship Report– I	Course Category	IAPC	Internship/Apprenticeship / Project/ Community Outreach	L	T	P	O	C
							0	0	8	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
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																		
Course Learning Outcomes (CLO):	**At the end of this course, learners will be able to:**																		
CLO-1 :	To get an inside view of an industry and organization/company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	To gain valuable skills and knowledge	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	To make professional connections and enhance networking	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	To get experience in a field to allow the student to make a career transition	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	To get an inside view of an industry and organization/company	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

Students can choose a company of their own interest for internship for a period of minimum TEN weeks (Part-time) to learn about the application of their related field in real time environment. All students have to give a presentation about their observations made by them in internship as per the schedule given. At the end of the internship period, every student shall submit a structured internship report within 15 days from the date of the completion of the internship period.

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

Course Code	UCD23P02L	Course Name	Project Work – I	Course Category	IAPC	Internship/Apprenticeship / Project/ Community Outreach	L	T	P	O	C
							0	0	8	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
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																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	To get an inside view of an industry and organization/company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	To gain valuable skills and knowledge	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	To make professional connections and enhance networking	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	To get experience in a field to allow the student to make a career transition	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	To get an inside view of an industry and organization/company	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

Students can choose problems of their own interest for research and analysis in the field of Chemistry. There will be two reviews conducted during the project period for all the students. At the end of the project, every student shall submit a structured project report and will take a Viva Voce examination.

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

Course Code	UCD23P03L	Course Name	Apprenticeship – I	Course Category	IAPC	Internship/Apprenticeship / Project/ Community Outreach	L	T	P	O	C
							0	0	8	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	To get an inside view of an industry and organization/company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	To gain valuable skills and knowledge	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	To make professional connections and enhance networking	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	To get experience in a field to allow the student to make a career transition	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	To get an inside view of an industry and organization/company	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

Students can choose a company of their own interest for Apprenticeship for a period of minimum TEN weeks (Part-time) to learn about the application of their related field in real time environment. All students have to give a presentation about their observations made by them in internship as per the schedule given. At the end of the internship period, every student shall submit a structured internship report within 15 days from the date of the completion of the internship period.

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

SEMESTER – IV

Course Code	UCD23P04L	Course Name	Internship Report– II	Course Category	IAPC	Internship/Apprenticeship / Project/ Community Outreach	L	T	P	O	C
							0	0	8	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Demonstrate skills learnt in the real time environment.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
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																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	To get an inside view of an industry and organization/company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	To gain valuable skills and knowledge	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	To make professional connections and enhance networking	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	To get experience in a field to allow the student to make a career transition	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	To get an inside view of an industry and organization/company	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

Students can choose a company of their own interest for internship for a period of minimum TEN weeks (Part-time) to learn about the application of their related field in real time environment. All students have to give a presentation about their observations made by them in internship as per the schedule given. At the end of the internship period, every student shall submit a structured internship report within 15 days from the date of the completion of the internship period.

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

Course Code	UCD23P05L	Course Name	Project Work – II	Course Category	IAPC	Internship/Apprenticeship / Project/ Community Outreach	L	T	P	O	C
							0	0	8	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
CLO-1 :	To get an inside view of an industry and organization/company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	To gain valuable skills and knowledge	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	To make professional connections and enhance networking	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	To get experience in a field to allow the student to make a career transition	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	To get an inside view of an industry and organization/company	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

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

Course Code	UCD23P06L	Course Name	Apprenticeship – II	Course Category	IAPC	Internship/Apprenticeship / Project/ Community Outreach	L	T	P	O	C
							0	0	8	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to,	Learning	Program Learning Outcomes (PLO)

		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Demonstrate skills learnt in the real time environment.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning
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																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	To get an inside view of an industry and organization/company	3	80	70	L	H	M	H	L	M	L	L	L	L	L	H	M	L	L
CLO-2 :	To gain valuable skills and knowledge	3	85	75	M	H	H	M	L	M	L	L	M	L	L	H	M	L	L
CLO-3 :	To make professional connections and enhance networking	3	75	70	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-4 :	To get experience in a field to allow the student to make a career transition	3	85	80	M	H	M	H	L	M	M	L	M	L	M	H	M	L	L
CLO-5 :	To get an inside view of an industry and organization/company	3	85	75	H	H	M	H	L	M	M	M	M	L	M	M	M	L	L

Students can choose a company of their own interest for Apprenticeship for a period of minimum TEN weeks (Part-time) to learn about the application of their related field in real time environment. All students have to give a presentation about their observations made by them in internship as per the schedule given. At the end of the internship period, every student shall submit a structured internship report within 15 days from the date of the completion of the internship period.

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